**AP Chemistry Syllabus Mrs. G Wentzel (wengay@wilsonsd.org)**

**Course Description**

This AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first year of college. This course is structured around the six big ideas articulated in the AP Chemistry curriculum framework provided by the College Board. A special emphasis will be placed on the seven science practices, which capture important aspects of the work that scientists engage in, with learning objectives that combine content with inquiry and reasoning skills**.** AP Chemistry is open to all students that have completed a year of chemistry who wish to take part in a rigorous and academically challenging course.

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| **Big Idea 1:** Structure of matter **Big Idea 2:** Properties of matter-characteristics, states, and forces of attraction **Big Idea 3:** Chemical reactions **Big Idea 4:** Rates of chemical reactions **Big Idea 5:** Thermodynamics **Big Idea 6:** Equilibrium |

**Science Practice 1:** The student can use representations and models to communicate scientific phenomena and solve scientific problems.

**Science Practice 2:** The student can use mathematics appropriately.

**Science Practice 3:** The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.

**Science Practice 4:** The student can plan and implement data collection strategies in relation to a particular scientific question.

**Science Practice 5:** The student can perform data analysis and evaluation of evidence.

**Science Practice 6:** The student can work with scientific explanations and theories.

**Science Practice 7:** The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

A minimum of 25% of student contact time will be spent doing hands-on laboratory activities. There are two double lab periods (each period is 52 minutes) in a 6 day cycle. The equipment used is similar to that used in college labs. It includes spectrophotometers, Pasco data collection probes, vacuum aspirators, laptop computers, distillation condensers, titration burettes, etc. Students work in groups of 2 or 3 to complete most labs. Some labs require formal lab write-up (including title, objective, procedure, data tables, analysis, calculations, conclusion, and pre and post question) Students will be given a rubric describing the specific expectation for each part of the lab report. Students are required to keep a lab notebook.

**Text**: Zumdahl, Steven and Susan, Chemistry, 7th ed., Boston, Houghton Mifflin, 2007.

**Lab manuals**:

The College Board. AP Chemistry Guided Inquiry Experiments: Applying the Science Practices. 2013

Vonderbrink, Sally Ann, Laboratory Experiments for Advanced Placement Chemistry, Batavia, IL, Flinn Scientific, 2001.

Flinn Scientific Spectrophotometer laboratory manual, Batavia, IL, Flinn Scientific, 1996

Hall, James, Experimental Chemistry, 4th ed. Boston, Houghton Mifflin, 1997

Pasco Science Workshop, Chemistry lab with Computers, Roseville, CA. Pasco Scientific, 1996

Course Outline:

U**nit 1**: Foundations of chemistry –chapter 1 (Most of this chapter is covered in July summer assignments) (2 days)

- Units of measurement, significant digits, density calculations, dimensional analysis

*Laboratories*: Lab safety-students use James Hall “Experimental chemistry” lab book to review proper safety procedures and rules. Students will sign a contract to agree to these rules.

Using balances and volumetric glassware - Using James Hall “Experimental chemistry” lab manual, students will mass objects on various balances and use assorted volumetric glassware to determine errors in measurement.

Density-Using James Hall” Experimental chemistry” lab book, students will determine the density of salt solutions, graph the density vs. % mass on computer and find % error**.**

**Unit 2**: Chemical formulas and composition – chapter 2 (Most of this chapter is covered in August summer assignment) (6 days) Big **Idea 1, EK 1.A.1 / LO 1.1**

* history of atom, nomenclature of inorganic compounds, nomenclature of organic compounds, nomenclature of complex coordination compounds

*Laboratories:* Analysis of Alum-Using Sally Ann Vonderbrink’s” Laboratory Experiments for Advanced Placement Chemistry”, students find the Melting point and water of hydration of Alum.

Separation of mixtures – In this activity, students take “dirty” water and perform various separation methods to purify it. These methods include distillation, filtration, physical absorption and centrifugation. This requires a partial written lab report.

**Unit 3**: Stoichiometry – chapter 3 (10 days) **Big Idea 1, EK 1.A.2 / LO 1.2, 1.3, EK 1.A.3 /LO 1.4** **Big Idea 3, EK 3.A.2/LO3.3, 3.4, EK 3.C.1/LO 3.10**

* atomic mass and the mole, % compositions, limiting reactants, % yield, empirical and molecular formula, mass- mass stoichiometry, balancing equations

*Laboratory*: Limiting reactants and % yield – In this activity, students reacting calcium chloride with sodium carbonate in various proportions to find the limiting reactant and % yield.

**Unit 4**: Chemical reactions – chapter 4 (7 days) Big **Idea 1, EK 1.E.1/LO1.17,**

**EK 1.E.2/LO 1.18, 1.19, 1.20 Big Ideas 3, EK 3.A.1/LO3.2, 3.B.1/LO 3.5, 3.6, EK 3.B.2/LO 3.7. EK 3.B.3/LO 3.8, 3.9**

* Types of reactions and predicting products, Net ionic equations, balancing redox equations, solutions concentrations and stoichiometry

*Laboratories*: Standardization of NaOH and determination of molarity of vinegar using titration.-Using James Hall lab manual students will use KHP to standardize NaOH. Then with this NaOH they will titrate vinegar to find its molarity and %mass.

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|  | **Guided Inquiry lab #3** | **Science Practices** |
|  | What makes hard water hard? This lab is found in the college board guided inquiry experiment book | SP 7.1, 1.5, 2.2, 5.1, 6.4, 4.2, 5.3, 6.2, 7.2 |

**Unit 5**: Thermochemistry – chapter 6 (6 days) Big **Idea 3, EK 3.C.2/LO 3.11 Big Idea 5, EK 5.A.1/LO5.2, EK5.A.2/LO5.3, EK 5.B.1, 2,3,4/LO 5.4,5.5,5.6,5.7 EK 5.C.2/LO 5.8**

* Enthalpy, Hess’s law, bond energies

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|  | **Guided inquiry lab #12** | **Science Practices** |
|  | Hand warmer design challenge: where does the heat come from? This lab is found in the college board guided inquiry experiment book | SP 1.4, 6.4, 7.2, 4.2, 5.3, 2.2, 2.3, 5.1 |

*Laboratorie*s:

Calorimetry and Hess’s Law-Using Sally Ann Vonderbrink’s lab manual, the students perform three separate reactions and find their heats of reaction. Using these three reactions they verify Hess’s Law. This lab will include a written lab report

Pasco probe introduction - students use computer and Pasco probes to find the average temperature of a mixture of hot and cold water.

**Unit 6**: Atomic Structure chapter 7 (5 days) Big **Idea 1, EK 1.B.2/LO1.7,1.8, EK 1.C.1,2/LO 1,9,1.10,1.11,1.12, EK 1.D.1,2,3/LO1.13,1.14,1.15,1.16,**

* Orbitals,electronic configuration,orbital diagrams,periodic table trends

*Laboratory*- Atomic spectroscopy and flame test-Using James Hall lab manual, the students will look at discharge tubes through spectroscopes and measure the wavelengths of energy emitted.

**Unit 7**: Bonding – chapter 8 ,9 (10 days) **Big Idea 2; EK2.C.1,2,3,4/LO2.18,2.19,2.20,2.21 ,EK 2.D.1,2,3,4/LO 2.23,2.24,2.25,2.26,2.27,2.28,2.29,2.30,2.31,2.32**

-types of bonds, Electronegativity,Polarity, dipole moments,Lewis structures,exceptions to octet,VSEPR model,hybridization model

*Laboratories-*molecular model building –Using James Hall lab manual, students build molecules and determine the Lewis structure, geometry, & polarity.

**Unit 8**: Gas Laws – chapter 5 (8 days) **Big Idea 2; EK 2.A.2/LO 2.4,2.5,2.6**

-Boyles Law-Charles Law-Avogadro’s Law-Ideal Law & applications-Dalton’s law-Kinetic molecular theory-effusion and diffusion-real gases vs. ideal gases

*Laboratories-* Boyles and Ideal using Pasco data probes-Using computers and data probes, students graph the relationship between volume and pressure and temperature and pressure.

Molar mass of a volatile liquid –Using James Hall lab manual, the students find the molar mass of an unknown volatile liquid (used as Midterm performance assessment) This lab requires a lab report following rubric.

**Unit 9**: Liquids and Solids -chapter 10 (7 days) Big **Idea 2: EK 2.A.1/LO 2.3, EK 2.B.1,2,3/LO 2.11,2.12,2.13,2.14,2.15,2.16 Big Idea 5: EK 5.D.1,2,3/LO 5.9,5.10,5.11**

* intermolecular forces vs. intramolecular forces, bonding in metals, network solids, vapor pressure, heating curves, phase diagrams

*Laboratory:* Introduction to spectrophotometers – Using Flinn Scientific Spectrophotometer manual students will learn how use the instrument and make an absorption curve.

**Unit 10**: Solutions – chapter 11 (6 days) Big **Idea 2; EK 2.A.3/LO 2.7,2.8,2.9,2.10**

- Solution composition and formation

-factors that affect solubility, colligative properties, calculations involving freezing point depression and boiling point elevations , osmotic pressure

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|  | **Guided inquiry #1** | **Science Practices** |
|  | What is the relationship between the concentration of a solution and the light transmitted? This lab is found in the college board inquiry experiment book. | SP 2.2, 5.1, 4.2, 4.1, 6.4 |

*Laboratories*- Properties of solutions and freezing point depression-using James Hall lab manual, the students will investigate colligative properties to see what effects they have on freezing and boiling points

**Unit 11**: Kinetics - chapter 12 (9 days) **Big Idea 4: EK 4.A.1,2,3/LO 4.1,4.2,4.3, EK 4.B.1,2,3/LO 4.4,4.5,4.6, EK 4.C.1,2,3/LO 4.7 ,EK4.D.1,2/LO 4.8,4.9**

-Reaction rates-Rate law-integrated rate law-mechanisms- Catalyst

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|  | **Guided inquiry #10** | **Science Practice** |
|  | **How long will that marble statue last? This lab is found in the college board guided inquiry experiment book.** | **SP 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1, 7.2** |

U**nit 12**: Chemical Equilibrium – chapter 13 (8 days) **Big Idea 6: EK 6.A.1,2,3,4/LO 6.1,6.2,6.3,6.4,6.5,6.6,6.7, EK6.B.1,2/LO 6.8,6.9,6.10**

-Equilibrium conditions and constants-applications of equilibrium using ice charts

-Le Chatelier’s principle

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|  | **Guided inquiry # 13** | **Science Practices** |
|  | Can we make the colors of the rainbow? This lab is found in the college board guided inquiry book. | SP 4.1, 4.3, 4.2, 5.1, 6.2, 6.4 |

Laboratories- Spectrophotometer Equilibrium constant-Using Sally Ann Vonderbrink’s lab manual, the students will first prepare a calibration curve and then find the equilibrium constant for the formation of FeSCN2+ (This lab is used for the final performance assessment) This lab requires a written lab report following the rubric.

**Unit 13**: Acids and Bases - chapter 14 (8 days**) Big Idea 5: EK 6.C.1/LO 6.11-6.17**

-definitions of acids and bases-strengths of acids, bases, conjugate acids, conjugate bases

-pH, pOH, Kw, equilibrium calculations for weak acids and bases-polyprotic acids

-salts, pH equilibrium calculations

*Laboratories*- Titration curves using Pasco data probes-Student work in different groups to titrate an assortment of strong or weak acids or bases. They use Pasco pH probes and make a pH curve then do the calculations at various points of the titration. Students will present their titration using the rubric provided.

**Unit 14**: Applications of aqueous Equilibrium - chapter 15 (8 days) **Big Idea 5: EK 6.C.2, 3/LO 6.18- 6.24**

-common ion effect-buffers-titration curves-indicators

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|  | **Guided inquiry experiment #15** | **Science Practices** |
|  | To what extent do common household products have buffering activity? This lab is found in the college board guided inquiry experiment book | SP 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4 |

**Unit 15**: Spontaneity, Entropy, and Free Energy – chapter 16 (8 days)  **Big Idea 5: EK 5.E.1,2,3,4,5/LO 5.12-5.18 Big Idea 6: EK 6.D.1/LO6.25**

-Second and third Law of Thermodynamics-Entropy, universe, system and surrounding

-Free Energy, calculations and relationship to equilibrium constant

*Laboratories*-Gravimetric Analysis of an unknown metal carbonate – Students use a Flinn Scientific kit to find the unknown metal in a carbonate by precipitating the metal carbonate and finding its molar mass.

**Unit 16**: Electrochemistry and Nuclear Chemistry - chapter 17, 21 (10 days) Big **Idea 3: EK 3.C.3/LO 3.12,3.13**

Galvanic cells, anode, cathode, cell potential, standard reduction potentials, non standard conditions (Nernst equations), radioactive decay reactions, particles and energy, half-lives, isotope dating

*Activity*- Galvanic cell (This is a demonstration where I construct a cell and measure the voltage with a digital voltmeter)

*Laboratory* - Separation and identification of unknown cations and anions- Students use Flinn Scientific kit to find their individual cation and anion.

**Unit 17**: Review for AP test

-take practice multiple choice during double lab period

-take practice free response during double lab period

-review material as identified from weakness after taking practice test