

Catasauqua Area School District Planned Course of Study

Course Title: Advanced Placement Chemistry/Honors Chemistry II

Grade Level(s): 11/12

Text: Chang 13th Edition

Course Description

The AP Chemistry course provides students with a college-level foundation to support future advanced coursework in chemistry. Students cultivate their understanding of chemistry through inquiry-based investigations, as they explore content such as: atomic structure, intermolecular forces and bonding, chemical reactions, kinetics, thermodynamics, and equilibrium. The AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first college year. This course requires that 25 percent of instructional time engages students in lab investigations. This includes a minimum of 16 hands-on labs (at least six of which are inquiry-based).

Essential Questions & Competencies

BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.

BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.

BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events.

BIG IDEA 4: ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.

The student should be able to:

- 1.A Describe the components of and quantitative information from models and representations that illustrate particulate-level properties only.
- 1.B Describe the components of and quantitative information from models and representations that illustrate both particulate-level and macroscopic level properties.
- 2.A Identify a testable scientific question based on an observation, data, or a model.
- 2.B Formulate a hypothesis or predict the results of an experiment.
- 2.C Identify experimental procedures that are aligned to a scientific question (which may include a sketch of a lab setup).
- 2.D Make observations or collect data from representations of laboratory setups or results, while attending to precision where appropriate.
- 2.E Identify or describe potential sources of experimental error.
- 2.F Explain how modifications to an experimental procedure will alter results.
- 3.A Represent chemical phenomena using appropriate graphing techniques, including correct scale and units.
- 3.B Represent chemical substances or phenomena with appropriate diagrams or models (e.g., electron configuration).
- 3.C Represent visually the relationship between the structures and interactions across multiple levels or scales (e.g., particulate to macroscopic).
- 4.A Explain chemical properties or phenomena (e.g., of atoms or molecules) using given chemical theories, models, and representations.
- 4.B Explain whether a model is consistent with chemical theories.
- 4.C Explain the connection between particulate-level and macroscopic properties of a substance using models and representations.
- 4.D Explain the degree to which a model or representation describes the connection between particulate-level properties and macroscopic properties.
- 5.A Identify quantities needed to solve a problem from given information (e.g., text, mathematical expressions, graphs, or tables).
- 5.B Identify an appropriate theory, definition, or mathematical relationship to solve a problem.
- 5.C Explain the relationship between variables within an equation when one variable changes.
- 5.D Identify information presented graphically to solve a problem.
- 5.E Determine a balanced chemical equation for a given chemical phenomenon.
- 5.F Calculate, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures).
- 6.A Make a scientific claim.
- 6.B Support a claim with evidence from experimental data.
- 6.C Support a claim with evidence from representations or models at the particulate level, such as the structure of atoms and/or molecules.
- 6.D Provide reasoning to justify a claim using chemical principles or laws, or using mathematical justification.
- 6.E Provide reasoning to justify a claim using connections between particulate and macroscopic scales or levels.
- 6.F Explain the connection between experimental results and chemical concepts, processes, or theories.
- 6.G Explain how potential sources of experimental error may affect the experimental results.

Catasauqua Area School District**Course Title:** AP Chemistry/Honors Chemistry II**Grade Level:** 11/12**Course Syllabus**

Course Content	Tentative Timeframe	Assessment Anchors	State Standards
<u>Unit One: The Study of Change</u>	2.5 weeks		
1. Measurement and the MKS System a. Significant Figures b. Scientific Notation c. Accuracy & Precision d. Dimensional Analysis e. Logarithms		S11A.1.1.1 Thru S11S.1.1.5	3.1.10 A 3.1.10 E 3.2.10 A 3.2.10 B
2. Atoms, Molecules & Ions a. Atomic Theory b. Atomic Structure c. Atomic Number, Mass Number & Isotopes d. Periodic Law e. Molecules & Ions f. Ionic & Covalent Bonding g. Electron Configuration & Quantum Mechanics h. Nomenclature i. Modeling and VSEPR Theory j. Types of Reactions and Balancing		S11.C.1.1.1 S11.C.1.1.2 S11.A.3.2.1 S11.A.3.2.2 S11.A.3.2.3 S11.A.3.3.1 S11.A.3.3.2 S11.A.1.1.4 S11.C.1.1.3	3.4.10 A 3.4.10 B 3.1.10 B 3.2.10 B
3. Stoichiometry a. Mole Relationships b. Percent Composition c. Empirical Formula d. Chemical Reactions & Chemical Equations e. Percent Yield f. Limiting Reagents		SC11.A.2.2.1	3.7.10 B 3.8.10 B
<u>Unit Two: Gas Laws</u>	1 week		
1. Substances that are Gases 2. The Kinetic Molecular Theory of Gases 3. Gas Pressure 4. The Gas Laws a. Boyle's Law b. Charles' Law & Gay-Lussac's Law		S11C1.1.5	3.4.10A

<ul style="list-style-type: none"> 5. Avagardo's Law 6. The Ideal Gas Equation & Deviations 7. Gas Stoichiometry 			
<p><u>Unit Three: States of Matter and Solution Chemistry</u></p> <ul style="list-style-type: none"> 1. Molecular Forces relating to the Kinetic-Molecular Theory 2. Changes of State and Phase Diagrams 3. Crystal Structure & Intermolecular Forces <ul style="list-style-type: none"> a. Amorphous Solids b. Types of Crystals c. Lattice Energy 4. Properties of Aqueous Solutions <ul style="list-style-type: none"> a. Types of Solutions b. Solution Process c. Effect of Temperature & Pressure on Solubility d. Precipitation Reactions 5. LeChatelier's Principle and Chemical Equilibrium 6. Boiling Point Elevation, Freezing Point Depression, and Vapor Pressure Depression 7. Colligative Properties and Osmotic Pressure 	2.5 weeks	SC11.C.2.1.1 S11.C.1.1.2	3.4.10 A 3.4.10 B 4.1.10 B 4.6.10 A
<p><u>Unit Four: Acids, Bases, and Neutralization</u></p> <ul style="list-style-type: none"> 1. Arrhenius, Bronsted and Lewis Acids & Bases 2. Acid/Base Properties of Water 3. pH and Indicators 4. Acid/Base Strength and Ionization Constants 5. Conjugate Acids and Bases 6. Diprotic and Polyprotic Acids 7. Salts 8. Common Ion Effect 9. Buffer Solutions 10. Acid/Base Neutralization Titrations 	3 weeks	S11.A.3.1.2	3.1.10 A 3.1.10 E 4.3.10 C
<p><u>Unit Five: Oxidation/Reduction Reactions</u></p> <ul style="list-style-type: none"> 1. Determining Oxidation States and Rules for Assigning Oxidation Numbers 2. Net Ionic Equations and Half Reactions 3. Identifying Oxidation, Reduction, Oxidizing and Reducing Agents 	1.5 weeks	S11.B.3.2.3	4.3.10 C

<ol style="list-style-type: none"> 4. Balancing Redox Reactions <ol style="list-style-type: none"> a. Oxidation Number Exchange Method b. Half Reaction Method 5. Corrosion and Corrosion Protection 6. Redox Titrations 			
<p><u>Unit Six: Electrochemistry</u></p> <ol style="list-style-type: none"> 1. Galvanic Cells <ol style="list-style-type: none"> a. Half Cell Reactions b. Cell Voltage 2. Standard Reduction Potentials 3. Cell Emf Concentration Effect <ol style="list-style-type: none"> a. Faraday Constants b. Nernst Equation 4. Batteries and Fuel Cells <ol style="list-style-type: none"> a. Dry Cells b. Lead Storage Batteries c. Lithium Ion Batteries 5. Electrolysis 	1.5 weeks	S11.B.3.1.5	4.3.10 C
<p><u>Unit Seven: Kinetics and Thermodynamics</u></p> <ol style="list-style-type: none"> 1. Reaction Rates 2. Rate Laws with First, Second, and Zero Order Reactions 3. Reaction Mechanisms and Energy Diagrams <ol style="list-style-type: none"> a. Catalysis b. Activation Energy 4. Equilibrium and Spontaneous Reactions <ol style="list-style-type: none"> a. Equilibrium Constant and Law of Mass Action b. Heterogeneous & Homogeneous Equilibria c. Equilibrium Calculations 5. Laws of Thermodynamics <ol style="list-style-type: none"> a. Nature of Energy & Types of Energy b. Energy Changes in Chemical Reactions 6. Entropy and Enthalpy 7. Gibb's Free Energy, Hess' Law and Related Calculations 8. Born-Haber Cycle 9. Calorimetry 	2 weeks	S11.C.2.1.3 S11.C.1.1.6	3.4.10 A 3.4.10 B
<p><u>Unit Nine: Nuclear Chemistry</u></p> <ol style="list-style-type: none"> 1. Nuclear Reactions 	1 week	S11.B.3.2.3	3.1.10 C 4.2.10 D

<ol style="list-style-type: none"> 2. Nuclear Stability & Radioactivity 3. Nuclear Transmutation <ol style="list-style-type: none"> a. Fission b. Fusion 4. Use of Isotopes & Biological Effects 			
<u>Unit Eight: Organic Chemistry</u> <ol style="list-style-type: none"> 1. Classes of Organic Compounds 2. Aliphatic Hydrocarbons 3. Aromatic Hydrocarbons 4. Functional Groups 5. Polymers, Synthetics & Proteins 	2 weeks	S11.B.1.1.1	3.3.10 B
<u>Unit Ten: Descriptive Chemistry and Exam Review</u> <ol style="list-style-type: none"> 1. Precipitation and Combustion Reactions 2. Redox and Gas Forming Reactions 3. Color of Elements and Compounds 4. Periodic Trends and Group Characteristics 5. Acid/Base Reactions and Trends 6. Flame Testing and Identification of Unknowns 7. Applying the Concepts to the AP Exam 	1 week	S11.A.2.2.1	3.7.10 B 3.8.10 B

Teaching Strategies Utilized

Lecture
Modeling
Independent Research

Laboratory Activities & Demonstrations
Classroom Discussion
Cooperative Learning

Nepris
POGIL Independent Learning
Guided Inquiry

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Objectives	Level of Ach.	Suggested Learning Activities	Forms of Assessment	Assess. Anchor	PA Stand.
<i>The student will be able to:</i>					
Unit One: The Study of Change					
Work within the Metric System using calculations with the correct Scientific Notation and number of Significant figures.	M	Teacher designed projects Laboratory activities	Quizzes Tests Homework	S11A.1.1.1 Thru S11S.1.1.5	3.1.10 A 3.1.10 E 3.2.10 A 3.2.10 B
Apply numerical functions to data collection and laboratory work. Demonstrate proper laboratory usage and safety techniques.	R	Homework Class Discussion Class/Group work	Graded Activities and Assignments Lab Activities and Lab Reports	S11.C.1.1.1 S11.C.1.1.2 S11.A.3.2.1 S11.A.3.2.2 S11.A.3.2.3 S11.A.3.3.1 S11.A.3.3.2 S11.A.1.1.4 S11.C.1.1.3	3.4.10 A 3.4.10 B 3.1.10 B 3.2.10 B
Explain the relationship between trends in atomic properties of elements and electronic structure and periodicity.	AP	POGIL			
Balance, identify and predict products of chemical reactions.	M			SC11.A.2.2.1	3.7.10 B 3.8.10 B
Calculate quantities of a substance or its relative number of particles using dimensional analysis and the mole concept.	M				
Apply concepts to Laboratory situations for analysis	R				
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Videos	Laboratory Equipment Chemicals Worksheets & Lab Manuals Nepris Interactions				
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences					

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<p><i>The student will be able to:</i></p> <p>UNIT TWO – Gas Laws</p> <p>Describe the behavior of gases defined by the Kinetic-Molecular Theory.</p> <p>Calculate pressure, volume, temperature and number of moles using the gas laws.</p> <p>Derive equations using the gas law formulas.</p> <p>Consider the forces involved in ideal and non-ideal gas and take these factors into account.</p>	<p>K</p> <p>AP</p> <p>R</p> <p>AP</p>	<p>Teacher designed projects</p> <p>Laboratory activities</p> <p>Homework</p> <p>Class Discussion</p> <p>Class/Group work</p> <p>POGIL</p>	<p>Quizzes</p> <p>Tests</p> <p>Homework</p> <p>Graded Activities and Assignments</p> <p>Lab Activities and Lab Reports</p>	<p>S11C1.1.5</p>	<p>3.4.10A</p>
Resources/Materials					
<p>Textbook/iPads/Online Resources</p> <p>Student Study Guide</p> <p>Calculators</p> <p>Videos</p>	<p>Laboratory Equipment</p> <p>Chemicals</p> <p>Worksheets & Lab Manuals</p> <p>Nepris Interactions</p>				
Interdisciplinary Relationships					
<p>Physics - atomic interaction and movement</p> <p>Reading - acquisition and interpretation of research</p> <p>Mathematics - calculations</p> <p>Social Studies - relation to societal influences</p>					

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<p><i>The student will be able to:</i></p> <p><u>UNIT THREE – States of Matter and Solution Chemistry</u></p> <p>Identify the forces within solids (metallic, ionic, and covalent), liquids (molecular and ionic), and gases.</p> <p>Identify changes and state in response to temperature and pressure.</p> <p>Calculate Equilibrium problems. Interpret a Phase Diagram.</p>	<p>AP</p> <p>AP</p> <p>AP</p>	<p>Teacher designed projects</p> <p>Laboratory activities</p> <p>Homework</p> <p>Class Discussion</p> <p>Class/Group work</p>	<p>Quizzes</p> <p>Tests</p> <p>Homework</p> <p>Graded Activities and Assignments</p> <p>Lab Activities and Lab Reports</p>	<p>SC11.C.2.1.1 S11.C.1.1.2</p>	<p>3.4.10 A 3.4.10 B 4.1.10 B 4.6.10 A</p>
Resources/Materials					
<p>Textbook/iPads/Online Resources Student Study Guide Calculators Laboratory Equipment Chemicals Worksheets & Lab Manuals Videos Nepris Interactions</p>					
Interdisciplinary Relationships					
<p>Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences</p>					

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<i>The student will be able to:</i>					
<u>UNIT FOUR – Acids, Bases, and Neutralization</u>					
Relate Acid/Base Theories to properties and reactions of acids and bases.	K, AP	Teacher designed projects	Quizzes	S11.A.3.1.2	3.1.10 A 3.1.10 E 4.3.10 C
Calculate the K_a and the K_b of acids and bases in solution.	K, AP	Laboratory activities	Tests		
To determine the pH of a solution using various instruments, calculations and techniques.	M	Homework	Homework		
To perform a titration identifying neutralization, end point, and equivalence point.	AP, M	Class Discussion	Graded Activities and Assignments		
To calculate the molarity and pH of an unknown using titration techniques.	K, AP	Class/Group work	Lab Activities and Lab Reports		
Differentiate between conjugate acid and base pairs.	AP				
Incorporate their knowledge of buffers and buffer capacities into laboratory activities.	R				
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Videos	Laboratory Equipment Chemicals Worksheets & Lab Manuals Nepris Interactions				
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences					

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<i>The student will be able to:</i>					
UNIT FIVE – Oxidation/Reduction Reactions					
Assign oxidation numbers to elements and compounds using the outlined rules.	M, R	Teacher designed projects	Quizzes	S11.B.3.1.5	4.3.10 C
Identify which substances are oxidized and which are reduced as well as the oxidizing and reducing agents.	K, AP	Laboratory activities Homework	Tests Homework		
Balance a redox equation using the Oxidation-Number Exchange Method.	K, AP	Class Discussion Class/Group work	Graded Activities and Assignments		
Balance a redox equation using the Half Reaction Method in an Acidic or Basic Solution.	M, AP		Lab Reports and Lab Activities		
Discuss corrosion in terms of metal oxidation. Predict cathodes and anodes based on experimental results.	R				
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Laboratory Equipment Chemicals Worksheets & Lab Manuals Videos Nepris Interactions					
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences					

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<i>The student will be able to:</i>					
<u>UNIT SIX - Electrochemistry</u>					
Identify anodes and cathodes in electrochemical cells.	K, AP	Teacher designed projects	Quizzes	S11.B.3.1.5	4.3.10 C
Determine the oxidation/reduction process in a spontaneous reaction.	AP	Laboratory activities	Tests		
Calculate voltage in standard conditions and those that are not standard.	K, AP	Homework	Homework		
Use Gibbs Free Energy Constant and calculations relating to Nernst and Faraday.	K, AP	Class Discussion	Graded Activities and Assignments		
Successfully apply concepts of electrolysis and electroplating to laboratory activities.	K, AP	Class/Group work	Lab Activities and Lab Reports		
	R				
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Laboratory Equipment Chemicals Worksheets & Lab Manuals Videos Nepris Interactions					
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences					

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<i>The student will be able to:</i>					
<u>UNIT SEVEN - Kinetics and Thermodynamics</u>					
Define disappearance and appearance of reactants and products.	K, AP	Teacher designed projects	Quizzes	S11.C.2.1.3 S11.C.1.1.6	3.4.10 A 3.4.10 B
Interpret energy diagrams and calculate reaction rates.	K, AP	Laboratory activities Homework	Tests Homework		
Predict how concentrations will vary during reactions based on the factors that affect them.	AP	Class Discussion Class/Group work	Graded Activities and Assignments		
Discuss the activation energy, identify the intermediate product, and graph the reaction.	K, AP		Lab Reports		
Use Gibb's Free Energy to predict and calculate the spontaneity of a reaction.	K, AP				
Relate Entropy and Enthalpy in terms of solids, liquids, and gases.	AP				
Relate Hess's Law to the state functions of entropy and enthalpy.	AP				
Predict lattice energies using the Born-Haber cycle.	M				
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Videos		Laboratory Equipment Chemicals Worksheets & Lab Manuals Nepris Interactions			
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences					

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<i>The student will be able to:</i>					
<u>UNIT EIGHT – Organic Chemistry</u>					
Identify organic compounds as alkanes, alkenes, alkynes, or aromatic hydrocarbons.	K, AP	Teacher designed projects	Quizzes	S11.B.1.1.1	3.3.10 B
Identify the chemical and physical properties of alcohols, carboxylic acids, carbohydrates, ketones, aldehydes, esters, and amines along with their associated functional group.	K, AP	Laboratory activities Homework	Tests Homework		
Draw and interpret isomers in both geometry and physical properties.	R	Class Discussion	Graded Activities and Assignments		
Predict substitution, condensation, and hydrolytic reactions.	AP	Class/Group work	Lab Reports		
Identify and perform polymer reactions.	AP		Construct Models		
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Laboratory Equipment Chemicals Worksheets & Lab Manuals Videos Nepris Interactions					
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences Foreign Language - using Latin prefixes and roots to interpret models					

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<i>The student will be able to:</i>					
<u>UNIT NINE – Nuclear Chemistry</u>					
Differentiate between alpha, beta, and gamma, radiation.	K, AP	Teacher designed projects	Quizzes	S11.B.3.2.3	3.1.10 C 4.2.10 D
Complete a nuclear equations and radioactive decay based on half- lives	K, AP	Laboratory activities	Tests		
Differentiate and discuss fission and fusion reactions under controlled conditions and during a chain reaction.	AP	Homework Class Discussion	Homework Graded Activities and Assignments		
Understand the basic function of a nuclear reactor and its implications.	K	Class/Group work Video –“ <i>Fat Man and Little Boy</i> ”			
Resources/Materials					
Textbook/iPads/Online Resources Student Study Guide Calculators Worksheets Videos					
Interdisciplinary Relationships					
Physics - atomic interaction and movement Reading - acquisition and interpretation of research Mathematics - calculations Social Studies - relation to societal influences					

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<p><i>The student will be able to:</i></p> <p><u>UNIT TEN – Descriptive Chemistry and Exam Review</u></p> <p>Successfully pass the AP Exam</p>	<p>AP, M</p>	<p>Teacher designed projects</p> <p>Laboratory activities</p> <p>Homework</p> <p>Class Discussion</p> <p>Class/Group work</p>	<p>Notebooks</p> <p>AP Exam</p> <p>Final Exam based on the AP Exam</p>	<p>S11.A.2.2.1</p>	<p>3.7.10 B</p> <p>3.8.10 B</p>
Resources/Materials					
<p>Textbook</p> <p>Student Study Guide</p> <p>Calculators</p> <p>Laboratory Equipment</p> <p>Chemicals</p> <p>Worksheets & Lab Manuals</p> <p>AP Exam Practice Manual</p>					