

WINTHROP HIGH SCHOOL

AP Chemistry Syllabus

Course Overview

Description from the College Board Website

The AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first college year. The goal is that students will take the AP Exam to receive college credit or placement at the student's college of choice. Students may be able to undertake second-year work in the chemistry sequence at their institution or take courses for which general chemistry is a prerequisite. For other students, this course fulfills the laboratory science requirement and frees time for other courses.

The course centers around six big ideas and seven science practices:

Big Ideas

1. Structure of Matter
2. Bonding and Intermolecular Forces
3. Chemical Reactions
4. Kinetics
5. Thermodynamics
6. Chemical Equilibrium

Science Practices

1. Drawing, explaining, and interpreting representations
2. Using mathematics and logical routines appropriately
3. Asking and refining scientific questions
4. Designing and implementing data collection strategies
5. Analyzing and evaluating data
6. Making predictions and justifying claims with evidence
7. Connecting chemistry concepts across the big ideas.

Students who take the AP Chemistry course, designed with this curriculum framework as its foundation will develop a deep understanding of the concepts within the big ideas through the application of the science practices in the required laboratory component of the course. Students must complete a minimum of 16, hands-on lab investigations to support the learning objectives in the curriculum framework. At least six of the lab investigations must be guided inquiry-based labs. The result will be readiness for the study of advanced topics in subsequent college courses — a goal of every AP course.

Description of Six Big Ideas and 7 Science Practices

The six **Big Ideas** of this course are:

Big Idea 1: The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.

Big Idea 2: Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.

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

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

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

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

In addition to the Big Ideas, AP Chemistry incorporates seven **Science Practices**:

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

Science Practice 2: The student can use mathematics appropriately.

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

Science Practice 4: The student can plan and implement data collection strategies in relation to a particular scientific question. [Note: Data can be collected from many different sources, e.g., investigations, scientific observations, the findings of others, historic reconstruction, and/or archived data.]

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

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

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

Materials

This course will utilize the following texts:

1. *Tro, Nivaldo J., *Chemistry, A Molecular Approach*, 5th ed., Upper Saddle River, NJ: Pearson Education, Inc., 201.
2. **Pearson Education Test Prep Series for AP® Chemistry: A Molecular Approach

* This text will be provided via [MasteringChemistry](#) – an online platform

** Students are required to purchase this book on their own

3. [Laboratory Notebook - 50 pages in duplicate](#)
4. Composition Notebook
5. [5-7 pocket expandable file folder](#)
6. 10 page protectors

Curriculum Content Map

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Unit 1 - Atomic Structure and Properties

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
1	Atomic Structure and Properties Atomic Structure and Properties - Including the Mole Electrons and Periodic Trends	1-3 7-8	2 wks	1-2	Unit 1 Atomic Structure and Properties	1.1 - Moles and Molar Mass 1.2 - Mass Spectroscopy of the Elements 1.3 - Elemental Composition of Pure Substances 1.4 - Composition of Mixtures 1.5 - Atomic Structure and Electron Configuration 1.6 - Photoelectron Spectroscopy 1.7 - Periodic Trends 1.8 - Valence Electrons and Ionic Compounds

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual
Mole Conversions Practice	X			
Isotopes and Mass Spectroscopy	X			X
Mass Spectroscopy POGIL	X			
M&M Paper Chromatography Lab		X	X	
Electron Configurations Worksheet #1 Electron Configurations	X			
PES Lab				X
Photoelectron Spectroscopy POGIL				
Advanced Periodic Trends POGIL				
Atomic Spectroscopy		X		X

Unit 2 - Molecular and Ionic Compound Structure and Properties

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
2	Molecular and Ionic Compound Structure and Properties	9 10	3 wks	3-4	Unit 2 Molecular and Ionic Compound Structure and Properties	2.1 - Types of Chemical Bonds 2.2 - Intramolecular Force and Potential Energy 2.3 - Structure of Ionic Solids 2.4 - Structure of Metals and Alloys 2.5 Lewis Diagrams 2.6 Resonance and Formal Charge 2.7 - VSEPR and Bond Hybridization

Activities/ Labs	Student	Hands on Lab	Inquiry Based	Virtual

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	Centered		Lab	
Types of Bonds POGIL	X			
Types of Solids POGIL	X			
Alloys POGIL	X			
Introduction to Bonding Activity	X	X		
Molecular Geometry Dry Lab	X	X		
Molecular Shapes Lab and Post Lab		X		X
PhET - Molecule Shapes				X

Unit 3 - Intermolecular Forces and Properties

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment
3	Intermolecular Forces and Properties		4 wks	5-8	Unit 3 Intermolecular Forces and Properties 3.1 - Intermolecular Forces 3.2 - Properties of Solids 3.3 - Solids, Liquids and Gases 3.4 - Ideal Gas Law 3.5 - Kinetic Molecular Theory 3.6 - Deviation from Ideal Gas Law 3.7 - Solutions and Mixtures 3.8 - Representations of Solutions 3.9 - Separation of Solutions and Mixtures, Chromatography 3.10 - Solubility 3.11 - Spectroscopy and the Electromagnetic Spectrum 3.12 - Photoelectric Effect 3.13 - Beer-Lambert Law
	Gas Laws	5			
	Interactions of Matter	11			
	Solutions	13			

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual
Gas Law Problems	X			
Maxwell-Boltzman POGIL	X			
Deviations from the Ideal Gas Law POGIL	X			
IMF Worksheet	X			
Molar Volume of Hydrogen Gas LAB - Collecting a Gas Over Water		X		
IMF Lab		X		X

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Water as a Solvent	X			
Saturated and Unsaturated Solutions	X			
Solution - Dilution Calculations	X			
Preparing Glucose Solutions of Known Concentration	X	X		
Atomic Spectroscopy Lab		X		X
Balmer Series Worksheet	X			
Spectrophotometric Analysis of Food Dye		X	X	

Unit 4 - Chemical Reactions

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
4	Chemical Reactions Stoichiometry	3.9-3.10 4 19.2	4 wks	9-12	Unit 4 Chemical Reactions	4.1 - Introduction for Reactions 4.2 - Net Ionic Equations 4.3 - Representations of Reactions 4.4 - Physical and Chemical Changes 4.5 - Stoichiometry 4.6 - Introduction to Titration 4.7 - Types of Chemical Reactions 4.8 - Introduction to Acid-Base Reactions 4.9 - RedOx Reactions

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual Lab
Stoich Problems Worksheet	X			
Molarity POGIL	X			
Net Ionic Equations Practice	X			
Worksheet - Chem Bear	X			
Acid/ Base Titration Basics Worksheet	X			
Strength of Acids POGIL	X			
RedOx AP POGIL	X			
RedOx Practice Worksheet #1	X			
RedOx Practice Worksheet #2	X			
Vitamin C in Fruit Juices by RedOx Titration		X		

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Unit 5 - Kinetics

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
5	Kinetics Kinetics	14	4 wks	13-16	Unit 5 Kinetics	5.1 - Reaction Rates 5.2 - Introduction to Rate Law 5.3 - Concentration Over Time 5.4 - Elementary Reactions 5.5 - Collision Model 5.6 - Reaction Energy Profile 5.7 - Introduction to Reaction Mechanisms 5.8 - Reaction Mechanisms and Rate Law 5.9 - Steady-State Approximation 5.10 - Multistep Reaction Energy Profile 5.11 - Catalysis

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual
Reaction Rates - POGIL	X			
Rate Law Problems Worksheet #1	X			
Rate-Law Expressions Worksheet #2	X			
Integrated Rate Law Problems Worksheet #3	X			
Molecularity Notes	X			
Kinetics Worksheet Worksheet #4	X			
U5 Study Questions	X			
Bluffers - Study Guide	X			
Crystal Violet Fading		X	X	

Unit 6 - Thermodynamics

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
6	Thermodynamics Thermochemistry	6, 13.3, 9.10	3 wks	17-19	Unit 6 Thermodynamics	6.1 - Endothermic and Exothermic Processes 6.2 - Energy Diagrams 6.3 - Heat Transfer and Thermal Equilibrium 6.4 - Heat Capacity and Calorimetry 6.5 - Energy and Phase Changes 6.6 - Introduction to Enthalpy of Reaction 6.7 - Bond Enthalpies 6.8 - Enthalpy of Formation 6.9 - Hess's Law

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual

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Mitten Problem - The Concept of Heat Hand Warmer - Group Activity	X			
Heating and Cooling Curve of Water - Calculations involving Heat	X			
Calorimetry POGIL	X			
Calorimetry Basics Worksheet	X			
Calorimetry Worksheet #1	X			
Hess' Law Worksheet	X			
Heat of Formation POGIL	X			
Enthalpy of Reaction Worksheet	X			
Bond Energy POGIL	X			
Average Bond Energies Worksheet	X			
Heat of Fusion for Ice Demo/ Lab		X	X	
Heat of Solution Lab		X		
Heat of Combustion Lab and Report Form		X		
Designing a Handwarmer - Inquiry Lab		X	X	
Heating and Cooling Curve of Water - Calculations involving Heat	X			
Engineering Design Challenge - Design Your Own Calorimeter		X	X	

Unit 7 - Equilibrium

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
7	Equilibrium Equilibrium	15 17.5- 17.7	3 wks	20-22	Unit 7 Equilibrium	7.1 - Introduction to Equilibrium 7.2 - Direction of Reversible Reactions 7.3 - Reaction Quotient and Equilibrium Constant 7.4 - Calculating the Equilibrium Constant 7.5 - Magnitude of the Equilibrium Constant 7.6 - Properties of the Equilibrium Constant 7.7 - Calculating Equilibrium Concentrations 7.8 - Representations of Equilibrium 7.9 - Introduction to Le Chatelier's Principle 7.10 - Reaction Quotient and Le Chatelier's Principle 7.11 - Introduction to Solubility Equilibria 7.12 - Common Ion Effect 7.13 - pH and Solubility

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					7.14 - Free Energy of Dissolution
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Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual
Equilibrium POGIL	X			
Chemical Equilibrium Problem Set #1	X			
Reaction Quotient POGIL	X			
Chemical Equilibrium Problem Set #2	X			
Chemical Equilibrium Problem Set #3	X			
Work, Equilibrium and Free Energy POGIL	X			
Equilibrium Study Questions	X			
Unit 6 - Bluffer Guide	X			
Le Chatelier's Principle - Activity - Equilibrium Doesn't Equal		X		X
Beyond Benign Equilibrium Lab		X		

Unit 8 - Acids and Bases

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
8	Acids and Bases Acids and Bases Properties of Acids and Bases	16 17	4 wks	23-26	Unit 8 Acids and Bases	8.1 - Introduction to Acids and Bases 8.2 - pH and pOH of Strong Acids and Bases 8.3 - Weak Acid and Base Equilibria 8.4 - Acid-Base Reactions and Buffers 8.5 - Acid-Base Titrations 8.6 - Molecular Structure of Acids and Bases 8.7 - pH and pKa 8.8 - Properties of Buffers 8.9 - Henderson-Hasselbalch Equation 8.10 - Buffer Capacity

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual
Conjugate Acid/ Base Pair Practice Worksheet	X			
Acids and Bases POGIL	X			
Strength of Acids POGIL	X			
Acid-Base pH Practice #1	X			

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Acid-Base pH Calculations #2	X			
Ch 16.4-16.7 In Class Notes and Practice Problems	X			
Ch 16.8-16.11 In Class Notes and Practice Problems	X			
Ch 16 - The Chemistry of Acids and Bases - Study Questions & Problems and Bluffer's Guide	X			
Buffers POGIL	X			
Common Ion Effect on Acid Ionization POGIL	X			
Common Ion Effect on Solubility POGIL	X			
Fractional Precipitation POGIL	X			
Ch 17-Reactions Between Acids and Bases - Study Questions & Problems and Bluffer's Guide	X			
Properties of Buffers		X		
pH Properties of Buffer Solutions		X		
Determination of Ka of Weak Acids		X	X	
Acid-Base Titrations		X		

Unit 9 - Applications of Thermodynamics

Unit	Topic	Ch.'s	Time	WK #	College Board Unit Alignment	
9	Applications of Thermodynamics Thermodynamics	??	3 wks	27-39	Unit 9 Applications of Thermodynamics	9.1 - Introduction to Entropy 9.2 - Absolute Entropy and Entropy Change 9.3 - Gibbs-Free Energy and Therodynamic Favorability 9.4 - Thermodynamic and Kinetic Control 9.5 - Free Energy and Equilibrium 9.6 - Coupled Reactions 9.7 - Galvanic (Voltaic) and Electrolytic Cells 9.8 - Cell Potential and Free Energy 9.9 - Cell Potential Under Nonstandard Conditions 9.10 - Electrolysis and Faraday's Law

Activities/ Labs	Student Centered	Hands on Lab	Inquiry Based Lab	Virtual
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Gibbs Free Energy POGIL	X			
Thermodynamics Worksheet	X			
Ch 6 & 18 AP Review Problems	X			
Electrochemical Cell Voltage POGIL	X			
Electrochemistry Free Response Questions	X			
Batteries POGIL	X			
Electrochemistry AP Free Response Questions	X			
Electrochemical Cells LAB		X	X	

Weeks 30-31 will be devoted to review for the AP Exam.

The AP chemistry exam is Thursday May 7, 2020.

Following the AP Exam students will work on the following:

- Production of a "[Chemistry Magic Show](#)" in collaboration with the Winthrop Middle School 6th grade to demonstrate and explain some of the fundamental chemical principles they have learned over the course of the academic year.
- Unit of study on nuclear chemistry with a field trip to the MIT Nuclear Reactor.
- Inquiry based labs provided by the Chemistry Olympiad.

Final Exam Project:

[Heat of Fusion for Ice Demo/ Lab](#)

[Heat of Combustion Lab](#) and [Report Form](#)

[Engineering Design Challenge - Design Your Own Calorimeter](#)

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Vision of the Graduate

Winthrop High School strives to ensure its graduates are able to become productive citizens of their town, their state, and their nation. To do this, the school in 2011 embraced the following learning objectives, on which students are evaluated quarterly. Taken together, they express a community vision for what we want our graduates to be, know, and do.

WHS Students will become...

Critical Thinkers

- They will use, apply, and evaluate multiple problem-solving strategies in a variety of Disciplines.
- They will be able to select, organize, and evaluate new ideas.
- They will demonstrate the ability to actively and critically read.
- They will develop the skills and acquire the knowledge necessary to prepare them for college and career success
- They will be able to set priorities, and manage their time and tasks.

Effective Communicators

- They will communicate ideas and information with clarity and with an understanding of their audience.
- They will integrate and use a variety of communication forms.
- They will listen effectively and respond appropriately to spoken communication.
- They will master standard English-language conventions.

Conscientious Citizens

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- They will be aware of, and follow, their community's rules and laws
- They will respect themselves and the community at large.
- They will be aware of and respect social and cultural diversity.
- They will understand, promote, and show the importance of hard work to achieve success.
- They will own their mistakes, and will learn from them.

Creative Achievers

- They will show curiosity and enthusiasm in everything they do.
- They will work and think originally.
- They will appreciate the arts in their many forms.
- They will select, organize, and develop innovative ideas.
- They will build off the ideas of others.