**AP Chemistry Course Description**

This AP Chemistry course is designed to be the equivalent of the general chemistry course generally taken during the first year of college. For most students, the course enables them to undertake, as a freshman, second year work in the chemistry sequence at their institution or to register in courses in other fields where general chemistry is a prerequisite. This course is structured around the six big ideas articulated in the AP Chemistry curriculum framework provided by the College Board. **[CR2]** 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.

The AP Chemistry Course is structured around the six “Big Ideas”. Within each big idea, enduring understandings and essential knowledge statements are covered.

**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

**Textbook and Lab Books**

Student Text: Brown, Lemay, Bursten. *Chemistry the Central Science, Eighth Edition*. Upper Saddle River, New Jersey: Prentice Hall, 2000

Teacher Resource Texts:

Brown, LeMay, Bursten, Murphy, and Woodward. *Chemistry the Central Science, Twelfth Edition*. Upper Saddle River, New Jersey: Prentice Hall, 2012 [CR1]

Zumdahl and Zumdahl. *Chemistry,Nineth Edition*, Belmont, California: Brooks Cole. 2014

Lab Book Resources:

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

Vonderbrink, Sally. *Laboratory Experiments for AP Chemistry*. Batavia: Flinn Scientific, 2001.

Drnevich, Marilyn. *Advanced Chemistry Labs.* Buffalo: Kenmore West, 1999

Nelson, Kemp. *Chemistry the Central Science, Laboratory Experiments, Tenth Edition.* Upper Saddle River, New Jersey: Prentice Hall, 2005

Randall, Jack. *Advanced Chemistry with Vernier Second Edition.* Beaverton, Oregon: Vernier Software 2007

**Required Materials**

Graphing Calculator, splash proof goggles, laboratory notebook

**Laboratory Investigations**

The laboratory portion of this class is designed to be the equivalent of a college level laboratory experience. It will include minimum of 16 formal labs. Inquiry is emphasized in many of the experiments students complete. Students will work in pairs while in the lab to collect data. Each student will be required to submit, for grading, a lab report, which includes each of the following: the purpose, materials, procedure, all data, data analysis, error analysis, results and conclusions. **[CR7].** Students are encouraged to retain, and take with them to college, their laboratory folder. **[CR7].**

A minimum of twenty-five percent of instructional time will be spent in the laboratory. **[CR5a]**

**Assessment**

Students will be assessed using both formative and summative assessments. Formative, checks for understanding will be included throughout each unit. This will include problem sets, in class activities, collaborative problem solving, and discussions of relevant demonstrations to assess understanding. A unit test, consisting of multiple choice, and problem based essays will be given at the end of each unit.

**Curriculum Map**

**Unit 1- The Structure of Matter**

Class Periods (42 minutes): 13

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| **Topic** | **Curriculum Articulation**  **Big Ideas** | **Experiments/Activities**  **[CR5a] [CR5b] [CR6]** | **Learning Objectives/Science Practices[CR6]** |
| Scientific Method | BI 1.D.1:a | Activity: The Black Box |  |
| Classification of Matter   * Pure substances vs. mixtures * Law of definite proportions * Law of multiple proportions * Chemical & physical changes | 1.A.1:b  1.A.1:c  1.A.1:d  3.C.1:b, 3.C.1:c, 5.D:2 | **Lab 1:** An Experiment Applying Green Chemistry to Purification *(guided inquiry)*  Activity: Determine the number of formula units of calcium carbonate in signing your name with chalk  Activity: Classifying substances (picture cards):  Physical vs Chemical  Pure Substances vs mixtures  **[CR3a]** | LO 3.5  SP 2, 3, 4, 5, 6  LO 1.2, 1.3  SP 2.2, 6.1 |
| Nomenclature of Binary Compounds | 1.E.2:b |  |  |
| Polyatomic Ions and Other Compounds | 1.E.2:b |  |  |
| Determining Atomic Masses | 1.A.1:a | **Lab 2:** Using Mass Spec to data to Identify Elements | LO 1.14  SP 1.4, 1.5 |
| Mole Concept | 1.A.3:b, 1.A.3:c, 1.A.3:d, 1.E.2:b | Activity: Calculate how many atoms thick a piece of Al foil would be. | LO 1.2, 1.4  SP 7.1 |
| Percent Composition | 1.A.2:b | **Lab 3:** How Can Color be Used to Determine the Mass Percent of Copper in Brass? *(guided inquiry)* | LO 1.16 |
| Empirical and Molecular Formula | 1.A.2:b | Class Demo: Tin + Nitric Acid | LO 1.2, 3.3, 3.4  SP 2.2, 5.1, 6.4 |
| Writing Chemical Equations & Drawing Representations | 1.E.1:a, 1.E.1:c, 3.C.1:a |  |  |
| Balancing Chemical Equations | 1.A.3:a, 1.E.2:c, 1.E.2:d, 3.A.1:a |  |  |
| Applying Mole Concept to Chemical Equations (stoichiometry) | 1.A.3:a, 1.E.1:b | **Lab 4:** Finding the Ratio of Moles of Reactants in a Chemical Reaction | LO1.1, 3.3, 3.4  SP 2, 5 |
| Determine limiting reagent, theoretical and percent yield | 3.A.2:a |  |  |

**Unit 2- Types of Chemical Reactions**

Class Periods (42 minutes): 13

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Electrolytes and Properties of water | 2.A.3:h |  |  |
| Molarity and preparations of solutions | 1.D.3:c, 2.A.3:I, 2.A.3:j |  |  |
| Precipitations reactions and solubility rules | 6.C.3:d |  |  |
| Acid Base reactions | 1.E.2:f, 3.A.2:c | Activity: Investigating Acid rain, and acidity of local waterways: Ellicot Creek, Tonawanda Creek, Two Mile Creek, and Sheridan Park Ponds. **[CR4]** | LO 3.7  SP 4 |
| Balancing Redox | 3.B.3:a, 3.B.3:b, 3.B.3:c, 3.B.3:d |  |  |

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| Simple Redox Titrations | 1.E.2:f | **Lab 5:** Analysis of Commercial Bleach | LO 1.18, 3.8, 3.9  SP 2, 5 |
| Gravimetric Calculations | 1.E.2:e | **Lab 6:** What Makes Hard Water Hard? *(guided inquiry)* | LO 1.2  SP 3, 4, 5,6,7 |

**Unit 3 – AP Style Net Ionic Equations**

Class Periods (42 minutes): 10

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Redox and single replacement reactions | 3.A.1, 3.B.3:e, 3.C.1:d | **Lab 7:** How can we determine the actual percentage of H2O2 in a drugstore bottle of hydrogen peroxide? *(guided inquiry)* | LO 3.9  SP 2, 3, 4, 5, 6 |
| Double Replacement Reactions | 3.A.1, 3.C.1:d | Activity: Utilize online simulation for modeling types of chemical reactions **[CR3c]** | LO 3.2 |
| Combustion Reactions | 3.A.1, 3.B.3:e |  |  |
| Addition Reactions | 3.A.1, 3.B.1:a |  |  |
| Decomposition Reactions | 3.A.1, 3.B.1:a, 3.C.1:d |  |  |

**Unit 4 – Gas Laws**

Class Periods (42 minutes): 10

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Measurement of Gases |  |  |  |
| General Gas Laws | 2.A.2:a, 2.A.2:c |  | LO 2.6  SP 2.2, 2.3 |
| Dalton’s Law of Partial Pressure | 2.A.2:b |  |  |
| Molar Volume of gases and stoichiometry | 3.A.2:b |  |  |
| Graham’s Law |  | Class Demo: Graham’s Law | LO 2.6  SP 1, 6 |
| Kinetic Molecular Theory | 2.A.2:d, 5.A.1 |  |  |

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| Real gases and deviation from Ideal Gas Law | 2.A.2:e, 2.A.2:f, 2.A.3:g, 2.B.2:c. 2.B2:d | Review Activity: Classroom Quiz Show “Whose Gas Law is it Anyway”? |  |

**Unit 5 – Thermochemistry**

Class Periods (42 minutes): 10

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Law of Conservation of Energy, Work and Internal Energy | 5.B.1, 5.E.2:a |  |  |
| Endothermic & Exothermic Reactions | 3.C.2, 5.B.3:e, 5.B.3:f | **Lab 8:** Hand Warmer Design Challenge *(guided inquiry)* | LO 5.7  SP 2, 3, 4, 5, 6 |
| Potential Energy Diagrams | 3.C.2, 5.C.2:c, 5.C.2:d, 5.C.2:e |  |  |
| Calorimetry, heat capacity and specific heat | 5.A.2, 5.B.2, 5.B.3:a, 5.B.3:b, 5.B.4 |  |  |
| Hess’s Law | 5.B.3:a | **Lab 9:** Thermochemistry and Hess’s Law | SP 4,5,6 |
| Heat of Formation/Combustion | 5.C.2:g |  |  |
| Bond Energies | 2.C.1:d, 5.C.1, 5.C.2:a, 5.C.2:b |  |  |

**Unit 6 – Atomic Structure and Periodicity**

Class Periods (42 minutes): 10

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Electron Configuration and the Aufbau Principle | 1.B.2:a |  |  |
| Valence Electrons and Lewis Dot Structures | 1.B.2:c |  |  |
| Periodic Trends | 1.B.1:b, 1.B.1:c, 1.B.2:b, 1.B.2:d, 1.C.1:a, 1.C.1:b, 1.C.1:d | Activity: The Six Rows of Representative Elements: Follow the clues to determine which of the elements is being described and locate it on the periodic table. | BI 1, LO 1.9  SP1 |
| Table arrangement based on electronic properties | 1.C.2:e, 1.D.3:a, 5.E.4:b |  |  |
| Atomic Spectra of hydrogen and energy levels | 1.B.1:d, 1.B.1:e, 1.D.3:b |  |  |
| Quantum Mechanical Model | 1.C.2:d |  |  |
| Quantum Theory and electron orbitals | 1.C.2:c |  |  |
| Orbital Shape and energies | 1.C.2:b |  |  |
| Spectroscopy | 1.D.2:a, 1.D.2:b, 1.D.2:c, 1.D.3:b | **Lab 10:** What is the Relationship Between the Concentration of a Solution and the Amount of Light Transmitted Through the Solution? *(guided inquiry)* | LO 1.15 |

**Unit 7 – Chemical Bonding**

Class Periods (42 minutes): 10

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Lewis Dot Structures | 2.C.4:a |  |  |
| Resonance Structures and formal charge | 2.C.4:c, 2.C.4:d, 2.C.4:e |  |  |
| Bond Polarity and Dipole Moment | 2.C.1:c, 2.C.1:e, 2.C.1:f | **Lab 11:** Sticky Question: How Do You Separate Molecules that are Attracted to One Another? *(guided inquiry)* | LO 2.10  SP 3, 4, 6 |
| VSEPR models and molecular shape | 2.C.4:b, 2.C.4:e, 2.C.4:f | Activity: Use Gum Drops or Balloons to model VSEPR orientation. **[CR3b]** | LO 2.21  SP 1 |
| Polarity of Molecules | 2.C.1:e |  |  |
| Lattice Energies | 1.B.1:a, 1.C.2:a, 2.C.1:d (1-2), 2.C.2:a, 2.C.2:b, 2.D.1:b |  |  |
| Hybridization | 2.C.4:g |  |  |
| Molecular Orbits and Diagrams | 2.C.4:h, 2.C.4:i |  |  |

**Unit 8 – Liquids, Solids & Solutions**

Class Periods (42 minutes): 10

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Structure and Bonding   * Metals, network and molecular | 2.A.1:a, 2.A.1:d, 2.C.3, 2.D.1:a, 2.D.1:b, 2.D.3, 2.D.4 |  |  |
| Structure and Bonding   * Ionic, hydrogen, London, van der Waals | 2.A.1:b, 2.B.1:a, 2.B.1:b, 2.B.1:c, 2.B.2:a, 2.B.2:b, 2.B.2:c, 2.B.2:d, 2.B.2:a, 5.D:1 |  |  |
| Vapor pressure and changes in state |  | **Lab 12:** Vapor pressure and enthalpy of Vaporization of Water | LO 2.3, 2.12, 2.13, 2.16  SP 2,5,6 |
| Heating and Cooling Curves | 2.A.1:e, 5.B.3:c, 5.B.3:d | Activity: Online in groups: Heating and Cooling Curve simulation. (davidson.edu) **[CR3e]** | SP 5 |
| Composition of solutions | 2.A.1:c, 2.A.3:b, 2.A.3:c, 2.B.3:b |  |  |
| Colloids and suspensions | 2.A.3:a, 2.A.3:b, 2.A.3:g |  |  |
| Separation Techniques | 2.A.3:e, 2.A.3:f | **Lab 13:** Paper Chromatography: Separation of Cations and Dyes. | LO 2.7  SP5 |
| Effect on Biological Systems | 2.B.3:e, 2.D.3, 5.E.4:c |  |  |

**Unit 9 - Kinetics**

Class Periods (42 minutes): 13

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Rates of Reaction | 4.A.1:a |  |  |
| Factors that affect Rates of Reaction | 4.A.1:b, 4.A.1:c, 4.D.1, 4.D.2 | **Lab 14:** How Long Will that Marble Statue Last *(guided inquiry)* | LO 4.1  SP 5,6 |
| Reaction Pathways | 4.B.3:a, 4.B.3:b | Activity: Online Kinetics to study the elementary steps of a mechanism **[CR3d]** | SP 5 |
| Rate Equation Determination | 4.A.2:a, 4.A.3, 4.B.1, 4.C.1, 4.C.2, 4.C.3 |  |  |
| Method of Initial Rates | 4.A.2:c |  |  |
| Integrated rate laws | 4.A.2:b, 4.A.3:d | **Lab 15:** What is the Rate Law of the Fading of Crystal Violet Using Beer’s Law? *(guided inquiry)* | LO 4.2  SP 4,5,6 |
| Activation energy and the Boltzmann distribution | 4.B.2, 4.B.3:c |  |  |

**Unit 10 – General Equilibrium**

Class Periods (42 minutes):13

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Characteristics and conditions to equilibrium | 6.A.1, 6.A.3:a, 6.A.3:f |  |  |
| Equilibrium expression derived from rates | 6.A.3:b |  |  |
| Factors that affect equilibrium | 6.A.3:c |  |  |
| LeChatlier’s Principle | 6.A.3:b, 6.B.1, 6.B.2, 6.C.3:e, 6.C.3:f | **Lab 16:** How Can we Make the Colors of the Rainbow? *(guided inquiry)*  Activity: Online Gas Phase Equilibrium **[CR3f]** | LO 6.9  SP 4  LO 6.8, 6.9  SP1,6 |
| The equilibrium constant | 6.A.3:d, 6.A.3:e, 6.A.4 |  |  |
| Solving Equilibrium problems | 6.A.2 |  |  |

**Unit 11 – Acids & Bases**

Class Periods (42 minutes):13

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Definition and nature of acids and bases | 3.B.2, 6.C.1:c, 6.C.1:d, 6.C.1:e, 6.C.1:f |  |  |
| Kw and pH scale | 6.C.1:a, 6.C.1:b, 6.C.1:g |  |  |
| pH of strong and weak acids and bases | 6.C.1:h | **Lab 17:** How Do the Structure and the Initial Concentration of an Acid and a Base Influence the pH of the Resultant Solution During Titration? *(guided inquiry)* | LO 6.13 |
| Polyprotic acids | 6.C.1:n |  |  |
| pH of salts |  |  |  |

**Unit 12 – Buffers, Ksp and Titrations**

Class Periods (42 minutes):13

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Characteristics can capacity of buffers | 6.C.2 |  |  |
| Titration and pH curves | 6.C.1:I, 6.C.1:j, 6.C.1:k, 6.C.1:l, 6.C.1:m | **Lab 18:** Titration of a Diprotic Acid: Identifying an Unknown | LO 6.13, 6.17  SP4 |
| Choosing acid/base indicators |  |  |  |
| pH and solubility |  |  |  |
| Ksp calculations and solubility | 6.C.3:a, 6.C.3:b |  |  |

**Unit 13 – Thermodynamics – Part 2**

Class Periods (42 minutes):14

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Law of Thermodynamics |  |  |  |
| Spontaneous process and entropy | 5.E.1 |  |  |
| Spontaneity, enthalpy, and free energy | 5.E.2:c, 5.E.3 | **Lab 19:** Solubility and Determination of H, S and G of Calcium Hydroxide | LO 5.12, 5.13, 5.14, 5.18, 6.25  SP 2, 5, 6 |
| Free Energy | 5.E.2:d, 5.E.2:e, 5.E.2:f, 6.C.3:c, 6.D.1:a |  |  |
| Free energy and equilibrium | 5.E.2, 6.D.1:b, 6.D.1:c, 6.D.1:d |  |  |
| Rate and Spontaneity | 5.E.2:e, 5.E.5 |  |  |

**Unit 14 - Electrochemistry**

Class Periods (42 minutes):14

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| **Topic** | **Curriculum Articulation** | **Experiments/Activities**  **[CR5b] & [CR6]** | **Learning Objectives/Science Practices** |
| Balancing Redox Equations | 3.B.3:a, 3.B.3:b, 3.B.3:c, 3.B.3:d |  |  |
| Electrochemical cells and voltage | 3.C.3:a, 3.C.3:b, 3.C.3:c, 5.E.4:a | **Lab 20:** Electrochemical Cells | LO 3.12, 3.13, 5.16  SP 2, 5 |
| The Nernst equation | 3.C.3:d |  |  |
| Spontaneous and non-spontaneous equations | 3.C.3:e |  |  |
| Chemical Applications | 3.C.3:f |  |  |