PLAINFIELD HIGH SCHOOL
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AP CHEMISTRY SYLLABUS-2016-2017

With the ever-increasing need for innovators, problem finders, and designers of materials, pharmaceuticals, and even new fuels, comes the need for individuals skilled in the science practices and knowledgeable about chemistry. The redesigned Advanced Placement (AP) Chemistry course provides students with training for such knowledge and skills through guided inquiry labs, a more focused curriculum on content relevant to today's problems, and an exam that assesses students' mental models of the particulate nature of matter instead of memorization of rules to understand chemistry. Students who take the AP Chemistry course, designed with this curriculum framework as its foundation will develop a deep understanding of the concepts within the big ideas through the application of the science practices in the required laboratory component of the course.

Curricular Requirements		**Syllabus Index (page #)**
CR1	Students and teachers use a recently published (within the last ten years) college-level chemistry textbook	2
CR2	The curse is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework	2,3,9
CR3a	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 1: Structure of Matter	6
CR3b	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 2: Properties of matter-characteristics, states, and forces of attraction.	6
CR3c	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 3: Chemical Reactions	6
CR3d	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 4: Rates of Chemical Reactions	6
CR3e	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 5: Thermodynamics	6
CR3f	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 6: Equilibrium	6
CR4	The course provides students with the opportunity to connect their knowledge of chemistry snd science to major societal or technological components. (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.	6, 7, 9
CR5a	Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.	2, 4, 8, 9
CR5b	Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.	9
CR6	The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.	9
CR7	The course provides opportunities for students to develop, record, and maintain evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral written, and graphic presentations.	7,8

Course Design:

Advanced Placement Chemistry is designed by the College Board and their standards on a freshman level chemistry course; General Chemistry. Students will take the AP Chemistry Examination in May and based on their results they may receive college credit for General Chemistry. The school follows period schedule daily for 40 minutes duration, 5 days a week. Prerequisites for the course are successful completion, grade of "B" or better, in two previous years of math and science. A minimum of 25 percent of the scheduled instructional time will be devoted to the laboratory program including class discussions regarding appropriate procedures and quantitative analysis of inquiry based as well as traditional format laboratory investigations [CR 5a]. Labs will be held on Tuesdays in which we will meet before school, during lunch, or after school to complete the labs. Pre-labs will be handed out on Fridays and they must be completed prior to entering lab on Tuesday. Wednesday's we will discuss the previous lab and all labs will consist of a formal laboratory report that is due on Fridays.

In the two semesters of AP Chemistry students will explore, investigate and problem solve. In addition, it is expected of students to spend at least an additional four to five hours each week outside of class studying and applying their chemistry content knowledge to problem sets and laboratory reports. It is expected all Big Ideas, Enduring Understandings, and Learning Objectives be studied and evaluated in both formative and summative fashion before the Spring Break which is the first two weeks of April [CR 2]. This will provide for approximately three weeks of class time to continue the laboratory component of the class and to review the course material focusing on the overall student development of Enduring Understandings from integration of the Learning Objectives and Science Practices with the Big Ideas as described in the AP Chemistry Curriculum Framework [CR 2]. The content in this course can be achieved with great work-ethic and motivation resulting in preparation for the AP Chemistry Examination and future success in college science courses.

Textbook:

Brown, Theodore L., H. Eugene Lemay, and Bruce Edward Bursten. 2009. Chemistry: The Central Science AP Edition, 11th edition. New Jersey: Pearson Education. [CR 1]

Supplemental Textbooks:
Zumdahl, Steven S., and Susan A. Zumdahl, Chemistry, Sixth Edition, Houghton Mifflin Company, Boston, MA, 2006
Zumdahl, Steven S., and Susan A. Zumdahl, Chemistry, Fifth Edition, Houghton Mifflin Company, Boston, MA, 2003.

Laboratory Resources:
AP Chemistry Guided Inquiry Experiments: Applying the Science Practices. College Board, 2013.

Vonderbrink, Sally, Laboratory Experiments for Advanced Placement Chemistry, 2nd Edition, Flinn Scientific, Inc., 2006

Shakhashiri, Bassam, Chemical Demonstrations, Volumes 1,2,3,4, University of Wisconsin Press, Madison, Wisconsin, 1985.

Kits: Obtained from Flinn Scientific, Carolina Biological and Wards Scientific

Miscellaneous Resources:

Trout, Laura. 2012. POGIL: Activities for High School Science. Flinn Scientific, The POGIL Project.
Journal of Chemical and Engineering News.
Journal of Chemical Education.

Calculator:

TI-84 PLUS will be provided for class use.

Curriculum Map:

The curriculum map that follows is designed to adhere to the AP Chemistry Big Ideas, Enduring Understandings, Science Practices, and Learning Objectives outlined in the AP Chemistry Curriculum Framework. Appropriate alignment with each component is provided as appropriate. Listing of appropriate laboratory components follows the curriculum map. Connections to biological systems will be implemented throughout all units of study as appropriate. Particulate-level modeling and qualitative explanations/descriptions will be stressed in addition the necessary quantitative analysis for each component of the course.

AP Chemistry: Six Big Ideas [CR 2]

1) The Chemical Elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.
2) Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.
3) Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.
4) Rates of chemical reactions are determined by details of the molecular collisions.
5) The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.
6) Any bond or intermolecular attraction that can be formed can be broken. These two processes are in dynamic competition, sensitive to external conditions and external perturbations.

LO = Learning Objectives, SP = Science Practices, EKC = Essential Knowledge Connections [CR 5a]

Unit	*Content Description*	*Textbook Chapter(s)*	*AP Chemistry Curriculum Framework Alignment*	*Topics*
1	Review of Atomic Theory (including Photoelectron Spectroscopy analysis), Nomenclature, Chemical Reactions, (except redox) Stoichiometry	2, 3, 6, 7	LO 1.1, 1.3, 1.17, 2.1, 3.1, 3.2, 3.4, 3.5, 3.6, SP 1.5, 2.1, 2.2 , 4.2, 5.1, 6.1, 6.4 7.1,	History of atomic theory, Isotopes, PES, Atomic Mass, Empirical and Molecular Formulas, Waves, Light, Electronic Structure, Periodicity, Ionic and Covalent Nomenclature including Acids and Hydrated Compounds, Reaction Types and prediction of products, Mole Concept, Limiting and Excess Reagents, Yield
2	Solutions and Reactions (molarity, redox, electrochemistry, Free Energy)	4.1, 4.4, 4.5, 20	LO 1.4, 1.18, 3.1, 3.2, 3.3, 3.8, 3.9, 3.13, 3.12 SP 1.4, 1.5, 2.2, 2.3, 4.2, 5.1, 6.1, 6.4, 7.1,	Electrolytic Solutions, General Solubility, Redox reactions (including acidic and basic solutions), Hydrogen and Halogen replacement Reactions, Disproportionation reactions
3	Energy and Thermodynamics (including foods and fuels)	5.1-5.6, 5.8, 19	LO 3.11, 5.2, 5.3, 5.4, 5.6, 5.7, 5.8, 5.12, 5.13, 5.14, SP 1.1, 1.4, 1.5, 2.2, 2.3, 4.2, 4.4, 5.1, 6.4, 7.1, 7.2, EKC 5.B.1, 5B.2, 5.E.2, 5.E.3	Enthalpy, Enthalpy of reaction and Solution, Calorimetry, Hess' Law, Bond Energies, Entropy, Gibb's Free Energy

4	Atomic and Molecular Structure: Chemical Bonding and Molecular Geometry	8, 9.1-9.7	LO 1.6, 1.9, 1.10 1.11, 1.12, 1.13, 2.17, 2.18, 2.19, 2.20, 2.23, 2.24, 2.25, 2.26, 2.27, 2.28, 3.1 SP 1.1, 1.4, 1.5, 3.1, 5.1, 5.3, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 EKC 2.D.1, 2.D.2	Ionization Process and Ionic Bonding, Covalent Compounds and Lewis Structures, Expanded Octets and Electron Deficient Molecules, Resonance Structures and Coordinate Covalent Bonds, Molecular Geometry and the VSEPR Theory, Polar Bonds and Molecules, Hybridization,
5	Intermolecular Forces and Gases	11, 10	LO 2.1, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.16, 3.4, 5.2, 5.5, 5.9, 5.11, SP 1.1, 1.2, 1.3, 1.4, 2.2, 2.3, 4.2, 5.1, 6.2, 6.4, 6.5, 7.1, 7.2 EKC 5B.1, 5.B.2, 2.A.2	Determination of the Types of Intermolecular Forces and relationship to Primary States of Matter, Pressure, Ideal Gas Behaviors, Partial Pressures, Mole Fractions of Mixtures, Energy of Gas Particles, Effusion and Diffusion, Non-Ideal Gas Behaviors
6	Kinetics	14	LO 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 SP 2.1, 1.4, 1.5, 2.2, 4.2, 5.1, 6.2, 6.4, 6.5, 7.1, 7.2 EKC 4.A.3, 4.B.2	Reaction Rates, Reaction Order, Rate Laws, Integrated Rate Laws, Activation Energies and Factors Affecting Reaction Rates, Reaction Mechanisms, Catalysis
7	General Equilibrium	15	LO 6.6, 6.8, 6.10, 6.25 SP 1.4, 2.2, 2.3, 6.4, 7.2	Equilibrium Constants and Expressions, Equilibrium Concentrations and Pressures, Manipulating the Equilibrium Constant, The Reaction Quotient, Le Chatelier's Principle, Gibb's Free Energy and Equilibrium Relationship
8	Solution Analysis, Solubility Equilibria, Qualitative Analysis	13.1-13.3, 17.4-17.7	LO 6.6, 6.8, 6.10, 6.21, 6.22, 6.23, 6.24, 6.25 SP 1.4, 2.2, 2.3, 5.1, 6.4, 7.1, 7.2 EKC 5.E.2, 5.E.3, 6.A.2, 6.B.1, 6.D.1	Types of Solutions, Molecular Structure and Solubility Relationships, Solubility of Gases, Solubility Product Constant, Particulate Descriptions of Colligative Properties in Ideal and Non-Ideal Situations
9	Acids and Bases (including equilibria of weak acids and bases, common ions, and buffers)	16.1-16.10, 17.1-17.3	LO 6.11, 6.12, 6.13, 6.14, 6.15, 6.16, 6.17, 6.18, 6.19, 6.20 SP 1.1, 1.4, 2.2, 2.3, 4.2, 5.1, 6.2, 6.4 EKC 1.E.2	Bronsted-Lowery and Arhenius Theories of Acids and Bases, Strengths of Acids and Bases, Auto-ionization of Water, Ka and Kb, pH, pOH, Monoprotic

				vs. Polyprotic Acids, Acid Base Reactions in Solution and Gas Phases, Review of Common Ion Effect and Buffers, Complex Ion Formation, indicators and pKa pKb (half-ionization to determine Ka Kb), Neutralization Reactions and Acid Base Titrations.
10	Year-End Review, Continuation of Laboratory Program	Comprehensive	Comprehensive	Comprehensive
--	AP Testing Period	--	--	Students are allowed to use class time following the AP Chemistry Exam to study for their additional upcoming AP Exams. Students without additional AP Exams will use this time to study for their regular classes.
11	Food Safety and Chemical Interactions in the Gastronomical Sciences	25	Comprehensive	Focused analysis of biological concerns with processing, handling, and cross-contamination of food stuffs. Biological metabolism and nutrition analysis combined with structure and interaction of common compounds found in foods; particularly lipids, proteins, starches and sugars, and aromatics. [CR 4]

Big Idea Activities:

At a minimum the following activities will be performed by the students either individually or in Process Oriented Guided Inquiry Learning (POGIL) groups. Although only one activity is listed for each Big Idea, it should be understood that multiple activities for each of the six Big Ideas will be performed throughout the school year to enhance student instruction and learning of the concepts therein. Descriptions of each Big Idea can be found with the Curriculum map section of this syllabus. While some of these activities may relate to laboratory experiences, they are not a specific component of any laboratory exercises; they are to be conducted outside the laboratory environment in the regularly scheduled instructional component of the course and do not use any laboratory resources or matierials. Bibliographic information can be found in the Textbook, and Miscellaneous Resources sections of this syllabus. [CR 3a-f]

Big Idea	Activity Name, Brief Description, and Resources
1.	Essential and Applied Inquiry 10-2, 10-3: Empirical Formulas and Molecular Formulas. Students work in POGIL groups to investigate method for determining empirical and molecular formulas from experimental data. Advanced application of this activity includes researching the methods of collection of pertinent required data. All resources are teacher generated and published.
2	Provided pertinent information (PV=nRT and n = mass/molar mass, students will derive the equation necessary to calculate the molar mass of an unknown gas. Students will describe the measurements that must be taken in order appropriately calculate this descriptor of a gas. No special resources are needed for this inquiry activity.
3	Limiting and Excess Reactants: Is there enough of each chemical reactant to make a desired amount of product? Students will be provided a certain number of "parts" to build model cars. Students will determine the limiting and excess reagents in their model car kits (Trout, Laura, 2012. P. 175).
4	Provided appropriate data, students will analyze reaction rates in relationship to the concentration of the reactants in two reactant systems. Students will use this data to determine if presented chemical reactions are zero, first, or second order in terms of individual reactants and the overall. Sample and Practice Exercises 14.6 (Brown and Lemay, 2009. Pp584-585).
5	Bond Energy: What makes a reaction endothermic or exothermic? In POGIL groups, students will investigate the energy required to break and assemble bonds during a chemical reaction. The data provided in the activity allow the students to calculate Change in Enthalpy of specific chemical reactions. Further analysis allows students to connect concepts with Potential Energy Diagrams, and to develop their own definition of bond energy (Trout, Laura, 2012, pg 225.)
6	Equilibrium: At what point is a reversible reaction "completed"? Students will describe the changes in a system as it reaches equilibrium, as well as develop an understanding that the product/reactant ratio of a system at equilibrium is independent of the initial conditions, but related to the rates of the forward and reverse reactions (Trout, Laura, 2012. P. 235)

In addition to the above specific activities, students are also required to read and report, in written format, a minimum of three articles from the Journal of Chemical and Engineering News and/or The Journal of Chemical Education. Journal articles from the previous year are available to the students in the regular classroom. The report must specify how the article relates to societal or technological issues, in addition to building a correlation to the content that has been studied within the course. If a student chooses an article from The Journal of Chemical Education, the report must specify the results of research that exemplifies how the content of the article has been shown, or desires to show, the increased understanding of the chemical concepts discussed. These three article analyses are expected to be completed during the second semester of the course after a good deal of the class content has been articulated. [CR 4] [CR 7]

Assessments:

1.) Tests: will be given periodically throughout the year. In the Grand Prairie Independent School District, teachers must have at least four major grades for every 9 week period. Each major grade test will consist of multiple choice and Free Response Questions that are appropriate for that particular unit. Essay questions, graphing analysis, and equations may also appear on the test. For review purposes, three old exams will be given with the AP Exam format. We will hold a discussion after exam in preparation for the AP Exam.

Students are quizzed once each week. Quizzes are timed and designed to take no more than 15 to 20 minutes. Quizzes are considered formative as students have the opportunity to retake a second version of any quiz within a one-week period of the original quiz date. Mid-quarterly exams and quarterly exams are given for a total of four exams during each eighteen week semester.

2.) Homework: Homework will count as daily grades and will be assigned in the beginning of each new chapter and due close to the end of the chapter. Students will be required to take notes on the chapter to prepare for in-depth lessons on that chapter. This allows the students to have read the chapter before commencing to do work and any open

discussions that will occur during class time.

The majority of the homework will be from the student textbook, however some questions may come from old AP Chemistry Examination questions. In any case our class does not meet for a day, (due to testing, pep-rally's, etc.) students are still required to follow the homework policy.

3.) Lab Notebook: Labs are essential to understanding Chemistry. As always goggles must be worn at all times. No open toed shoes are allowed during lab.

On Monday the calculations of the lab, chemicals, and procedure are gone over in class. Laboratory experiments will be held every Tuesday and students are required to write a formal laboratory report (in ink) in a graphical composition book. Wednesday is the post lab discussion and if necessary, any group work that needs to be shared/complied is at this time. Friday all lab books are submitted for grading. The formal lab must be written in the following order.
Labs are on Tuesday and are due on Friday. The introduction and the procedure are due the day of the lab. This will help you and ultimately help me because you will understand the lab better.

TABLE OF CONTENTS – Labs must be written in the following manner and only on the right side of the page. The left side is reserved for mathematical and chemical calculations.

TITLE
I. INTRODUCTION – The student will be given the pre-lab report on the Friday before the actual lab will be performed. In the introduction, the student will need to provide any definitions, equations, statements, and drawings. This part of the lab report should be no less than three paragraphs.

II. SAFETY - List the safety requirements one must follow in order to perform this particular lab experiment.

III. MATERIALS – List all materials (chemicals, glassware, equipment)

IV. PROCEDURE – In your own words rewrite the lab procedure. Brief statements are fine as long as they convey the meaning and you can follow along during the lab.

ALL THE ABOVE MUST BE COMPLETE BEFORE THE LAB EXPERIMENT MAY BEGIN

V. DATA – This area is where tables, graphs, and calculations will be placed. All graphs must be labeled with a title and x and y axis labeled appropriately. All calculations for any part of the lab are placed here and on the left side of the page. Calculations from a graph will be entered on the left side as well. If a chart is used, number the chart and then number your calculations to coincide with the table. All formulas, labels and significant figures must be used. Students will place pictures that are of the lab and drawings of beakers containing molecules at the molecular level at various stages throughout the experiment.

VI. QUESTIONS – All questions must be written down and all answers must be answered below.

VII. CONCLUSION – In a short statement (2-3 sentences) on what you discovered.

VIII. GLOSSARY – Save the last four pages of the lab book for lab vocabulary terms. Your instructor will supply the vocabulary needed for each lab you perform.

Laboratory Program Framework and Requirements

All students are required to maintain a 1.5" three-ring binder to organize all of their laboratory investigations including the pre-lab discussion notes, procedural designs and pertinent handouts, as well as the completed laboratory report for each investigation performed. The laboratory reports will constitute 25% of the overall student grade in alignment with the 25% requirement regarding total instructional time. The lab notebook is designed for the students to present to appropriate staff when enrolled in the college or university of their choice. The laboratory is architecturally designed to be conducive to a college-level chemistry laboratory program. The laboratory is stocked with all necessary glassware, reagents, and equipment necessary for students to complete all required labs in groups of two and three. [CR 5a][CR7] students will work in groups of two per station; all students will turn in their own independent laboratory report. [CR 7]

The laboratory component of the AP Chemistry class is based on the AP Chemistry Guided-Inquiry: Applying the Science Practices Lab Manual. It is intended that no less than ten of these hands-on laboratory investigations will be conducted in a guided or open-inquiry format with others being modified to a more traditional format. The laboratory is stocked with all appropriate equipment, lab-wares, and reagents necessary to provide for a college-level laboratory experience. The appropriate curriculum alignment (CR, BI, LO, EK, EU, SP) can be found within the College Board

Published manual. Many of the labs provide students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components. These labs will account for 25% of the instructional component of the class. [CR 2, CR 4, CR 5a, CR 5b, CR 6]

Laboratory Titles from AP Chemistry Guided-Inquiry: Applying the Science Practices

1) What is the Relationship Between the Concentration of a Solution and the Amount of Transmitted Light Through the Solution?

2) How Can Color Be Used to Determine the Mass Percent of Copper in Brass?

3) What Makes Water Hard?

4) How Much Acid Is in Fruit Juices and Soft Drinks?

5) Sticky Question: How do You Separate Molecules That are Attracted to One Another?

6) What's in That Bottle?

7) Using the Principle That Each Substance Has Unique Properties to Purify a Mixture: An Experiment Applying Green Chemistry to Purification

8) How Can We Determine the Actual Percentage of H2O2 is a Drugstore Bottle of Hydrogen Peroxide?

9) Can the Individual Components of Quick Ache Relief Be Used to Resolve Consumer Complaints?

10) How Long Will That Marble Statue Last?

11) What is the Rate Law of the Fading Crystal Violet Using Beer's Law?

12) The Hand Warmer Design Challenge: Where Does the Heat Come From?

13) Can We Make the Colors of the Rainbow? An Application of Le Chatelier's Principle.

14) How Do the Structure and the Initial Concentration of an Acid and a Base Influence pH of the Resultant Solution During Titration?

15) To What Extent Do Common Household Products Have Buffering Activity?

16) The Preparation and Testing of and Effective Buffer: How Do Components Influence a Buffer's pH and Capacity?