AP Chemistry Syllabus and Information Guide 2018-19

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Course Description:

The AP chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first year of college. For most students, the course enables them to undertake, as college freshman, second year work in the chemistry sequence or to register in course in other fields where general chemistry is a prerequisite. This course meets five times per week, 55 minutes per day. Laboratory periods average 1 to 2 days per week. Students are engaged in hands-on laboratory work, integrated through the course. This lab work accounts for more than 25% of the course. Emphasis is placed on depth of understanding of topics, rather than breadth of topics.

Objectives: A learning objective is a statement of specific concepts students are expected to learn by the end of the school year. There are 97 learning objectives embedded into the Six Big Ideas. All exam questions will be based on these learning objectives. The learning objectives are posted in the College Board AP Chemistry Course Description on my website.

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 analytical 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 Thermo Scientific Spec 20, Vernier LabQuests, probes and LoggerPro software.
9. Measure, compare, order, scale, locate, and code accurately.
10. Do scientific research and report and display the results.
11. Learn to think critically in order to solve problems.

The course is structured around the six big ideas articulated in the AP chemistry curriculum framework provided by the College Board. Emphasis will be placed on the seven science practices, capturing important aspects of the work that scientists engage in, with learning objectives that combine content with inquiry and reasoning skills.

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 6: Equilibrium

Who should take AP Chemistry? AP chemistry is open to all students that have competed a year of chemistry and those wish to take part in a rigorous and academically challenging course, have a desire to continue in the sciences, a good work ethic, aptitude for math and problem solving and an excellent attitude. Enrolling students should understand that they will be expected to do college level work.

What to Expect: As you read the course outline, you will notice the large volume of material that must be covered before the AP exam in the spring. This means WE WILL MOVE VERY QUICKLY! Expect to average at least one hour of homework per school night. In order to help you stay organized, you will be provided a list of objectives, reading assignments and homework problems at the begging of each unit. You should spend approximately 5 – 7 hours each week working on problems, reading the textbook and/ or studying. This class requires reading of the chapters BEFORE it is discussed in class. Class discussion will focus on major themes and difficult concepts. Formative quizzes are used to ensure that students keep up with reading and homework. **You will learn the material best when you read and comprehend it. Don't rely on class lecture and discussion as your sole source of information**.

Textbooks and Reference Materials:

Chang, Raymond and Ken Goldsby. Chemistry, 11th Edition-Updated AP Edition. New York: McGraw-Hill Education. 2014.

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

Vernier. Chemistry Investigations for Use with AP Chemistry, 4th Edition. Beaverton, Oregon: Vernier Software & Technology. 2017.

Lab References:
Nelson, John H and Kemp, Kenneth C. Laboratory Experiments. Upper Saddle River, NJ: Prentice Hall, Inc, 2000
Hollenberg, J Leland, et al. Chemistry in the Laboratory. New York: Freeman Press, 2000
Flinn Scientific Spectrophotometer Laboratory Manual. Flinn Scientific, 1994

Course Assessments:

Homework: students are encouraged to ask questions as needed.
Learning to do problems of all types, quickly, will be one of the major goals of this class. Homework will be assigned on a regular basis. Most assignments will probably take more than one evening to complete. Homework for the preceding week will be due by 3:30pm on Thursdays. Homework one day late will be accepted for 90% credit, and will not be accepted more than one day late. Homework grades will be calculated from homework quizzes which will be given on Fridays. Students who turn in homework problems each week will be allowed to retake the homework quiz that week if they do not receive an 80% or above on the quiz.

Formative Assessments: questions, observations, discussions, graphic organizers, practice problems, reading logs, review games, daily work and quizzes

Summative Assessments: Unit tests will cover all materials, including labs. Tests will be similar in format to the AP exam, including multiple choice and free response questions.

Grading: student grades are determined by a weighted average as follows:

15% Homework/Formative Assessments
25% Labs/Projects
60% Tests

Required Materials:

Scientific calculator, splash proof safety goggles, carbon capable laboratory notebook.

AP Exam: Thursday, May 9, 2019

The AP Exam is offered through The College Board each spring. The exam is partially multiple choice and partially free-response questions. Participation in this exam is by individual choice. If you do not take the AP exam, you MUST take a class final exam. Many colleges and universities offer college credit to students who score a 3, 4 or 5 on the exam. Visit The College Board's website at www.collegeboard.com for more information including participating colleges.

The final ten full class days before the AP exam are used for exam review and practice tests using old AP chemistry exam materials. Students work in cooperative groups to solve a packet of free response problems. Several practice exams are administered during this two-week review period.

Notes about AP Chemistry

1. All labs are completed by the students individually or in groups of 2/3
2. Labs are graded both qualitatively and quantitatively over the year
3. Students have numerous quizzes over covered topics (app. 50/ year)
4. Students are given old AP free response questions (approx.3 to 5) for homework, collected and graded AP style
5. Tests always include multiple choice and free response questions given after a unit
6. Students spend time in lab during class.
7. Descriptive chemistry is taught throughout the year, not as a separate unit.

In order to simulate the National AP Exam testing format, unit tests will be formatted in multiple choice and free response questions. You will have 24 minutes to complete 20 multiple choice questions (no calculators used) and 32 minutes to complete two free response questions (with calculator). If you have

an excused absence the day of the test, you will need to take the exam the day you return to school unless you previously arrange a makeup time with the instructor.

Academic honesty:

Students often work together in advanced science classes. This is valuable and I encourage working together. HOWEVER, copying another person's homework, lab report, or answers to any other sort of assessment is CHEATING. While you and your lab partner will share data, you need to do your OWN calculations and your OWN analysis. Using unapproved outside resources is also cheating. You will not receive credit for an assignment or assessment if you cheat.

Example: You do not know how to approach solving an old AP Test question that you have for homework. What should you do?

Search the internet for the answer	NO—that is CHEATING
Search the internet for another explanation of the topic	YES—good idea!
Copy the answer from your friend or older sister	NO—that is CHEATING
Tell your friend you could do a, b, and c but are stuck on d.	NO—that is CHEATING
Ask your friend to point you in the right direction.	YES—good idea!
Steal the answer key from your teacher	NO—that is CHEATING
Ask your teacher for help a day or two before the due date	YES—good idea!
Ask your teacher for help a day or two after the due date	Better late than never, but your teacher might get annoyed
Cry	Okay for the short term, but you still need to figure out the answer!
Ignore it and hope it goes away.	NO—it won't go away, and neither will your teacher

Teacher Responsibilities

This class will be very demanding on both the students and the teacher. As your teacher, I will make the following commitments to you:

1. You will be my top priority. My AP Chemistry students will be the most important students I have. If you need help outside of class, I will do everything in my power to help you. If you come to my room for help, you will be first in line, even if others have been waiting. My culpj@gardencityschools.com Please feel free to email me any day, seven days a week, before 9 PM with questions.

2. I will grade your papers promptly. Any assignments, tests, experiments, etc. will be graded quickly. I will grade your papers before I grade papers from another class.

3. I will be prepared for class every day. This class will cover a lot of material; therefore, there will be little time to work on homework in class. Lectures, example problems, discussions, and experiments will take up the bulk of the class time.

4. I will always be on your side. I will not view you as opponents, but teammates. As far as I am concerned this is not a competition between you and me, but rather a competition between us and the AP Chemistry Exam. Please take advantage of my availability. Do not let yourself fall behind. If you find a topic that you do not understand, seek extra help immediately.

It cannot be emphasized enough that this is a very difficult and demanding course. **You can be successful and earn college credit if you do the following:**

1. Make an honest attempt to do all homework problems.
2. Make an honest attempt to **understand**, as well as complete all lab activities. This means doing the pre-lab assignments and preparing for lab work in advance.
3. Attend class on time, every day. **You cannot afford to miss this class.**
4. Attend extra help sessions regularly. These will be offered on Mondays and Thursdays after school.
5. Stay on top of things or you can become lost and overwhelmed very quickly.

I am here to help you succeed. Ask questions and stay involved. Good luck in A.P. Chemistry.

Labs:

The labs completed require following or developing processes and procedures, taking observations, and data manipulation. See lab list provided for lab details. Students communicate and collaborate in lab groups; however, each student writes a laboratory Report for every lab they perform. A minimum of 25 student contact time will be spent doing hands-on laboratory activities.

Some colleges require proof of the laboratory portion of the course before granting credit, so all students will keep a laboratory notebook. Students are encouraged to take their lab notebook with them to college.

Students will be asked to prepare for all labs prior to lab day. This includes reading assigned material, answering questions and possibly creating your own experimental procedures. Many of the labs use materials that are both expensive and perishable. This means that if a student misses a lab for any reason, it cannot be made up. ATTENDANCE IS CRUCIAL. Due to this policy, one lab experiment grade can be dropped at the end of each marking period.

Post-lab quizzes will be given in order to establish mastery of the procedure and content.

The 10 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.

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

1. **Title:** The title should be descriptive. For example, "pH Titration Lab" is a descriptive title and "Experiment 5" is not a descriptive title.

2. **Date:** the date the student performed the experiment.

3. **Purpose:** a statement summarizing what the student is trying to achieve.

4. **Hypothesis:** a prediction of the outcome of the experiment. Must include both independent and dependant variables.

5. **Procedure:** an outline of the procedure. Number the instructions 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.

6. **Pre-Lab Questions:** Students will be given some questions to answer before the lab is done. 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 notebook, 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.

7. **Data Tables:** create data tables or charts necessary for data collection in the lab.

During the Lab

8. **Data:** record all data. All data must be labeled clearly and contain proper units of measure. Underline, use capital letters, or use any device they choose to help organize this section well. Data should be formatted neatly and clearly.

Post-Lab Work

9. **Calculations and Graphs**: Students must show work for calculations in their lab write up. Graphs must be titled, axes must be labeled and units must show on the axis.

10. **Analysis questions**: Students may be given questions to answer after the experiment is completed. Rewrite the question or incorporate it in the answer. Responses must be in complete sentences.

11. **Conclusions**: This will vary from lab to lab. All answers must be well thought out and well written. They must include a summary of the lab, address if the hypothesis was supported by data and error analysis.

Students must turn in typed laboratory reports for each lab.
All lab reports will be compiled in their lab portfolio binder.
At the end of each semester students will be required to present their results for one lab using a method of their choice (PowerPoint, Poster, Article, etc.)

AP Chemistry Course Outline:

Chapters in Chang and Goldsby	AP Chemistry Topic Covered
1. Chemistry: The Study of Change	States of Matter Big Idea #1 and #2
2. Atoms, Molecules, and Ions	Atomic Theory and Atomic Structure Big Idea #1 and #2
3. Mass Relationships in Chemical Reactions	Mass relationships Big Idea #1 and #3
4. Reactions in Aqueous Solutions	Solution Reactions Big Idea #1, #2, #3 and #6
5. Gases	Gases Big Idea #2, #3 and # 5
6. Thermochemistry	Thermochemistry Big Idea #3 and #5
7. Quantum Theory and the Electronic Structure of Atoms	Quantum Theory and Structure of Atom Big Idea #1
8. Periodic Relationships Among the Elements	Periodic Table Big Idea #1
9. Chemical Bonding I : Basic Concepts	Chemical Bonding Big Idea #1, #2, #3 and #5
10. Chemical Bonding II: Molecular Geometry and Hybridization of Atomic Orbitals	Chemical Bonding Big Idea #2
11. Intermolecular Forces and Liquids and Solids	IMF Big Idea #2, #5 and #6
12. Physical Properties of Solutions	Solutions Big Idea #2 and #5
13. Chemical Kinetics	Reaction Rates Big Idea #4
14. Chemical Equilibrium	Equilibrium Big Idea #6
15. Acid and Bases	Acid and Bases Big Idea #6
16. Acid-Base Equilibria and Solubility Equilibria	Acid and Bases Big Idea #1, #3 and #6
17. Entropy, Free Energy, and Equilibrium	Thermochemistry Big Idea #5 and #6
18. Electrochemistry	Electrochemistry Big Idea #3
19. Nuclear Chemistry	Nuclear Chemistry
20. Chemistry in the Atmosphere	Ozone, Acid Rain and Greenhouse effect Big Idea #4
24. Organic Chemistry	Organic Chemistry
25. Synthetic and Natural Organic Polymers	Polymers

Structure of the Course:

The following labs (included in both semesters) will require 25% of the instructional time.

Guided inquiry labs taken from the College Board lab manual are indicated by *****

Guided inquiry labs created by the instructor are indicated by ******

Unit	***Topics***	***Labs/Activities (Source)***	***Chapters and Problems***
Unit 1: Chemical Foundations	<u>Chapter 1: Change</u> ▪ Chemistry ▪ Scientific Method ▪ Classification of Matter ▪ States of Matter ▪ Physical /Chemical Properties ▪ Measurement ▪ Density ▪ Handling Numbers ▪ Dimensional Analysis	Labs: ▪ Skittles Lab – What is an Inquiry Lab (Culp) ▪ Lab Safety (Culp) ▪ Basic Lab Techniques (Culp) ▪ Hot Hands (Vernier Intro to LabQuest) ▪ Classification of Matter (Culp/Coogan) ****** ▪ Identification of Substances- Physical Properties (Davis) ▪ Chromatography: "Sticky Question: How do you Separate Molecules that are Attracted to One Another?" (CB)* ▪ Rainbow Lab (Ed Innovations) (Measuring) Activities: Kinesthetic Particles –Temp/KE/IMF	Ch 1: 7,8,11,17,22,26, 31,33,42,46,49, 53,59,88
	<u>Chapter 2: Atoms, Molecules and Ions</u> ▪ Atomic Theory ▪ Atomic Structure ▪ Atomic Number ▪ Mass Number ▪ Isotope ▪ Periodic Table ▪ Molecules and Ions ▪ Chemical Formulas ▪ Naming Cpds ▪ Intro Organic Cpds	Labs: ▪ Physical and Chemical Changes: "Can the individual Components of Quick Ache Relief Be Used to Resolve Consumer Complaints?" (CB)***** Activities: ▪ Formula of a Hydrate - Copper Sulfate ▪ Ionic Dice Activity / Formulators Activity ▪ Chemical Formulas and % Composition	Ch 2: 12,18,21,22,31,35 37,42,47,66,73, 78,80, 89,98,108, 117
	<u>Chapter 3:</u> <u>Mass Relationships</u> ▪ Atomic Mass ▪ Molar Mass ▪ Molecular Mass ▪ Mass Spectrometer ▪ % Composition ▪ Empirical Formulas ▪ Chemical Reactions ▪ Chemical Equations ▪ Stoichiometry ▪ Limiting Reagents ▪ Reaction yield	Labs: ▪ Comparing Mole Quantities Lab (Culp/Coogan)****** ▪ Chemical Reaction Copper and Sulfur ▪ Reaction Types Lab I-(Ions in Chemical Reactions Predicting Products) ▪ Reaction Types Lab II (Culp) ****** ▪ Stoichiometry: "Using the Principle that Each Substance has Unique Properties to Purify a Mixture." (CB) ***** Activities continued…	Ch 3: 5,9,10,13,20,23, 30,31,34,35,42,46 49,52,54,55,59, 63,68, 70,72,76, 82 ,84,90, 92,168,169

		Activities: ▪ Balancing Equations – Human Equations - pHet simulations ▪ Students solve a stoichiometry problem on the amount of carbon dioxide produced in the burning of a tankful of gasoline (assumed to be octane) with information of the size of the gas tank of the vehicle, the density of octane (0.7028 g mL^{-1}), and a variety of other conversion factors. Following the solution of this problem, a discussion of what happens to this carbon dioxide will ensue encompassing the greenhouse effect, whether the burning of fossil fuels contributes to global climate change, and if something should be done about the burning of fossil fuels (especially given current estimates for the amount of fossil fuel remaining in the earth and the students estimated lifetime).	
Unit	***Topics***	***Labs/Activities (Source)***	***Chapters and Problems***
Unit 2: Quantum Theory and Periodicity	<u>Chapter7: Quantum Theory and the Electronic Structure of Atoms</u> ▪ Quantum Theory ▪ Photoelectric Effect ▪ Bohr's Theory ▪ Electrons ▪ Quantum Mechanics ▪ Quantum Numbers ▪ Atomic Orbitals ▪ Electron Configuration	Labs: Activities:	Ch 7: 7, 8, 13, 16, 20, 26, 28, 29, 46, 48, 56, 66, 68, 76, 78, 90, 92, 98, 102, 110, 112, 120, 130, 142, 148
	<u>Chapter 8: Periodic Relationships among the Elements</u> ▪ Periodic Table ▪ Periodic Classifications ▪ Periodic Variation of Physical Properties ▪ Ionization Energy ▪ Electron Affinity ▪ Representative Elements	Labs: Activities: Periodicity: Students will graph and interpret several data sets on atomic properties (atomic radius, first ionization energy and electronegativity) in order to arrive at the periodic table from the jumps in the graphs.	Ch 8: 8, 9, 11, 12, 20, 24, 28, 38, 39, 40, 41, 42, 43, 44, 45, 49, 52, 56, 58, 62, 63, 72, 74, 78, 80, 81, 82, 88, 92, 96, 98, 102, 104, 114, 118, 124, 130, 136, 144

Unit	*Topics*	*Labs/Activities (Source)*	*Chapters and Problems*
Unit 3 : Bonding	<u>Chapter 9: Chemical Bonding I - Basic Concepts</u> ▪ Lewis Dot Structures ▪ Ionic Bonds ▪ Lattice energy ▪ Covalent Bonds ▪ Electronegativity ▪ Formal Charges Resonance ▪ Exceptions to Octet Rule ▪ Bond Enthalpy	Labs: ▪ Bonding in Solids: "What's in that Bottle?" (CB) ***** Activities: ▪ White Boards ▪ Molecular Models	Ch 9: 5, 7, 8, 11, 16, 18, 22, 26, 30, 31, 36, 37, 38, 44, 48, 48, 54, 57, 58, 70, 90, 92, 440
	<u>Chapter 10: Chemical Bonding II – Molecular Geometry and Hybridization of Atomic Orbitals</u> ▪ Molecular Geometry ▪ Dipole moments ▪ Valence Bond Theory ▪ Hybridization of Orbitals ▪ Molecular Orbital Theory ▪ Molecular Orbital Configuration ▪ Delocalized Molecular Orbitals	Labs: Activities: ▪ Molecular Models ▪ Prepare models of various electron pair arrangements, and complete a table which shows the Lewis structure, electron pair geometry, molecular structure, and use that information to predict the presence or absence of a dipole moment.	Ch 10: 5, 6, 8, 10, 12, 18, 20, 23, 24, 25, 28, 30, 32, 34, 36, 42, 44, 45, 49, 50, 56, 62, 63, 66, 72, 76, 118, 125,
	<u>Chapter 11: Intermolecular Forces Liquids and Solids</u> ▪ Kinetic Molecular Theory ▪ Intermolecular Forces ▪ Properties of Liquids ▪ Crystal Structure ▪ X-Ray Diffraction ▪ Amorphous Solids ▪ Phase Changes	Labs: ▪ IMF Races – Comparing Compound Types via IMF (Culp/Coogan) ****** Activities: ▪ Magnetic Water Models – IMF types ▪ White Boarding – Students ▪ Students will explore an animation on heating and cooling curves (www.kentchemistry.com, select heating curves) and answer a series of questions regarding their observations of particulate motion in the various phases.	Ch 11: 1-7, 14, 16, 18, 21, 22, 26, 28, 48, 49, 52, 56, 57, 58, 59, 60, 66, 68, 71, 72, 73, 76, 77, 82, 86, 90

Unit	***Topics***	***Labs/Activities (Source)***	***Chapters and Problems***
Unit 4 : Solutions	<u>Chapter 4:</u> <u>Reactions in Aqueous Solutions</u> ▪ Properties of Aqueous Solutions ▪ Precipitate Reactions ▪ Activity series ▪ Acid-Base Reactions ▪ ReDox Reactions ▪ Concentration ▪ Gravimetric Analysis ▪ Acid-Base Titrations ▪ ReDox Titrations	Labs: ▪ Introduction to Solubility - Copper Sulfate ▪ Introduction to Titration – Acid /Base (Culp) ▪ Redox Titration: "How can we Determine the Actual Percentage of H2O2 in a Drugstore Bottle of Hydrogen Peroxide?" (CB) ***** ▪ Spectroscopy: "What is the relationship between the Concentration of a Solution and the Amount of Transmitted Light through the Solution?" (CB) ***** ▪ Gravimetric Analysis: "What makes Hard Water Hard?" (CB) ***** Activities: ▪ White boarding schematics of solutions.	Ch 4: 4-8, 10, 12, 15,--18, 20, 22, 24, 26-30, 32, 24, 35, 37, 39, 44, 46, 48, 54, 56, 62, 64, 66, 68, 74, 78, 82, 90, 98, 100
	<u>Chapter 12:</u> <u>Physical Properties of Solutions</u> ▪ Types of Solutions ▪ Molecular View of Solution Process ▪ Concentration Units ▪ Temperature and Solubility ▪ Pressure and Solubility ▪ Colligative properties ▪ Colloids	Labs: ▪ Colligitive Properties (Davis) ▪ Titration: "How Much Acid is in Fruit Juice and Soft Drinks?" (CB) ***** Activities:	Ch 12: 1-12, 15, 16, 18, 22, 26, 28, 31, 21, 32, 26, 69, 40, 45, 46, 47, 50, 56, 79, 80,
Unit 5 : Gases	<u>Chapter 5: Gases</u> ▪ Pressure ▪ Gas laws ▪ Ideal Gas Equation ▪ Stoichiometry ▪ Dalton's law of Partial Pressures ▪ Kinetic Molecular Theory ▪ Ideal Behavior Deviation	Labs: ▪ Gas Laws Lab (Culp) ****** ▪ Determining R: The Gas Law Constant (Davis) Activities: ▪ Algebra review – isolating variables, direct vs. indirect proportions, and estimation	Ch 5: 9, 15, 17, 18, 20, 24, 26, 32, 34, 42, 44, 48, 50, 54, 58, 62, 70, 75, 76, 82, 88, 91

Unit	*Topics*	*Labs/Activities (Source)*	*Chapters and Problems*
Unit 6: Thermo-chemistry	<u>Chapter 6: Thermochemistry</u> ▪ Nature and Types of Energy ▪ Energy Change in Chemical Rxns ▪ Thermodynamics ▪ Enthalpy ▪ Calorimetry ▪ Standard Enthalpy of Formation and Reaction ▪ Heat of Solution and Dilution	Labs: ▪ Endo / Exo (Culp / Coogan) ****** ▪ Coffee Culp Calorimetry (Culp/Coogan) ▪ The Candle Lab – Heat Transfer (Culp) ▪ Calorimetry: "The Hand Warmer Design Challenge: Where Does the Heat Come From?" (CB) ***** Activities:	Ch 6: 2, 8, 11, 16, 23, 24, 26, 31, 32, 33, 43, 51, 54, 62, 66, 67, 70, 89, 98, 146
	<u>Chapter 17: Entropy, Free Energy and Equilibrium</u> ▪ Laws of Thermodynamics ▪ Spontaneous Processes ▪ Entropy ▪ Gibbs Free Energy ▪ Free Energy and Chemical Equilibrium	Labs: Activities: Students will work in pairs to create FRQ style questions with answer key to share with the class. Questions must be appropriate, FRQ style with grading rubric.	C h 17: 1-8, 12, 15, 16, 18, 20-24, 30, 33, 34, 36, 40, 58-60, 70, 86
Unit 7: Kinetics	<u>Chapter 13: Chemical Kinetics</u> ▪ Reaction Rates ▪ Rate law ▪ Activation Energy ▪ Concentration Dependence ▪ Temperature Dependence ▪ Rate Constants ▪ Reaction Mechanisms ▪ Catalysis	Labs: ▪ Rates of Reaction – Clock Reaction ▪ Kinetics/Reaction Rates: "How long will that Marble Statue Last?" (CB) ***** ▪ Kinetics: Rate laws: "What is the Rate law of the Fading of Crystal Violet using Beer's law?" (CB) ***** ▪ Activities: Students will demonstrate their knowledge of the determination of kinetics by displaying the solution to the following problem to the class. The thermal decomposition of an organic nitrile produced the following data: t / (10^3 s) 0 2.00 4.00 6.00 8.00 10.00 12.00 ∞ [nitrile] / (mol L^{-1}) 1.10 0.86 0.67 0.52 0.41 0.32 0.25 0.00 Determine the order of reaction and rate constant.	Ch 13: 1-4, 6, 9-12, 14, 16, 18, 21-26, 29, 30, 31, 33, 35, 38, 40, 48, 50, 51, 56, 58, 59, 60, 61, 68, 86, 116, 117

Unit	*Topics*	*Labs/Activities (Source)*	*Chapters and Problems*
Unit 8 : Acids and Bases	<u>Chapter 15: Acids and Bases</u> ▪ Bronsted Acids ▪ Water ▪ pH ▪ Strength of Acids and Bases ▪ Ionization Constants ▪ Diprotic Acids ▪ Polyprotic Acids ▪ Properties of Salts ▪ Properties of Oxides ▪ Lewis Acids	Labs: ▪ Titration of Acids and Bases ▪ Determination of Dissociation Constant of a Weak Acid (Davis) Activities: Students take the data from the spreadsheet "Titrations" on pH against added acid or base, and interpret the data in terms of the types of acid or base present, endpoints, the presence or absence of a buffer system, and appropriate indicators with justification based on the data.	Ch 15: 1-6, 9-18, 21, 27-32, 35, 36, 38-42, 44, 46, 51-54, 59-62, 64, 67, 68, 70, 73-76, 78, 84, 85, 88, 91, 94
	<u>Chapter 16: Acid-Base Equilibria and Solubility Equilibria</u> ▪ Common Ion Effect ▪ Buffer Solutions ▪ Titrations ▪ Indicators ▪ Solubility Equilibria ▪ Fractional Precipitation ▪ pH and Solubility ▪ Complex Ion Equilibria ▪ Qualitative Analysis	Labs: ▪ Acid-Base titration: "How do the Structure and Initial Concentration of an Acid and a Base Influence the pH of the Resultant solution During a Titration?" (CB) ***** ▪ ReDox Titration – Determination of Oxalate (Davis) ▪ Buffering Activity: "To what Extent do Common Household Products have Buffering Activity?" (CB) ***** ▪ Buffer Design: "The Preparation and Testing of an Effective Buffer: How do Components Influence a Buffer's pH and Capacity?" (CB)***** Activities:	Ch 16: 1-4, 6, 7, 10, 14, 20, 22, 25, 26, 28, 38, 41, 42, 44, 47-52, 60, 64, 66, 68, 72, 76, 78, 80, 85,
	<u>Chapter 20: Chemistry in the Atmosphere</u> ▪ Ozone ▪ Volcanoes ▪ Greenhouse Effect ▪ Acid Rain ▪ Photochemical Smog	Labs: ▪ Acid Rain simulation in a Petri Dish (Coogan) Activities: ▪ Acid Rain "debate" - Should SO2 emission regulations be loosened?	Ch 20: 1-4, 6-10, 12-18, 29-38, 43-48, 51, 52, 61-64,

Unit	***Topics***	***Labs/Activities (Source)***	***Chapters and Problems***
Unit 9 : Equilibrium	<u>Chapter 14: Chemical Equilibrium</u> ▪ Equilibrium ▪ Equilibrium Constant ▪ Relationship between Kinetics and Equilibrium ▪ Factors Affecting Equilibrium	Labs: ▪ Colorimetric Determination of an Equilibrium Constant (Davis) ▪ Le Chatelier's Lab Introduction ▪ Equilibrium: "Can We Make the Colors of the Rainbow?" (CB) ***** Activities:	Ch 14: 1-8, 13, 14, 16, 20, 26, 30, 33, 34, 35, 37, 38, 40, 46, 49, 50, 51, 52, 56, 60, 62, 100
Unit 10: Electro - chemistry	<u>Chapter 18: Electrochemistry</u> ▪ ReDox Reactions ▪ Galvanic Cells ▪ Standard Reduction Potentials ▪ Thermodynamics of Redox Rxns ▪ Cell Emf ▪ Batteries ▪ Corrosion ▪ Electrolysis	Labs: ▪ Electrolysis, the Faraday and Avogadro's Number (Davis) ▪ Energizer Lab (Cullen) Activities:	Ch 18: 2-7, 10, 12, 16, 18, 21, 24, 29, 30, 32, 36, 37, 38, 41-46, 50, 60, 94
Unit 11: Nuclear Chemistry	<u>Chapter 19: Nuclear Chemistry</u> ▪ Nuclear Stability ▪ Natural Radioactivity ▪ Transmutation ▪ Fission ▪ Fusion ▪ Use of Isotopes ▪ Biological Effects	Labs: Activities: ▪ Half-Life Simulation (Culp)	Ch 19: 1-7, 9-14, 16, 20, 26, 68, 30, 35, 36, 38, 40, 41-52,
Unit 12: Organic Chemistry	<u>Chapter 24: Organic Chemistry</u> ▪ Classes of Cpds ▪ Aliphatics ▪ Aromatics ▪ Functional Groups	Labs: Activities: ▪ Molecular Models (Culp)	Ch 24: 1-11, 14-16, 29-36,
	<u>Chapter 25: Synthetic and Natural Polymers</u> ▪ Polymers ▪ Synthetic Polymers ▪ Proteins ▪ Nucleic Acids	Labs: ▪ Synthesis of a Polymer (Culp) Activities:	Ch 25: 1-6, 10-18, 23-26

Possible Activities for Big Idea #1 (non-lab)

1. Students will graph and interpret several data sets on atomic properties (atomic radius, first ionization energy and electronegativity) in order to arrive at the periodic table from the trends in the graphs.
2. Students will use molecular models to build compounds and rearrange atoms to demonstrate chemical reactions.

Possible Activities for Big Idea #2 (non-lab)

1. Students will prepare models of the various electron pair arrangements, and complete a table which shows the Lewis structure, electron pair geometry, molecular structure, and use that information to predict the presence or absence of a dipole moment.
2. Students will draw scenarios of particle combinations identifying inter and intra molecular forces.
3. Using Potential Energy Curves, students will compare bond order and bond strength, looking for patterns

Possible Activities for Big Idea #3 (non-lab)

1. Students will identify and balance chemical reactions using a variety of techniques on a series of quizzes from the reactions problem from previous AP exams.
2. Students will use molecular models to simulate chemical reactions and balanced equations.
3. Students will use candy and paper plates to simulate nuclear decay and to construct graphs of change in unstable nuclei over time and the half-life of the candy.

Possible Activities for Big Idea #4 (non-lab)

1. Students will demonstrate their knowledge of the determination of kinetics by displaying the solution to the following problem to the class.

   The thermal decomposition of an organic nitrile produced the following data:

t / (10^3 s)	0	2.00	4.00	6.00	8.00	10.00	12.00	∞
[nitrile] / (mol L^{-1})	1.10	0.86	0.67	0.52	0.41	0.32	0.25	0.00

   Determine the order of the reaction and the rate constant.
2. Students will present analogies of reaction rates to the class using non-chemistry examples.

Possible Activities for Big Idea #5 (non-lab)

1. Students will explore an animation on heating and cooling curves (www.kentchemistry.com, select heating curves) and answer a series of questions regarding their observations of particulate motion in the various phases.

2. Given a set of conditions, the students determine favorability by identifying changes in entropy, enthalpy, and Gibbs Free Energy

Possible Activities for Big Idea #6 (non-lab)

1. Students take the data from the spreadsheet "Titrations" on pH against added acid or base, and interpret the data in terms of the types of acid or base present, endpoints, the presence or absence of a buffer system, and appropriate indicators with justification based on the data.
2. Students will identify various types of equilibrium problems and calculate missing values using an ICE (or RICE) table.

Possible Activities for Societal or Technological Impact of Chemistry (lab or non-lab)

1. Students solve a stoichiometry problem on the amount of carbon dioxide produced in the burning of a tankful of gasoline (assumed to be octane) with information of the size of the gas tank of the vehicle, the density of octane (0.7028 g mL^{-1}), and a variety of other conversion factors. Following the solution of this problem, a discussion of what happens to this carbon dioxide will ensue encompassing the greenhouse effect, whether the burning of fossil fuels contributes to global climate change, and if something should

be done about the burning of fossil fuels (especially given current estimates for the amount of fossil fuel remaining in the earth and the students estimated lifetime).

2. Students will research and debate the benefits and challenges of nuclear energy and the challenges that society faces in fulfilling the need for energy.

3. Students conduct an investigation into the major components of acid rain and write the reactions that occur between the pollutant and the compounds naturally present (i.e. water, oxygen, carbon dioxide). Group discussions will inform students about cause and effect of acid rain.

Science Practices for AP Chemistry:

A practice is a way to coordinate knowledge and skills in order to accomplish a goal or task. The science practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. These science practices capture important aspects of the work that scientists engage in, at the level of competence expected of AP Chemistry students.

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

The student can:

1.1 *create representations and models* of natural or man-made phenomena and systems in the domain.
1.2 *describe representations and models*
1.3 *refine representations and models*
1.4 *use representations and models* to analyze situations or solve problems qualitatively and quantitatively.
1.5 *re-express key elements* of natural phenomena

Science Practice 2: The student can use mathematics appropriately.

The student can:

2.1 justify the selection of a mathematical routine to solve problems.
2.2 apply mathematical routines to quantities that describe natural phenomena.
2.3 estimate numerically quantities that describe natural phenomena

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

The student can:

3.1 pose scientific questions.
3.2 refine scientific questions
3.3 evaluate scientific questions.

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

The student can:

4.1 justify the selection of the kind of data needed to answer a particular scientific question.

4.2 design a plan for collecting data to answer a particular scientific question.

4.3 collect data to answer a particular scientific question.

4.4 evaluate sources of data to answer a particular scientific question.

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

The student can:

5.1 analyze data to identify patterns or relationships.

5.2 refine observations and measurements based on data analysis.

5.3 evaluate the evidence provided by data sets in relation to a particular scientific question.

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

The student can:

6.1 justify claims with evidence.

6.2 construct explanations of phenomena based on evidence produced through scientific practices.

6.3 articulate the reasons that scientific explanations and theories are refined or replaced.

6.4 make claims and predictions about natural phenomena based on scientific theories and models.

6.5 evaluate alternative scientific explanations.

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

The student can:

7.1 connect phenomena and models across spatial and temporal scales.

7.2 connect concepts in and across domains to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

Chapter	Lab Name and Description	Science Practices
Chapter 1: Change	▪ Skittles Lab – What is an Inquiry Lab (Culp)	1,3,4,7
	▪ Basic Lab Techniques (Culp)	2, 3, 4
	▪ Hot Hands (Vernier Intro to LabQuest)	3, 4
	▪ Classification of Matter (Culp/Coogan) **	1, 5, 6, 7
	▪ Identification of Substances- Physical Properties (Davis)	1, 5, 6, 7
	▪ Chromatography: "Sticky Question: How do you Separate Molecules that are Attracted to One Another?" (CB)*	1, 2, 5, 6, 7
	▪ Rainbow Lab (Ed Innovations) (Measuring)	2, 4, 5, 7
Chapter 2: Atoms, Molecules and Ions	▪ Physical and Chemical Changes: "Can the individual Components of Quick Ache Relief Be Used to Resolve Consumer Complaints?" (CB)*	3, 4, 5, 6, 7
Chapter 3: Mass Relationships	▪ Comparing Mole Quantities Lab (Culp/Coogan)**	1, 2, 3, 4, 5,
	▪ Chemical Reaction Copper and Sulfur	3, 4, 5,
	▪ Reaction Types Lab I-(Ions in Chemical Reactions Predicting Products)	3, 4, 5, 6
	▪ Reaction Types Lab II (Culp) **	3, 4, 5, 6
	▪ Stoichiometry: "Using the Principle that Each Substance has Unique Properties to Purify a Mixture." (CB) *	2, 3, 4, 5,
Chapter 9: Chemical Bonding I - Basic Concepts	▪ Bonding in Solids: "What's in that Bottle?" (CB) *	2, 3, 4

Chapter	Lab Name and Description	Science Practices
Chapter 4: Reactions in Aqueous Solutions	▪ Introduction to Solubility - Copper Sulfate	3, 4, 5, 6
	▪ Introduction to Titration – Acid /Base (Culp)	2, 5, 6
	▪ Redox Titration: "How can we determine the Actual Percentage of H2O2 in a Drugstore Bottle of Hydrogen Peroxide?" (CB) *	2, 3, 4, 5,
	▪ Spectroscopy: "What is the relationship between the Concentration of a Solution and the Amount of Transmitted Light through the Solution?" (CB) *	2, 3, 4, 5, 6
	▪ Gravimetric Analysis: "What makes Hard Water Hard?" (CB) * .	1, 3, 4, 5, 6
Chapter 12: Physical Properties of Solutions	▪ Colligitive Properties (Davis)	2, 5, 6
	▪ Titration: "How Much Acid is in Fruit Juice and Soft Drinks?" (CB) *	2, 3, 4, 5, 6
Chapter 5: Gases	▪ Air Lab-How do Gases Behave? (Culp) **	1, 3, 4, 5, 6, 7
	▪ Determining R: The Gas Law Constant (Davis)	2, 5, 6
Chapter 6: Thermochemistry	▪ Endo / Exo (Culp / Coogan) **	4,5,6,7
	▪ Coffee Culp Calorimetry (Culp/Coogan)	2,5,6,7
	▪ The Candle Lab – Heat Transfer (Culp)	2,5,6,7
	▪ Calorimetry: "The Hand Warmer Design Challenge: Where Does the Heat Come From?" (CB) *	1,4,5,6,
Chapter 13: Chemical Kinetics	▪ Rates of Reaction – Clock Reaction	2, 5, 6
	▪ Kinetics/Reaction Rates: "How long will that Marble Statue Last?" (CB) *	1, 3, 4, 5, 6, 7
	▪ Kinetics: Rate laws: "What is the Rate law of the Fading of Crystal Violet using Beer's law?" (CB) *	2, 5, 6

Chapter	Lab Name and Description	Science Practices
Chapter 15: Acids and Bases	▪ Titration of Acids and Bases ▪ Determination of Dissociation Constant of a Weak Acid (Davis)	2, 5, 6 2, 4, 5, 6,
Chapter 16: Acid-Base Equilibria and Solubility Equilibria	▪ Acid-Base titration: "How do the Structure and Initial Concentration of an Acid and a Base Influence the pH of the Resultant solution During a Titration?" (CB) * ▪ ReDox Titration – Determination of Oxalate (Davis) ▪ Buffering Activity: "To what Extent do Common Household Products have Buffering Activity?" (CB) * ▪ Buffer Design: "The Preparation and Testing of an Effective Buffer: How do Components Influence a Buffer's pH and Capacity?" (CB)*	2, 4, 5, 6, 2, 4, 5, 1, 2, 5, 6, 7 2, 5, 6,
Chapter 20: Chemistry in Atmosphere	▪ Acid Rain simulation in a Petri Dish (Coogan)	1, 3, 4, 5, 6, 7
Chapter 14: Chemical Equilibrium	▪ Colorimetric Determination of an Equilibrium Constant (Davis) ▪ Le Chatelier's Lab Introduction ▪ Equilibrium: "Can We Make the Colors of the Rainbow?" (CB) *	4, 5, 6 5, 6 3, 4, 5, 6
Chapter 18: Electro-chemistry	▪ Electrolysis, the Faraday and Avogadro's Number (Davis) ▪ Energizer Lab (Cullen)	2, 4, 5, 6 4, 5, 6
Chapter 25: Polymers	▪ Synthesis of a Polymer (Culp)	1, 5, 6, 7