Course Title: AP Chemistry

Textbook: *Chemistry: The Central Science 14th Edition*
By Brown, LeMay, Bursten, Murphy, Woodward and Stoltzfus - 2018

Instructor: Mr. Wolff
Room: 229
E-mail: rwolff@cheltenham.org
Hours: 6:30-7:15am, 5:00pm-6:00pm
Phone #: (215) 517-3700

Course Description:

The purpose of Advanced Placement Chemistry is to provide a college level course in chemistry and to prepare the student to seek credit and/or appropriate placement in college chemistry courses. This course meets every day on a two day cycle. There will be single 47 minute periods every other day followed by 100 min periods on the opposite every other day. Laboratory periods average two to three days per week. Lectures are kept short since it is my philosophy that learning is active not passive. **Students are engaged in hands-on laboratory work, integrated throughout the course that accounts for more than 25% of the class time.** Emphasis is placed on depth of understanding of a topic, rather than breadth of topics.

Objectives:

Students will:

1. Learn the inquiry process through numerous laboratory investigations.
2. Gain an understanding of the six big ideas as articulated in the AP Chemistry Curriculum Framework.
3. Apply mathematical and scientific knowledge and skills to solve quantitative, qualitative, spatial, and analytic problems.
4. Apply basic arithmetic, algebraic, and geometric concepts.
5. Formulate strategies for the development and testing of hypotheses.
6. Use basic statistical concepts to draw both inferences and conclusions from data.
7. Identify implications and consequences of drawn conclusions.
8. Use manipulative and technological tools including graphing calculators, Vernier LabQuests, Vernier Probes, and Vernier's LoggerPro software.
9. Measure, compare, order, scale, locate, and code accurately.
10. Do scientific research and report and display the results of this research.
11. *Learn to think critically in order to solve problems.*

Other Textbook, Laboratory Materials, and Study Guides (CR1):

Zumdahl, Steven S., et. al., Chemistry, 7th Edition. Boston, New York, Houghton Mifflin Company, 2007.

Carolina. Investigations for AP Chemistry Complete Lab Kit. Burlington, NC, Carolina Publishing, 2013

Randall, Jack. Advanced Chemistry with Vernier. Oregon: Vernier Software and Technology, 2004.

Holmquist, Dan and Randall, Jack. Chemistry with Vernier. Oregon: Vernier Software and Technology, 2007.

Hague, George and Smith, Jane. Ultimate Chemical Equations Handbook. Batavia, IL, Flinn Scientific, 2001.

Moog, Richard and Farrell, John, Chemistry: A Guided Inquiry. 5th Ed., Hoboken, NJ, Wiley, 2011.

Trout, L. ed. *AP POGIL Activities for High School Chemistry.* Batavia, IL, Flinn Scientific, 2012.

STRUCTURE OF THE COURSE:

The AP Chemistry is built around six big ideas and seven science practices.

The big ideas are:

Big Idea 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.

Big Idea 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.

Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.

Big Idea 4: Rates of chemical reactions are determined by details of the molecular collisions.

Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

Big Idea 6: Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations.

The science practices for AP Chemistry are designed to get the students to think and act like scientists.

The science practices are:

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.

Laboratory Work:

All of the laboratory experiments in this course are hands-on. Students work individually or in a group depending upon the lab. They collect, process, manipulate, and graph data from both qualitative and quantitative observations. Inquiry is emphasized in many of the experiments that students complete. The laboratory work requires students to design, carry out, and analyze data using guided inquiry principles. For all labs, students are required to report the purpose, procedure, all data, data analysis, error analysis, results, and conclusions in a lab notebook **(CR7)** as well as in a typed report that is submitted for grading.

The following Labs will be completed throughout the year (alphabetical order):

1. Chemical Kinetics Lab
2. Chemical and Physical Changes Lab
3. Complexometric Titration of Calcium in Milk Lab
4. Concentration of Acetic Acid in Household Vinegar Lab*
5. Evaluating Lemonade as a Buffer Lab
6. Factors Affecting Reaction Rates Lab*
7. Fundamentals of Calorimetry Lab*
8. Gravimetric Analysis of Carbonate Lab
9. Le Chatelier's Principle and Equilibrium Shifts Lab
10. Molecular Spectroscopy Lab
11. Preparation of a Bufferd Solution Lab
12. Principles of Chromatography Lab
13. Spectrophotometric Analysis of Food Dyes Lab*
14. Stoichiometry of Chemical Reactions Lab*
15. Types of Chemical Bonds Lab*
16. Vitamin C in Fruit Juices by Redox Titrations Lab

All laboratory experiments are intended to be completed in one double period (100 minutes) except the following <u>Guided-Inquiry Labs</u> that require multiple days to complete (these labs are starred in the above list): (CR6)

1. *Stoichiometry of Chemical Reactions (Big Idea 3)*
2. *Fundamentals of Calorimetry (Big Idea 5)*
3. *Spectrophotometric Analysis of Food Dyes (Big Idea 1)*
4. *Types of Chemical Bonds (Big Idea 2)*
5. *Factors Affecting Reaction Rates (Big Idea 4)*
6. *Concentration of Acetic Acid in Household Vinegar (Big Idea 6)*

Technology:

Students use graphing calculators/ excel spreadsheets in both their class work and laboratory work. Students use Vernier LabPros and probes in laboratory work to gather data. Graphs are produced using Vernier LoggerPro software or Excel.

Laboratory Write-Up (CR7):

All completed lab reports documenting all lab experiences must be completed in a Laboratory Notebook **(CR7)** and a typed/printed lab report must be handed in. The lab write-up will be due one week after the lab is finished. See the outline below for the structure of a lab report. All Laboratory Notebooks turned in along with their lab write-ups at the end of each lab.

The 12 Parts of a Laboratory Report

A specific format will be given to the student for each lab. Students must follow that format and label all sections very clearly. AP Chemistry lab reports are much longer and more in depth than the ones completed in the first year chemistry course. Therefore, it is important that students don't procrastinate when doing pre-lab and post-lab work. Late labs will lose 10% each day. Labs not completed in the allotted class time must be done at lunch or before/after school by appointment.

Pre-Lab Work

Pre-lab work is to be completed and turned in on the day the lab is performed.

1. **Names** Your name first and then the names of your lab partners.
2. **Title** The title should be descriptive. For example, "pH Titration Lab" is a descriptive title and "Experiment 5" is not a descriptive title.
3. **Date** This is the date the you performed the experiment.
4. **Purpose** A purpose is a statement summarizing the "point" of the lab.
5. **Chemical Data + Safety**: List the chemical formula, Lewis structure, physical and chemical properties, and any safety precautions for each chemical. Also list any safety precautions for the lab in general.
6. **Procedure Outline** Students need to write an outline of the procedure. They should use bulleted statements or outline format to make it easy to read. If a student is doing a guided inquiry lab, they may be required to write a full procedure that they develop.
7. **Pre-Lab Questions** Students will be given some questions to answer before the lab is started. They will need to either rewrite the question or incorporate the question in the answer. The idea here is that when someone (like a college professor) looks at a student's lab write-up, they should be able to tell what the question was by merely looking at their lab report. It is important to produce a good record of lab work.
8. **Data Tables** Students will need to create any data tables or charts necessary for data collection in the lab.

During the Lab

9. **Data** Students need to record all their data into their pre-lab data tables (either a hard copy or directly into their electronic document). They are NOT to be recording data on scrap paper. They need to label all data clearly and always include proper units of measurement. Students should underline, use capital letters, or use any device they choose to help organize this section well. They should space things out neatly and clearly.

Post-Lab Work

10. Calculations and Graphs Students should show how calculations are carried out. If similar calculations are repeated, they need only show the work the first time. Graphs need to be titled, axes need to be labeled, and units need to be shown on the axis. To receive credit for any graphs, they must be at least ½ page in size.

11. Conclusions This will vary from lab to lab. Students will usually be given direction as to what to write, but it is expected that all conclusions will be well thought out and well written.

12. Post Lab Questions Students will be given some questions to answer after the lab is completed. They will need to either rewrite the question or incorporate the question in the answer (just like the Pre-Lab Questions).

Tests:

A chapter test is assigned for each chapter (except for Ch.1 -3 which are tested together). Due to the fact that chemistry topics build on each other, every successive chapter test may contain concepts from previous chapters tested. A comprehensive, standardized semester exam is administered at the end of 1st semester and a final exam at the end of the year.

AP Exam Review:

Review really starts after the first unit is complete. I recommend the following resource for review during the year:

1) AP Review Guide: *Princeton Review's Cracking the AP Chemistry Exam* ~$15

The final few weeks of class before the AP Chemistry Exam are used for exam review. Students will prepare study guides each night for the next day's review topic. After a brief quiz to start class, they will work in cooperative groups to solve a set of free response problems on the topic.

Course Outline by Chapter and Big Idea that is corresponds to:

Chapters in Zumdahl Chemistry	**AP Chemistry Topic Covered**
1. Chemical Foundations	None
2. Atoms, Molecules, and Ions	Atomic Theory & Atomic Structure **(BI 1 & 2)**
3. Stoichiometry	Stoichiometry **(BI 3)**
4. Solution Stoichiometry & Chemical Analysis	Reaction Types & Stoichiometry **(BI 3)**
5. Gases	Gases **(BI 1 & 2)**
17. Electrochemistry (except 17.3)	Reaction Types **(BI 3)**
12. Chemical Kinetics	Kinetics **(BI 4)**
13. Chemical Equilibrium	Equilibrium **(BI 6)**
14. Acids and Bases	Equilibrium **(BI 6)**
15. Applications of Aqueous Equilibria	Equilibrium **(BI 6)**
6. Thermochemistry	Thermodynamics **(BI 5)**
16. Spontaneity, Entropy, and Free Energy (+17.3)	Thermodynamics **(BI 5)**
7. Atomic Structure and Periodicity	Atomic Theory & Atomic Structure **(BI 1 & 2)**
8. Bonding - General Concepts	Chemical Bonding **(BI 1 & 2)**
9. Covalent Bonding: Orbitals	Chemical Bonding **(BI 1 & 2)**
10. Liquids and Solids	Liquids & Solids **(BI 1 & 2)**
11. Properties of Solutions	Solutions **(BI 2)**
22. Organic Chemistry	Descriptive Chemistry **(BI 2)**
AP Chemistry Exam Review	All

(BI) *refers to Big Ideas.*

Chapter Problem Sets:

Chapter problems sets will be posted on my Google Classroom . They will not be handed in or graded. They are for practice. Worked out answers will also be posted on my website. Any questions regarding these problems can be sent via e-mail or asked in person during open work time in class.

Summer Homework:

Students are required to complete Summer Review prior to AP Chemistry. The concepts covered over the summer are a review of what was learned in their previous chemistry class that is mandatory to have taken. This summer work is an online review course called FlinnPREP AP Chemistry Online Prep Course which is paid for by the CSD (https://www.flinnprep.com/). Students are required to show mastery of their prior learning by taking a Ch.1-3 test after the first week of class. This material is also incorporated in ALL exams given later in the year.

Grading per Marking Period: A student's grade for each marking period will be calculated by dividing total points earned by the total possible points. The following is a breakdown of the assessed categories and their relative percentages:

Tests + Quizzes	Labs	**Classwork**
70%	**20%**	**10%**

Late Work

All mandatory work must be turned in. Late work will be indicated on Power School as a LATE assignment. Work handed in late will have 40% of the total points deducted once it is turned in. If work is not turned in during a marking period or semester, the student will earn an incomplete on their report card which will not be changed to a grade until the work is handed in.

GRADING FOR THE COURSE

MP grade = (Total Points Earned / Total Points Possible) x 100
S1 grade = MP1 (0.50) + MP2 (0.50)
S2 grade = MP3 (0.50) + MP4 (0.50)

A	93-100
A-	90-92.99
B+	87-89.99
B	83-86.99
B-	80-82.99
C+	77-79.99
C	73-76.99
C-	70-72.99
D+	67-69.99
D	63-66.99
D-	60-62.99
F	<60

Curriculum Alignment

Chapter(s)	*Topics Covered*	*Activities*	*Lab Activities* **[CR5b]**	*Big Idea* **[CR2]**	*Enduring Understanding & Essential Knowledge*	*Learning Objective*
One	• The scientific method • Units of measurement and uncertainty • Significant figures • Problem solving methods • Dimensional analysis • Classification of matter • The history of chemistry • Fundamental laws of chemistry • Models of the atom • Molecules and ions • The periodic table • Naming compounds			1 2 3	1.A (1.A.1) 1.B (1.B.1) 1.E (1.E.1, 1.E.2) 2.A (2.A.3) 2.C 3.B (3.B.1)	1.1 1.5 1.6 1.17 1.18 2.7 2.8 2.9 2.10 3.5 3.6
Two and Three	• Atomic mass • The mole and molar mass • Percent composition • Empirical and molecular formulas • Combustion Analysis • Chemical equations • Balancing equations • Stoichiometric calculations • Limiting and excess reactants	• *Students travel through lab stations and identify chemical and physical changes. **[CR3a]**	"Chemical and Physical Changes Lab" *SP3,4,5* • *Students preform experiments at 15 different lab stations determining, describe and defining which experiments they performed were chemical or physical changes "Stoichiometry of Chemical Reactions Lab" *SP2,3,6* • Students will perform reactions and determine the stoichiometry values of a balanced reaction. **[CR6]**	1 3	1.A (1.A.1, 1.A.2, 1.A.3) 1.D (1.D.2) 1.E (1.E.1, 1.E.2) 3.A (3.A.1, 3.A.2) 3.B (3.B.1)	1.1 1.2 1.3 1.4 1.14 1.17 1.18 1.19 1.20 3.1 3.2 3.3 3.4 3.5 3.6

Curriculum Alignment

Chapter(s)	*Topics Covered*	*Activities*	*Lab Activities* **[CR5b]**	*Big Idea* **[CR2]**	*Enduring Understanding & Essential Knowledge*	*Learning Objective*
Four	• Double replacement reactions and precipitation, gas formation or liquid formation • Single replacement reactions and the activity series • Anhydride reactions • Oxidation-reduction reactions • Acid-base neutralization • Complex ion reactions • Addition and decomposition reactions	• *Students create a layered effect by separating a nail, salt and hydrated copper sulfate with filter paper in a test tube. Distilled water is added and students observe the ensuing changes over the week. They discuss the types of changes (chemical or physical) and try to write equations describing these changes. **[CR3c]** • Students play a game called "Equation Land" in which they draw cards and write equations to move forward. **[CR3c]**	"Vitamin C in Fruit Juices by Redox Lab" *SP3,4,5* • *Students are given various fruit juices and unknown solutions and are asked to titrate and determine the amount of Vitamin C in each one.	1 2 3 5 6	1.A (1.A.3) 1.E (1.E.1, 1.E.2) 2.A (2.A.1, 2.B (2.B.3) 2.D (2.D.1) 3.A (3.A.1, 3.A.2) 3.B (3.B.1, 3.B.2, 3.B.3) 3.C (3.C.1) 5.D (5.D.2) 6.C (6.C.3)	1.4 1.17 1.18 1.19 2.1 2.3 2.22 2.23 3.1 3.2 3.3 3.4 3.5 3.7 3.6 3.8 3.9 3.10 5.10 6.21 6.23 6.24
Six and Seven	• Electromagnetic spectrum • The nature of matter • The atomic spectrum of hydrogen • The Bohr Model • The quantum mechanical model • Quantum numbers • Orbital shapes and energies • Electron spin • Multi-Electronic atoms • The history of the periodic table • Periodic trends and properties • Group trends	• Students will complete and utilize a flip book of trends and properties as the unit progresses. **[CR3a]** • Students will practice trends and properties with "What Element Am I?" cards. **[CR3a]** • Students will complete "The Shell Model" activity (Chemistry: A Guided Inquiry) **[CR3a]**	"Molecular Spectroscopy Lab?" *SP2,4,5,6* • *Students analyze the absorption spectra of various solution samples and utilize their redox balancing skills from the last unit.	1 5	1.B (1.B.1, 1.B.2) 1.C (1.C.1, 1.C.2) 1D (1.D.1, 1.D.3) 5.E (5.E.4)	1.5 1.6 1.9 1.10 1.11 1.12 1.13 1.15 1.16 5.15 5.16 5.17

Curriculum Alignment

Chapter(s)	*Topics Covered*	*Activities*	*Lab Activities* **[CR5b]**	*Big Idea* **[CR2]**	*Enduring Understanding & Essential Knowledge*	*Learning Objective*
Eight and Nine	• Types of chemical bonds • Electronegativity • Bond polarity and dipole moments • Ions; configuration and size • Localized electron bonding model • Lewis structures • Octet exceptions • VSEPR • Hybridization • Molecular Orbital model • Photoelectron Spectroscopy	• Analyze PES data with students in class. **[CR3b]** • Students will complete "Photoelectron Spectroscopy" activity (Chemistry: A Guided Inquiry) **[CR3b]** • Students will complete "The Shell Model III" activity (Chemistry: A Guided Inquiry) **[CR3b]** • Students will complete "Bond Order and Bond Strength" activity (Chemistry: A Guided Inquiry) **[CR3b]**	"Types of Chemical Bonds" *SP2,3* • Students will determine the types of chemical bonds through completing various reactions and observing the products. **[CR6]**	1 2 5	1.B (1.B.1, 1.B.2) 1.C (1.C.1) 1.D (1.D.3) 2.C (2.C.1, 2.C.2, 2.C.4) 2.D (2.D.1) 5.C (5.C.1)	1.5 1.6 1.7 1.8 1.9 1.10 1.11 1.15 1.16 2.17 2.18 2.19 2.21 2.22 2.23 2.24 5.1

Curriculum Alignment

Chapter(s)	*Topics Covered*	*Activities*	*Lab Activities* **[CR5b]**	*Big Idea* **[CR2]**	*Enduring Understanding & Essential Knowledge*	*Learning Objective*
Eleven and Twelve	• Intermolecular forces • Liquids and solids • Metallic bonding • Network solids • Molecular solids • Ionic solids • Vapor pressure and changes of state	• Students will observe and take part in demonstrations describing intermolecular forces in liquids, properties of molecular and ionic solids and vapor pressure. **[CR3b]**	"Gravimetric Analysis of Carbonate Lab" *SP2,6,7* • Students will evaluate various carbonates through Gravimetric Analysis.	1	1.C (1.C.1)	1.9 1.11
				2	2.A (2.A.1, 2.A.3) 2.B (2.B.1, 2.B.2, 2.B.3) 2.C (2.C.2, 2.C.3) 2.D (2.D.1, 2.D.2, 2.D.3, 2.D.4)	2.3 2.7 2.8 2.9 2.10 2.11 2.12 2.13 2.14 2.15 2.16 2.19 2.20 2.19 2.24 2.25 2.26 2.27 2.28 2.29 2.30 2.31 2.32
				5	5.B (5.B.3) 5.D (5.D.1, 5.D.2, 5.D.3,)	5.6 5.9 5.10 5.11
				6	6.A (6.A.1)	6.1

Curriculum Alignment

Chapter(s)	• *Topics Covered*	• *Activities*	*Lab Activities* **[CR5b]**	*Big Idea* **[CR2]**	*Enduring Understanding & Essential Knowledge*	*Learning Objective*
Five and Nineteen	• Energy • Enthalpy and calorimetry • Hess's law • Enthalpies of formation • Energy Sources • Spontaneity • Entropy and free energy • Free energy in chemical reactions • Free energy, equilibrium and work	• Students will complete "Entropy I and II" activities (Chemistry: A Guided Inquiry) **[CR3e]** • Students will complete the inquiry activity "In the Bag" to discover and define endothermic and exothermic reactions. **[CR3e]**	"Fundamentals of Calorimetry Lab" *SP1,2,4,6,7* • *Students utilize their knowledge of energy in chemical reactions to design a hand warmer. **[CR6]**	2 3 5 6	2.B (2.B.3) 3.C (3.C.2) 5.A (5.A.1, 5.A.2) 5.B (5.B.1, 5.B.2, 5.B.3, 5.B.4) 5.C (5.C.2) 5.E (5.E.1, 5.E.2, 5.E.3, 5.E.4, 5.E.5) 6.D (6.D.1)	2.15 2.16 3.11 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.12 5.13 5.14 5.15 5.16 5.17 6.25
Fourteen	• Reaction rates • Rate laws • The integrated rate law • Reaction mechanisms • Catalysis	• Students will introduce the concept of kinetics by performing lab simulations found at http://introchem.chem.okstate.edu/DCICLA/Mechanisms.pdf . **[CR3d]**	"Chemical Kinetics Lab" *SP3.4.5.6.7* • *Students will investigate the speed of the chemical reaction between calcium carbonate and hydrochloric acid.	4	4.A (4.A.1, 4.A.2, 4.A.3) 4.B (4.B.1, 4.B.2, 4.B.3) 4.C (4.C.1, 4.C.2, 4.C.3) 4.D (4.D.1, 4.D.2)	4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9
Thirteen and Fifteen	• Equilibrium conditions • The equilibrium constant • Equilibrium and pressure • Heterogeneous equilibria • Solving equilibrium problems • Le Châtelier's principle	• Students will observe a series of three demonstrations to establish a general definition of equilibrium, reversible reactions and stress to systems. **[CR3f]**		6	6.A (6.A.1, 6.A.2, 6.A.3, 6.A.4) 6.B (6.B.1, 6.B.2)	6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9 6.10

Curriculum Alignment

Chapter(s)	*Topics Covered*	*Activities*	*Lab Activities* **[CR5b]**	*Big Idea* **[CR2]**	*Enduring Understanding & Essential Knowledge*	*Learning Objective*
Sixteen	• Solubility equilibria • Precipitation and qualitative analysis • Complex ion equilibrium	• Students use an on-line simulation to perform qualitative analysis of a series of solutions. **[CR3c]**	"Principle of Chromatography Lab" *SP 2,3,6,7* • Students will use chromatography to determine the ions present and the interactions of each complex ion. •	6	6.A (6.A.1) 6.C (6.C.3)	6.1 6.21 6.22 6.23 6.24
Twenty	• Balancing oxidation-reduction reactions • Galvanic cells • Standard reduction potentials • Cell potentials and electrical work • Cell potentials and concentrations • Batteries • Electrolysis	• Students will construct a voltaic cell and diagram it. They will change the concentration of the solutions used and then change the electrodes to view the changes that occur to the voltage of the cell. **[CR3c]**	"Complexometric Titration of Calcium in Milk" *SP2,3,4,5* • Students utilize their skills to balance a redox equation and stoichiometry to analyze the amount of active ingredient in commercial bleach.	3 5 6	3.A (3.A.1) 3.B (3.B.3) 3.C (3.C.3) 5.E (5.E.4) 6.A (6.A.1)	3.2 3.8 3.9 3.12 3.13 5.15 5.16 5.17 6.1
Twenty-One	• Nuclear stability • Radioactive decay and kinetics • Nuclear transformations • Detection and uses of radioactivity • Fission and fusion • Hydrocarbons • Hydrocarbon derivatives • Polymers	• Students will observe the reaction of bromine water with tomato juice to discuss the organic reactions that occur. **[CR3c]**		2 4 5	2.B (2.B.2) 4.A (4.A.3) 5.D (5.D.3)	2.13 4.2 4.3 4.4 5.D.3
AP Multiple Choice Review Manual by Hostage and Demmin	• All AP topics	• Students will work through this manual during the last six weeks. They will work at home, but review in class.		All	All	All