Western High School Science Department
Course Syllabus
A.P. Chemistry

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Room:	1143	**Planning Hour:**	***

COURSE DESCRIPTION: Advanced Placement Chemistry is designed to be the equivalent of a two-semester entry level chemistry course offered by many different colleges and universities. While universities have the advantage of emphasizing certain main topics, an A.P. course must be able to guarantee that any student who passes the exam has the background information that any school requires.

AP Chemistry should meet the objectives of a good college general chemistry course. Students in such a course should attain a depth of understanding of fundamentals and a reasonable competence in dealing with chemical problems. The course should contribute to the development of the students' abilities to think clearly and to express their ideas, orally and in writing, with clarity and logic. The college course in general chemistry differs qualitatively from the usual first secondary school course in chemistry with respect to the kind of textbook used, the topics covered, the emphasis on chemical calculations and the mathematical formulation of principles, and the kind of laboratory work done by students. Quantitative differences appear in the number of topics treated, the time spent on the course by students, and the nature and the variety of experiments done in the laboratory. **This course meets five times per week for 50 minutes per day is spent on AP Chemistry. Laboratory periods average two to three days per week plus additional time after school. Students are engaged in hands-on laboratory work, integrated throughout the course that accounts for more than 25% of the class time. [CR5a] Emphasis is placed on depth of understanding of a topic, rather than breadth of topics.**

This level of rigor requires students to have excellent independent study habits, high motivation, and to be enrolled in Pre-Calculus (or a higher math course). It is also necessary for students to keep up with all required work. *It is expected that students will read the text **before** the material is discussed in class.* Such familiarity makes it easier to understand class lectures. Reinforcement follows in the homework assignments and many students find it helpful to read the chapter once more before the unit test is given. This helps to "cement" the information for the student and will make it easier to recall when used later in the year.

> 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.

Resources:

Primary Text:	Chemistry, 8th Edition (Zumdahl)
Recommended Review Books:	Fast Track to a Five, Belmont, CA, Brooks/Cole Barron's Review for AP Chemistry, Kaplan's Guide to AP Chemistry, Cracking the AP Chemistry Test: Princeton Review
Websites:	www.prenhall.com/~chem http://apdl.rice.edu www.apcentral.collegeboard.com

YOUR GENERAL OBJECTIVES FOR THIS COURSE:

1. Score a **3** or higher on the A.P. Chemistry Exam
2. Learn as much chemistry as you can! WE LOVE CHEMISTRY!!
3. Study a LOT!! **A minimum of five hours of independent work per week is recommended by the college board for success in this class, in addition to the normal homework**. You should evaluate for yourself whether you need to spend the minimum recommended time, or more time, on the topics in order to truly understand the material.
4. Have as much fun as you can learn a difficult subject.

Materials:

Notebooks/Folders: A 3-ring binder and a lab notebook is highly recommended for this class.

Calculators: A scientific calculator is **necessary** for this class.

Approximate Grading Breakdown:	
Homework	15%
Labs	25%
Quizzes & Tests	60%

All assignments are graded on a point system. The final grade is tallied by the following method: the total cumulative points earned out of the total possible points will be converted to a percentage.

AP Chemistry Standards:

		Page(s)
CR1	Students and teachers use a recently published (within the last 10 years) college-level chemistry textbook.	2
CR2	The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework.	2-10
CR3a	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 1: Structure of matter.	4, 5
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.	4
CR3d	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 4: Rates of chemical reactions.	8
CR3e	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 5: Thermodynamics.	5
CR3f	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 6: Equilibrium.	15, 16
CR4	The course provides students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.	4
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
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.	2 - 10
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.	2 - 10
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.	2

Objectives:

Students will:

Learn the inquiry process through numerous laboratory investigations.
Gain an understanding of the six big ideas as articulated in the AP Chemistry Curriculum Framework. [CR2]
Apply mathematical and scientific knowledge and skills to solve quantitative, qualitative, spatial, and analytic problems.
Apply basic arithmetic, algebraic, and geometric concepts.
Formulate strategies for the development and testing of hypotheses.
Use basic statistical concepts to draw both inferences and conclusions from data.
Identify implications and consequences of drawn conclusions.
Use manipulative and technological tools including the , Vernier Probes, and Vernier's LoggerPro software.
Measure, compare, order, scale, locate, and code accurately.
Do scientific research and report and display the results of this research.
Learn to think critically in order to solve problems.

Textbook, Laboratory Manual, and Study Guides:

Zumdahl, Steven S., et. al., Chemistry, 8th Edition. Belmont, CA, Brooks Cole, 2010. **[CR1]**
Knoespel, Sheldon, et. al., Fast Track to a Five, Belmont, CA, Brooks/Cole, Cengage Learning, 2010.
Randall, Jack. Advanced Chemistry with Vernier, Oregon: Vernier Software and Technology, 2004.
Holmquist, Dan and Donald Volz, Chemistry with Computers, Oregon: Vernier Software and Technology, 2003.
Odyssey software, Wavefunction, Inc, Irvine, CA, 2009.

Laboratory Work:

All of the laboratory experiments in this course are hands-on. Students work individually or in a group of two 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 submit a lab report that is submitted for grading that conforms to the "The Laboratory Notebook" guidelines. [CR7] All laboratory experiments are intended to be performed during the class time with additional time after school as needed. Some guided-inquiry labs will require two days of work.

The Laboratory Notebook

A laboratory notebook should be used to explain laboratory procedures, record all laboratory data, show how calculations are made, discuss the results of an experiment, and to explain the theories involved. A record of laboratory work is an important document which will show the quality of the laboratory work that you have done. You may need to show your notebook to the Chemistry Department at a college or university in order to obtain credit for the laboratory part of your Advanced Placement Chemistry course. As you record information in your notebook, keep in mind that someone who is unfamiliar with your work may be using this notebook to evaluate your laboratory experience in chemistry. When you explain your work, list your data, calculate values and answer questions, be sure that the meaning will be obvious to anyone who reads your notebook.

Procedure

1. Use a quadrille-lined book with pages fastened in place.
2. Write your name and class on the front cover and inside the front cover.
3. In ink, number all the right-hand pages on the lower right comer if they are not already numbered. If you are left-handed, you may use the left pages instead of the right if you wish.
4. Save the first two pages for a Table of Contents. This should be kept current as you proceed. Each time you write up a lab, place the title and page number where the lab report begins in the Table of Contents.
5. Write in ink. Use only the right hand pages. You may use the left-hand pages for preliminary notes or for a quick graph. The left-hand pages will not be graded.
6. If you make a mistake DO NOT ERASE. Just draw ONE LINE through your error, and continue. It is expected that some errors will occur. You cannot produce a perfect, error-free notebook. Errors should be corrected by drawing one line through the mistake, and then proceeding with the new data.

Laboratory Reports

Include the following information in your laboratory reports:

1. Title. The title should be descriptive. Experiment 5 is not a descriptive title.
2. Date. This is the date (or dates) you performed the experiment.
3. Purpose. A brief statement of what you are attempting to do.
4. Procedure. A one- or two-sentence description of the method you are using. You may refer to the lab manual for specific instructions, but you should include a brief statement of the method. Do not include lengthy, detailed directions. A person who understands chemistry should be able to read this section and know what you are doing.
5. Data. Record all your data directly in your lab notebook on the right-hand pages. Organize your data in a neat, orderly form. Label all data very clearly. Use correct significant digits, and always include proper units (g, mL, etc.). Underline, use capital letters, or use any device you choose to help organize this section well. Space things

out---don't try to cram everything on one page.
Use tables where appropriate.

6. Calculations and Graphs. You should show *how* calculations are carried out. Give the equation used and show how your values are substituted into it. Give the calculated values. If graphs are included, make the graphs an appropriate size. Label all axes and give each graph a title. If experiments are not quantitative, this section may be omitted.
7. Conclusions. Make a simple statement concerning what you can conclude from the experiment.
8. Discussion of Theory. In this section you should include such information as: What theory was demonstrated in this experiment? What do the calculations show? How was the purpose of the experiment fulfilled? Why does (or doesn't) the experiment work? Refer back to the purpose of the lab to write this section.
9. Experimental Sources of Error. What are some *specific* sources of error, and how do they influence the data? Do they make the values obtained larger or smaller than they should be? Which measurement was the least precise? Instrumental error and human error exist in all experiments, and should not be mentioned as a source of error unless they cause a significant fault. Significant digits and mistakes in calculations are NOT a valid source of error. In writing this section it is sometimes helpful to ask yourself what you would do differently if you were to repeat the experiment and wanted to obtain better precision. If you can calculate a percent error or percent deviation, do so and include it in this section.
10. Questions. Answer any questions included in the lab directions.

Graphing Experimental Data

1 . All graphs should have a descriptive title ("Graph" is not a title).
2. Both the vertical and horizontal axes should have labels and units clearly marked. Use a ruler to draw the axes.
3. The scales chosen should reflect the precision of the measurements. For example, if temperature is known to be ±0.l °C, you should be able to plot the value this closely. Don't have each block of the graph equal to 10°C. You may need to use graph paper with smaller divisions than that in the laboratory notebook.
4. There should be a table in which the data values are listed. Don't put data in a graph unless you have first listed it in a table.
5. The controlled or independent variable is conventionally placed on the horizontal axis. The dependent variable is graphed on the vertical axis.
6. There should be an obvious small point on the graph for each experimental value. It is not necessary to include the coordinates of each point since they will be in the data table.
7. A smooth line should be drawn that lies as close as possible to most of the points. Do NOT draw a line connecting one point to the next one as in a dot-to-dot drawing. If the line is a straight line, use a ruler to draw it.

Technology:

Students use Vernier LabPros and probes in laboratory work to gather data. Graphs are produced using Vernier LoggerPro software.

Laboratory Notebook:

A laboratory notebook is required for the course. All completed lab reports documenting all lab experiences must be included in the notebook. The notebook is checked after two labs have been completed and a final check at the end of the course. [CR7]

Tests:

A chapter test is assigned for each chapter. 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:

The final week of class days before the AP Chemistry 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 from previous exams. Students practice net ionic equations and are quizzed on their progress. Several practice AP Exams are administered as part of the week review prior to the AP Chemistry Exam.

Course Outline: [CR2]

Chapters in Zumdahl <u>Chemistry</u>	**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. Types of Chemical Reactions & Solution Stoichiometry	Reaction Types & Stoichiometry **(BI 3)**
5. Gases	Gases **(BI 1 & 2)**
6. Thermochemistry	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)**
12. Chemical Kinetics	Kinetics **(BI 4)**
13. Chemical Equilibrium	Equilibrium **(BI 6)**
14. Acids and Bases	Equilibrium **(BI 6)**
15. Acid- Base Equilibria	Equilibrium **(BI 6)**
16. Solubility and Complex Ion Equilibria	Equilibrium **(BI 6)**
17. Spontaneity, Entropy, and Free Energy	Thermodynamics **(BI 5)**
18. Electrochemistry	Reaction Types **(BI 3)**
19. The Nucleus - A Chemist View	Nuclear Chemistry
20. The Representative Elements	Descriptive Chemistry **(BI 2**)
22. Organic Chemistry and Biological Molecules	Descriptive Chemistry

(BI) refers to 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.

Assignments:

Chapter 1: Chemical Foundations (10 days)

Topics Covered:	Curriculum Framework Articulation:
1. Scientific Method	BI 1.D.1:a
2. Classification of Matter	
pure substances vs mixtures	1.A.1:b
chemical and physical changes	3.C.1:b, 3.C.1:c, 5.D:2

Read: Pages 1-30
Problems: 15, 16, 20, 24, 26, 28, 30, 34, 36, 38, 40, 42, 46, 48, 52, 56, 60, 66, 68, 70, 74, 82.

Labs: Safety/Lab Skills/Lab Preparation (Flinn Lab Safety Video)

Lab: Math and Measurement in Science & Density of an Organic Liquid **Description:** Students learn how to measure mass and volume with varied pieces of equipment and focus on the accuracy of those pieces of equipment in their calculation and determination of significant figures. Students also determine the identity of an unknown organic liquid using density determination.

Guided Lab: Introduction to spectrophotometry. Students will be introduced to the proper use of a Spectronic 20 and discover lambda-max for various food coloring solutions. Students will use Excel spread sheet or another graphing capable program to graph their data. (SP 4.1; LO 1.15) [CR5a, 5b, CR6]

> C4—The course provides students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens. This component will be spread throughout the course in class discussion.

Review: Fast Track to a Five, pp. 51-59

Chapter 2: Atoms, Molecules, and Ions (8 days)

Topics Covered:	Curriculum Framework Articulation:
Classification of Matter	
law of definite proportions	1.A.1:c
law of multiple proportions	1.A.1:d
Nomenclature and formula of binary compounds	1.E.2.b

Read: Pages 40-67
Problems: 16, 20, 24, 26, 30, 32, 34, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 60, 62, 64, 66, 70, 72, 74, 76, 80, 82.

Lab: Beer's Law. Students will use the introduction spectrophotometry lab results to determine the concentration of a food coloring agent in a beverage and relate to GRAS. [CR4, CR5a, 5b, CR6]

Lab: Determining a Chemical Formula. Students will perform analysis of a hydrated compound and gravimetric stoichiometry to determine its formula. (SP 4.2, 5.1, 6.4; LO 3.5) [CR5a, 5b, CR6]

Review: Fast Track to a Five, pp. 63-71

Chapter 3: Stoichiometry (9 days)

Topics Covered:	Curriculum Framework Articulation:
Determination of atomic masses	1.A.1:a

Mole concept	1.A.3:b, 1.A.3:c, 1.A.3:d, 1.E.2:b
Percent composition	1.A.2:a
Empirical and molecular formula	1.A.2:b
Writing chemical equations and drawn representations	1.E.1:a, 1.E.1:c, 3.C.1:a
Balancing chemical equations	1.A.3:a, 1.E.2:c, 1.E.2:d, 3.A.1:a
Applying mole concept to chemical equations (Stoich)	1.A.3:a, 1.E.1:b
Determine limiting reagent, theoretical and % yield	3.A.2:a

Read: Pages 77-115
Problems: 24, 26, 28, 30, 34, 36, 37, **40**, 48, 50, 52, 54, 58, 64, **70**, 72, 74, **76**, 80, 84, 86, **90**, **94**, 98, 104, 106, 110, 114.

Guided Lab : Determining the Moles in a Chemical Reaction (SP 2.1, 2.2, 4.2, 5.1, 6.4; LO 3.3, 3.5) [CR5b, CR6] Students determine the correct mole ratio of reactants in an exothermic reaction by mixing different amounts of reactants and graphing temperature changes.

Activity: LO 3.6: Use data from synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions. [CR3c]

Review: Fast Track to a Five, pp. 75-84

Chapter 4: Types of Chemical Reactions and Solution Stoichiometry (11 days)

Topics Covered:	Curriculum Framework Articulation:
Electrolytes and properties of water	2.A.3:h
Molarity and preparation of solutions	1.D.3:c, 2.A.3:i, 2.A.3:j
Precipitation reactions and solubility rules	6.C.3:d
Acid Base reactions and formation of a salt by titration	1.E.2:f, 3.A.2:c
Balancing redox	3.B.3:a, 3.B.3:b, 3.B.3:c, 3.B.3:d
Simple redox titrations	1.E.2:f
Gravimetric calculations	1.E.2:e
Addition reactions	3.A.1, 3.B.1:a
Decomposition reactions	3.A.1, 3.B.1:a, 3.C.1:d

Read: Pages 130-169
Problems: 10, 12, 16, 18, 20, 24, 26, 30, 32, 36, 38, 40, 44, 48, 52, 56, 60, 62, 64, 66, 68, 72, 76, 80, 84, 88.

Guided Lab: Standardizing a Solution of Sodium Hydroxide. Students will learn to use KHP and indicators to standardize KOH solution. [CR5a, 5b, CR6]
Guided Lab: Acid-Base Titration. HCl with NaOH (SP 4.2, 5.1, 6.4; LO 1.20) [CR5a, 5b, CR6]

Review: Fast Track to a Five, pp. 89-101

Chapter 5: Gases (9 days)

Topics Covered:	Curriculum Framework Articulation:
General gas laws - Boyle, Charles, Combined, and Ideal	2.A.2:a, 2.A.2:c
Dalton's Law of partial pressure	2.A.2:b
Molar volume of gases and Stoichiometry	3.A.2:b
Kinetic Molecular Theory	2.A.2:d, 5.A.1
Graham's Law	
Real Gases and deviation from ideal gas law	2.A.2:e, 2.A.2:f, 2.A.2:g, 2.B.2:c, 2.B.2:d
Graham's Law demonstration	LO 2.6; SP 1, 6

Read: Pages 181-221
Problems: 20, 24, 28, 30, 32, 34, 42, 44, 46, 54, 58, 60, 62, 66, 70, 72, 74, 78, 80, 82, 86, 88, 96, 100, 104, 106.

TEACHER DEMO: Graham's Law of Diffusion **Description:** HCl and NH_3 are placed in either end of a glass tube. Using distance traveled of each gas by looking at formation of NH_4Cl ring. (SP 2.2, 2.3; LO 2.6)
Guided Lab: Exploring properties of Gases. Use Vernier probes to support gas laws. (SP 2.2, 2.3; LO 2.6) [CR5a, 5b, CR6]
Lab: The Determination of the Molar Mass of a Volatile Liquid (SP 1.3, 1.4, 6.4, 7.2; LO 2.4, 2.5) [CR5a, 5b, CR6]

Review: Fast Track to a Five, pp. 105-116

Chapter 6: Thermochemistry (10 days)

Topics Covered:	Curriculum Framework Articulation:

Law of conservation of energy, work, and internal energy	5.B.1, 5.E.2:a
Endothermic and exothermic reactions	3.C.2, 5.B.3:e, 5.B.3:f
Potential energy diagrams	3.C.2, 5.C.2:c, 5.C.2:d, 5.C.2:e
Calorimetry, heat capacity, and specific heat	5.A.2, 5.B.2, 5.B.3:a, 5.B.3:b, 5.B.4
Hess's law	5.B.3:a
Heat of formation/combustion	5.C.2:g
Bond energies	2.C.1:d, 5.C.1, 5.C.2:a, 5.C.2:b

Read: Pages 236-273
Problems: 10, 12, 16, 22, 26, 28, 32, 34, 36, 38, 40, 42, 44, 50, 52, 56, 58, 60, 62, 68, 72, 74, 78, 84, 90.

Guided Lab: Hess's Law (SP 4.2, 5.1, 6.4; LO 5.6, 5.7) [CR5a, 5b, CR6]

Activity: LO 5.2: Students relate temperature to the motions of particles, either via particulate representations, such as drawings of particles with arrows indicating velocities, and/or via representations of average kinetic energy and distribution of kinetic energies of the particles, such as plots of the Maxwell- Boltzmann distribution. [CR3e]
The questions lead to the interpretation of activation energy on the distribution curve and eventually the refining of collision theory.
Activity: Online Heating and Cooling Curve Simulations LO 5.6 & SP 1 [CR3e]

Review: Fast Track to a Five, pp. 119-134

Chapter 7: Atomic Structure and Periodicity (10 days)

Topics Covered:	Curriculum Framework Articulation:
Electron configuration and the Aufbau principle	1.B.2:a
Valence electrons and Lewis dot structures	1.B.2:c
Periodic trends	1.B.1:b, 1.B.1:c, 1.B.2:b, 1.B.2:d, 1.C.1:c, 1.D.1:b, 2.C.1:a, 2.C.1:b
Table arrangement based on electronic properties	1.C.1:a, 1.C.1:b, 1.C.1:d
Properties of light and study of waves	1.C.2:e, 1.D.3:a, 5.E.4:b
Atomic spectra of hydrogen and energy levels	1.B.1:d, 1.B.1:e, 1.D.3:b
Quantum mechanical model	1.C.2:d
Quantum theory and electron orbitals	1.C.2:c
Orbital shape and energies	1.C.2:b
Spectroscopy	1.D.2:a, 1.D.2:b, 1.D.2:c, 1.D.3:b

Read: Pages 285-327
Problems: 18, 20, 22, 24, 26, 30, 32, 34, **38**, **40**, **44**, 48, 56, 58, 60, **64**, 68, **70**, 73, **74**, 82, 84, 86, 92, 98, **103**, 104, 112, 120, 126.
Lab: Beer's Law and Analysis of Copper in a Sample (SP 4.2, 5.1; LO 3.4) [CR5a, 5b, CR6]

Activity: LO 1.10: Justify with evidence the arrangement of the periodic table and apply periodic properties to chemical reactivity. Students are given several elements pairing them by families or by period and are asked to rationalize the change in electronegativity of each group based on the electronic structure of the atom **[CR3a]**

Review: Fast Track to a Five, pp. 137-149

Chapter 8: Bonding: General Concepts (9 days)

Topics Covered:	Curriculum Framework Articulation:
Lewis Dot structures	2.C.4:a
Resonance structures and formal charge	2.C.4:c, 2.C.4:d, 2.C.4:e
Bond polarity and dipole moments	2.C.1:c, 2.C.1:e, 2.C.1:f
VSEPR models and molecular shape	2.C.4:b, 2.C.4:e, 2.C.4:f
Lattice energies	1.B.1:a, 1.C.2:a, 2.C.1:d (1-2), 2.C.2:a, 2.C.2:b, 2.D.1:b
Hybridization	2.C.4:g
Molecular orbitals and diagrams	2.C.4:h, 2.C.4:i

Read: Pages 341-390
Problems: 13, 14, 16, 18, 20, 24, 28, 30, 36, 38, 42, 46, 48, 52, 54, 56, 64, 66, 70, 74, 78, **79**, 80, **81**, 82, 84, 86, **87**, 90, 92, 96, **97**, 102, 108, 112, 118.

Lab: Molecular Geometry Use Lewis diagrams and VSEPR to predict the geometry of molecules, identify hybridization, and make predictions about polarity. (SP 1.4; LO 2.1, 2.21, 2.17, 2.19, 2.20, 5.1, 5.10; SP 1, 3, 4,) [CR5a, 5b, CR6]

Activity: Students construct balloon models of the arrangement of pairs of electrons around a central atom. They then draw 2D pictures of these arrangements and apply these to predicting the shapes of molecules. [CR3b]

Chapter 9: Covalent Bonding: Orbitals (9 days)

Topics Covered:	Curriculum Framework Articulation:
Resonance structures and formal charge	2.C.4:c, 2.C.4:d, 2.C.4:e
Bond polarity and dipole moments	2.C.1:c, 2.C.1:e, 2.C.1:f
VSEPR models and molecular shape	2.C.4:b, 2.C.4:e, 2.C.4:f
Hybridization	2.C.4:g

Read: Pages 404-428
Problems: 8, 10, 16, **22**, 24, 26, **30**, **34**, 36, 38, 40, **44**, 52, 58, 80.

Chapter 22: Organic and Biological molecules (3 days)

Topics Covered:	Curriculum Framework Articulation:
Hydrocarbons: saturated vs unsaturated	2.C.4
Aromatic hydrocarbons	2.C.4
Functional groups	5.D.3
Polymers	

Read: Pages 1006 - 1048
Problems: 2, 14, 22, 32, 34, 48, 50, 58, 62, 66, 70, 72, 80, 86, 108, 112.

Review: Fast Track to a Five, pp. 153-177

Chapter 10: Liquids and Solids (8 days)

Topics Covered:	Curriculum Framework Articulation:
Structure and bonding	
a. metals, network, and molecular	2.A.1:a, 2.A.1:d, 2.C.3, 2.D.1:a, 2.D.2:a, 2.D.1:b, 2.D.3, 2.D.4
b. ionic, hydrogen, London, van der Waals	2.A.1:b, 2.B.1:a, 2.B.1:b, 2.B.1:c, 2.B.2:a, 2.B.2:b, 2.B.2:c, 2.B.2:d, 2.B.3:a, 5.D:1
Vapor pressure and changes in state	
Heating and cooling curves	2.A.1:e, 5.B.3:c, 5.B.3:d

Read: Pages 439-483
Problems: 14, 20, 30, 32, 34, 36, 38, 39, 42, 44, **50**, 52, 54, 72, 80, **90**, **92**, 96.
Lab: Enthalpy of Vaporization of Water (SP 6.4, 7.1; LO 2.3) [CR5a, 5b, CR6]

Review: Fast Track to a Five, pp. 183- 193

Chapter 11: Properties of Solutions (8 days)

Topics Covered:	Curriculum Framework Articulation:
Composition of solutions	2.A.1:c, 2.A.3:b, 2.A.3:c, 2.B.3:b
Colloids and suspensions	2.A.3:a, 2.A.3:b, 2.A.3:g
Separation techniques	2.A.3:e, 2.A.3:f
Effect on biological systems	2.B.3:e, 2.D.3, 5.E.4:c

Read: Pages 498-528
Problems: 12, 14, 16, 24, 26, 28, **30**, 32, **36**, **44**, 46, 48, **52**, 54, 64, **70**, 78, 84.

Lab: Freezing Point Depression (SP 1.1, 1.2, 6.4; LO 2.8) [CR5a, 5b, CR6]
Lab: Chromatography (LO 2.3, 2.7, 2.8, 2.10) [CR5a, 5b, CR6]

Review: Fast Track to a Five, pp. 197-208

Chapter 12: Chemical Kinetics (12 days)

Topics Covered:	Curriculum Framework Articulation:
Rates of reactions	4.A.1:a
Factors that effect rates of reactions/ collision theory	4.A.1:b, 4.A.1:c, 4.D.1, 4.D.2
Reaction Pathways	4.B.3:a, 4.B.3:b
Rate equation determination	4.A.2:a
a. rate constants	4.A.3
b. mechanisms	4.B.1, 4.C.1, 4.C.2, 4.C.3
c. method of initial rates	4.A.2:c
d. integrated rate laws	4.A.2:b, 4.A.3:d
Activation energy and Boltzmann distribution	4.B.2, 4.B.3:c

Read: Pages 540-577
Problems: 10, 12, 16, 20, 24, 26, 28, 30, **32**, 36, **38**, 40, **41**, 44, 46, 50, **54**, 56, 58, 60, 64, **66**, 72.

Guided Lab: Rate Determination and Activation Energy (SP 4.2, 6.4; LO 4.1, 4.2) [CR5a, 5b, CR6]
Guided Lab: Rate Law Determination: Crystal Violet Reaction (SP 5.1, 6.4; LO 4.1, 4.2, 4.4) [CR5a, 5b, CR6]

Guided Inquiry: Factors that affect reaction rates and determining reaction rates and reaction mechanisms (SP 6.2, 7.2; LO 4.5, 4.9)

Activity: LO 4.8: Translate among reaction energy profile representations, particulate representations, and symbolic representations (chemical equations) of a chemical reaction occurring in the presence and absence of a catalyst.
Students create energy diagrams to explain why catalysts and raising the temperature can increase the rate of a chemical reaction. [CR3d]

Review: Fast Track to a Five, pp. 213-227

Chapter 13: Chemical Equilibrium (11 days)

Topics Covered:	Curriculum Framework Articulation:
Characteristics and conditions of chemical equilibrium	6.A.1, 6.A.3:a, 6.A.3:f
Equilibrium expression derived from rates	6.A.3:b
Factors that affect equilibrium	6.A.3:c
Le Chatlier's principle	6.A.3:b, 6.B.1, 6.B.2, 6.C.3:e, 6.C.3:f
The equilibrium constant	6.A.3:d, 6.A.3.e, 6.A.4
Solving equilibrium problems	6.A.2

Read: Pages 594-626
Problems: 10, 14, 18, 20, **21**, 22, 26, 28, 30, **32**, 36, 38, **40**, 42, **46**, 48, 54, **58**, 59, 61, 64, 66, 70.

Guided Lab: Determining the Equilibrium Constant (SP 4.2; LO 6.9) [CR5a, 5b, CR6]

Activity: LO 6.1: Given a set of experimental observations regarding physical, chemical, biological, or environmental processes that are reversible, student is able to construct an explanation that connects the observations to the reversibility of the underlying chemical reactions or processes.
Students view the NO_2/N_2O_4 Equilibrium simulation available on the "General Equilibria Animations Index" page at Iowa State University Department of Chemistry and report their answers to teacher supplied questions regarding the number of reactant and product molecules present at a particular point in the equilibrium process, the breaking and forming of bonds during the process, and how the reactant and product molecules are changing in order to illustrate the dynamic nature of equilibrium. [CR3f]

Review: Fast Track to a Five, pp. 231-244

Chapter 14: Acids and Bases (11 days)

Topics Covered:	Curriculum Framework Articulation:
Definition and nature of acids and bases	3.B.2, 6.C.1:c, 6.C.1:d, 6.C.1:e, 6.C.1:f
Kw and the pH scale	6.C.1:a, 6.C.1:b, 6.C.1:g
pH of strong and weak acids and bases	6.C.1:h
Polyprotic acids	6.C.1:n
pH of salts	

Read: Pages 639-684
Problems: 20, 28, **30**, 32, 34, 36, 38, 42, 44, 50, 52, 60, 64, 68, 70, 72, 76, 78, 84, 88, 92, 96, 102, 104, 114, 118, 122, 127, 129.

Guided Lab: Determination of Ka by the Half-Titration of Weak Acids (SP 1.1, 1.4, 2.3; LO 6.11) [CR5b] & [CR6]

Chapter 15: Applications of Aqueous Equilibria (12 days)

Topics Covered:	Curriculum Framework Articulation:
Characteristics and capacity of buffers	6.C.2
Titrations and pH curves	6.C.1:i, 6.C.1:j, 6.C.1:k, 6.C.1:l, 6.C.1:m
Choosing Acid Base Indicators	

Read: Pages 698-734
Problems: 18, 26, **32**, 40, 44, 46, 48, 52, 60, **70**, 80, 90.

Review: Fast Track to a Five, pp. 249-273 and pp.279-291

Chapter 16: Solubility and Complex Ion Equilibria

Topics Covered:	Curriculum Framework Articulation:
Ksp Calculations and Solubility Product	6.C.3:a, 6.C.3:b

pH and solubility

Read: Pages 744-764
Problems: 20, 28, 38, 50, 56, 60, 62, 64, 74

Lab: Determination of a Solubility Product Constant (SP 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 5.1; LO 1.4, 3.3, 6.12, 6.20) [CR5a, 5b, CR6]

Chapter 17: Spontaneity, Entropy, and Free Energy (8 days)

Topics Covered:	Curriculum Framework Articulation:
Laws of thermodynamics	
Spontaneous process and entropy	5.E.1
Spontaneity, enthalpy, and free energy	5.E.2:c, 5.E.3, 5.E.2:d, 5.E.2:e, 5.E.2:f, 6.C.3:c, 6.D.1:a
Free energy and equilibrium	5.E.2, 6.D.1:b, 6.D.1:c, 6.D.1:d
Rate and Spontaneity	5.E.2:e, 5.E.5

Read: Pages 773-804
Problems: 18, 22, 24, 28, 30, 32, **34**, 38, 42, 46, **48**, 54, 58, **66**, 70.

Chapter 18: Electrochemistry (11 days)

Topics Covered:	Curriculum Framework Articulation:
Balancing redox equations	3.B.3:a, 3.B.3:b, 3.B.3:c, 3.B.3:d
Electrochemical cells and voltage	3.C.3:a, 3.C.3:b, 3.C.3:c, 5.E.4:a
The Nernst equation	3.C.3:d
Spontaneous and non-spontaneous equations	3.C.3:e
Chemical applications	3.C.3:f

Read: Pages 81-858
Problems: 16, 26, 30, 32, 36, 40, **56**, 58, 60, **74**, 76, 80, 82, 86, 88, 92, 98, 104, 124.

Guided Lab: Electrochemical Cells (SP 2.2, 2.3, 5.1, 6.4; LO 3.12, 3.13) [CR5a, 5b, CR6]

Review: Fast Track to a Five, pp. 297-309

Chapter 19: The Nucleus: A Chemist's View (3 days)
Read: Pages 873-899
Problems: 12, 14, 22, 26, 34, 38, 42, 46, 52, 54, 72

Review: Fast Track to a Five, pp. 313-318

Chapter 20: The Representative Elements (5 days)
Read: Pages 908-942
Problems: 2, 8, 10, 16, 18, 24, 26, 28, 34, 36, 42, 44, 48, 52, 56, 60, 66, 78.

*Refers to Learning Objectives (LO) or Science Practices (SP)