2016-2017
A.P. Chemistry Syllabus
High School

Instructor:
Email:

Course Overview

My AP Chemistry course is designed to offer students a solid foundation in introductory college-level chemistry. By structuring the course around the six big ideas, enduring understandings, and science practices, I assist students in developing an appreciation for the study of life and help them identify and understand unifying principles within a diversified chemical world.

What we know today about chemistry is a result of inquiry. Science is a way of knowing. Therefore, the process of inquiry in science and developing critical thinking skills is the most important part of this course.

At the end of the course, students will have an awareness of the integration of chemistry in the other sciences, understand how matter interacts to form all of the substances that exist, and be knowledgeable and responsible citizens in understanding scientific issues that could potentially impact their lives.

***The AP Chemistry exam is Monday, May 1, 2017 at 8:00 AM**

Instructional Context

I teach AP Chemistry to juniors and seniors at a high school that follows a 6 period day. Each class meets 5 days a week for 50 minutes.

Students must have successfully completed both General Chemistry and Algebra 1 prior to enrolling in AP Chemistry.

Instructional Resources

Masterson, W.L. and Hurley, C.N., *Chemistry – Principles and Reactions,* 8th Edition, 2016, Cengage Learning.

AP Chemistry Guided-Inquiry Experiments, 2nd printing, 2013, The College Board.

POGIL Activities for High School Chemistry, High School POGIL Initiative, 2012, Flinn Scientific, Inc.

Advanced Placement Chemistry Content

My AP course is structured around the six big ideas, the enduring understandings within the big ideas and the essential knowledge within the enduring understanding.

The Big Ideas:

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

The Investigative Laboratory Component

The course is also structured around inquiry in the lab and the use of the seven science practices throughout the course. Students are given the opportunity to engage in student-directed laboratory investigations throughout the course for a minimum of 25% of instructional time. Students will conduct a minimum of sixteen lab investigations (a minimum of six of these will be guided inquiry) to deepen conceptual understanding and to reinforce the application of science practices within a hands-on, discovery based environment. All levels of inquiry will be used and all seven science practice skills will be used by students on a regular basis in formal labs as well as activities outside of the lab experience. The course will provide opportunities for students to develop, record, and communicate the results of their laboratory investigations. **Students are required to maintain an AP Chemistry course portfolio that includes all of their formal lab reports.**

AP Chemistry Formal Lab Write Up

A formal lab report is required to contain the following components. All lab reports will be submitted electronically. Graded lab reports will be printed and the hardcopy added to the AP Chemistry course portfolio.

TITLE PAGE : Include title, names of group members, class, teacher, date submitted.

INTRODUCTION: In paragraph form – Do not use numbers but be sure to cover each area thoroughly.

1. State the PURPOSE AND HYPOTHESIS. What concepts are important to understanding your experiment? Indicate what you hope to learn (purpose) and what your hypothesis is. (Identify it as the hypothesis.) You may use "If/Then" statements.
2. Identify the CONTROL GROUP that will be used for comparison. It does not contain the variable being tested.
3. Identify the DEPENDENT VARIABLE. (the one that will change; the experimental group)
4. Identify the INDEPENDENT VARIABLE. (the variable being manipulated)
5. Identify any other VARIABLES that are being held constant in the experimental group. For instance, each setup may be measured for the same amount of time; or each setup may have the same amount of solution in each beaker, etc.
6. Identify WHAT IS BEING MEASURED.

   Example: CO_2 or H_2O consumption; growth; production of a product; etc.
7. What METHOD and/or TIME FRAME is used?

   Example: I will take readings of…. Every 5 minutes for 30 minutes.
8. What is the RATE OF CALCULATION and/or STATISTICAL APPLICATION?

   Example: average number of trials, slope of the curve, etc.
9. How will the RESULTS BE VERIFIED? (sample size or repetition)
10. How will the experimental RESULTS be PRESENTED? (graphs, charts, etc.)
11. What are the EXPECTED RESULTS? WHY? (This will be your best educated guess based on the readings in the labs, and any other research you decide to do on your own. Yes, you should read the instructions to the labs.)

MATERIALS: List the materials that you used in your lab.

PROCEDURE: Give a brief description of the procedure to show how the lab was conducted. Describe methods for control variables and describe methods for collecting the data.

DATA: This section should contain a table or chart that has the information you gathered. Sometimes it will contain *quantitative* descriptions of what you measured, but sometimes it will contain *qualitative* observations of what you observed. Points will be taken off if the table is not constructed of straight ruled lines. You must include titles and labels for all tables & charts.

DATA ANALYSIS: This is where you answer any data analysis questions from the lab instructions. Students have a difficult time with this section because it calls for you to explain the data. Explanations show you understand the relationship of the data to what you are learning in class. Construct all graphs needed to show results, must include titles and labels. Answer all questions from the lab handout and include all equations and calculations. (Show algebraic equations if the experiment calls for calculations. As in math class, show your work.) Do not restate the question as your answer; for example, "Question: Why did you observe bubble in the test tube?" Answer: "The test tube had bubbles because it was bubbling." Instead, explain what caused the bubbles and what they were made of.

DISCUSSION & CONCLUSION: Write one or two sentences relating you results directly to the purpose.. Writing that you "learned a lot" or "had fun" is not addressing the results or the purpose. Do not repeat the purpose. Explain any unexpected results and why those results may have been obtained. Evaluate the data to determine if it supports your hypothesis using specific reference to your data. Evaluate the procedure, making suggestions for improvement if needed. Identify weaknesses & state realistic improvements

Science Practices

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.
6. The student can work with scientific explanations and theories.
7. The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

AP Chemistry Labs Summary

Lab Name	*AP Chemistry Guided-Inquiry Experiments Investigation Number*	Masterson Chapter Number	Guided Inquiry (Y or N)	Associated Science Practice Numbers
Chromatography separations	5	1	Y	1, 2, 3, 4, 5, 6, 7
Spectroscopy	1	2	Y	1, 2, 3, 4, 5, 6, 7
Gravimetric stoichiometry	7	3	Y	1, 2, 3, 4, 5, 6, 7
Basic acid/base titration	4	4	Y	1, 2, 3, 4, 5, 6, 7
Air bag challenge	N/A	5	N	1, 2, 3, 5, 6, 7
Spectrophotometry	2	6	Y	1, 2, 3, 4, 5, 6, 7
Separations using physical properties	9	7	Y	1, 2, 3, 4, 5, 6, 7
Calorimetry	12	8	Y	1, 2, 3, 4, 5, 6, 7
Bonding in solids	6	9	Y	1, 2, 3, 4, 5, 6, 7
Freezing point depression	N/A	10	N	1, 2, 3, 5, 6, 7
Reaction rates	10	11	Y	1, 2, 3, 4, 5, 6, 7
Rate laws	11	11	Y	1, 2, 3, 4, 5, 6, 7
Equilibrium	13	12	Y	1, 2, 3, 4, 5, 6, 7
Acid/base titrations	14	13	Y	1, 2, 3, 4, 5, 6, 7
Buffers	15	14	Y	1, 2, 3, 4, 5, 6, 7
Designing buffers	16	15	Y	1, 2, 3, 4, 5, 6, 7
Predicting spontaneous reactions using the activity series	N/A	16	N	1, 2, 3, 5, 6, 7
Redox titration	8	17	Y	1, 2, 3, 4, 5, 6, 7
Radioactive decay simulation	N/A	18	N	1, 2, 3, 5, 6, 7

AP Chemistry Unit Overview

Text Chapter:	Class Periods:	Topics Covered:	Labs or Alternative Activities:
1	11	• Matter and its classifications • Measurements • Properties of a substance	• POGIL Classification of matter • POGIL Safety first • POGIL Significant digits and measurements • POGIL Significant zeros • Guided Inquiry Lab: Chromatography separations (Investigation 5)
2	15	• Atoms and the atomic theory • Components of the atom • Quantitative properties of the atom • Introduction to the periodic table • Molecules and ions • Formulas of ionic compounds • Names of compounds	• POGIL Isotopes • POGIL Ions • POGIL Average atomic mass • POGIL Coulombic attraction • POGIL Naming ionic compounds • POGIL Polyatomic ions • POGIL Naming molecular compounds • POGIL Naming acids • Guided Inquiry Lab: Spectroscopy (Investigation 1)
3	11	• The mole • Mass relationships in chemical formulas • Mass relations in reactions	• POGIL Types of chemical reactions • POGIL Relative mass and the mole • POGIL Mole ratios • POGIL Limiting and excess reactants • POGIL Mass spectroscopy • POGIL Empirical formulas • Guided Inquiry Lab: Gravimetric stoichiometry (Investigation 7) • Freedom Week & Scientific Citizens/ Constitution Day: GMOs in food, is something better just because it is “green”, desalination to make drinking water, ocean acidification by carbon dioxide, & global warming (students will watch video clips, discuss props and cons, and hold a mock vote on these issues)
4	12	• Precipitations reactions • Acid-base reactions • Oxidation-reduction reactions • Combustion reactions	• POGIL Saturated and unsaturated solutions • POGIL Solubility • POGIL Molarity • POGIL Oxidation and reduction • POGIL The activity series • POGIL Net ionic equations • POGIL Combustion analysis • Guided Inquiry Lab: Basic acid/base titration (Investigation 4)
5	9	• Measurements on gases • The ideal gas law • Gas law calculations • Stoichiometry of gaseous reactions • Gas mixtures: Partial pressures and mole fractions • Kinetic theory of gases	• POGIL Gas variables • POGIL Partial pressures of gases • POGIL Deviation from the ideal gas law • Maxwell-Boltzmann distributions • PHET simulation: Gas properties • Guided Inquiry Lab: Air bag challenge

6	11	• Light, photon energies, and atomic spectra • The hydrogen atom • Quantum numbers • Atomic orbitals: shapes and sizes • Electron configurations in atoms • Orbital diagrams of atoms • Electron arrangements in monoatomic ions • Periodic trends in the properties of atoms	• POGIL Electron energy and light • POGIL Electron configuration • POGIL Cracking the periodic table code • POGIL Periodic trends • POGIL Advanced periodic trends • POGIL Photoelectron spectroscopy • Guided Inquiry Lab: Spectrophotometry (Investigation 2)
7	9	• Lewis structures; the octet rule • Molecular geometry • Polarity of molecules • Atomic orbitals; hybridization	• POGIL Molecular geometry • POGIL Types of bonds • POGIL Polar and nonpolar molecules • POGIL Properties of covalent bonds • POGIL Lattice energy • PHET simulation: molecule shapes • Guided Inquiry Lab: Separations using physical properties (Investigation 9)
8	10	• Principals of heat flow • Measurement of heat flow; calorimetry • Enthalpy • Thermochemical reactions • Enthalpies of formation • Bond enthalpy • The first law of thermodynamics	• POGIL Calorimetry • POGIL Bond energy • POGIL Heats of formation • Guided Inquiry Lab: Calorimetry (Investigation 12)
9	9	• Comparing solids, liquids, and gases • Liquid-vapor equilibrium • Phase diagrams • Molecular substances; intermolecular forces • Network covalent, ionic, and metallic solids • Crystal structures	• POGIL Types of solids • POGIL Alloys • PHET simulation: States of matter • Guided Inquiry Lab: Bonding in solids (Investigation 6)
10	9	• Concentration units • Principles of solubility • Colligative properties of nonelectrolytes • Colligative properties of electrolytes	• Lab: Freezing point depression
11	10	• Meaning of reaction rates • Reaction rate and concentration • Reactant concentration and time • Models for reaction rates • Reaction rate and temperature • Catalysis • Reaction mechanisms	• POGIL Rates of reactions • POGIL Method of initial rates • Guided Inquiry Lab: Reaction rates (Investigation 10) • Guided Inquiry Lab: Rate laws (Investigation 11)

12	9	• The N_2O_4-NO_2 equilibrium system • The equilibrium constant expression • Determination of K • Applications of the equilibrium constant • Effect of changes in conditions on an equilibrium system	• POGIL Equilibrium • POGIL Reaction quotient • Guided Inquiry Lab: Equilibrium (Investigation 13)
13	11	• Bronsted-Lowry acid-base model • The on product of water • pH and pOH • Weak acids and their equilibrium constants • Weak Bases and their equilibrium constants • Acid-base properties of salt solutions • The Lewis model	• POGIL Acids and bases • POGIL Strong versus weak acids • POGIL Calculating pH • POGIL Common ion effect on acid ionization • POGIL Strength of acids • POGIL Polyprotic acids • Guided Inquiry Lab: Acid/base titrations (Investigation 14)
14	9	• Buffers • Acid-base indicators • Acid-base titrations	• POGIL Buffers • POGIL Titration curves • Guided Inquiry Lab: Buffers (Investigation 15)
15	9	• Complex ion equilibria; formation constant • Solubility; solubility product constant • Precipitate formation • Dissolving precipitates	• POGIL Common ion effect on solubility • POGIL Fractional precipitation • Guided Inquiry Lab: Designing buffers (Investigation 16)
16	9	• Spontaneous processes • Entropy • Free energy • Standard free energy change • Additivity of free energy changes; coupled reactions	• POGIL Free energy • POGIL Work, equilibrium, and free energy • Lab: Predicting spontaneous reactions using the activity series of metals
17	10	• Oxidation-reduction reactions • Voltaic cells • Standard voltages • Relations between E^o, ΔG, and K • Effect of concentration on voltage • Electrolytic cells • Commercial cells	• POGIL Batteries • POGIL Electrochemical cell voltage • POGIL Faraday's law • Lab: Standard reduction potentials • Guided Inquiry Lab: Redox titration (Investigation 8)
18	7	• Nuclear stability • Radioactivity • Rate of radioactive decay • Mass-energy relations • Nuclear fission • Nuclear fusion	• Video: Modern Marvels, "The Manhattan Project" and discussion of the legacy of nuclear weapons and the impact of nuclear power on modern society • Lab: Radioactive decay simulation