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	Science Practices
1. Structure of Matter	1. Drawing, explaining, and interpreting representations
2. Bonding and Intermolecular Forces	2. Using mathematics and logical routines appropriately
3. Chemical Reactions	3. Asking and refining scientific questions
4. Kinetics	4. Designing and implementing data collection strategies
5. Thermodynamics	5. Analyzing and evaluating data
6. Chemical Equilibrium	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.

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*, 4th ed., Upper Saddle River, NJ: Pearson Education, Inc., 201.
    - ISBN-13: 978-0134112831
    - ISBN-10: 0134112830

2. **Pearson Education Test Prep Series for AP® Chemistry: A Molecular Approach ©2017
    - ISBN-1034431162
    - ISBN-139780134431161

* 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

WINTHROP HIGH SCHOOL

Curriculum Content Map

Unit	Topic	Ch.'s	Time	WK #	Activities/ Labs	Student Centered	Hands on Lab	Inquiry based Lab	Virtual
1	**First Year Review** Stoichiometry Electrons Periodic Trends Covalent Bonding	1-3 7-8 9-10	4 wks	1-4	Alloys POGIL	X			
					Types of Solids POGIL	X			
					Electron Configurations Worksheet #1 Electron Configurations (review) and Worksheet#2 Quantum Concepts	X			
					Balmer Series Worksheet	X			
BIG IDEAS					First Year Review Stations Activity		X		
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.					M&M Paper Chromatography Lab		X	X	
					PES Lab				X
					Molecular Geometry Dry Lab		X		
					Molecular Shapes Lab and Post Lab		X		X
					Atomic Spectroscopy		X		X

Unit	Topic	Ch.'s	Time	WK #	Activities/ Labs	Student Centered	Hands on Lab	Inquiry based Lab	Virtual
2	**Chemical Quantities and Aqueous Reactions** Stoichiometry Solutions	4 13	4 wks	5-8	Stoich Problems Worksheet	X			
					Molarity POGIL	X			
					Net Ionic Equations Practice	X			
					Worksheet - Chemy Bear	X			
BIG IDEAS					Acid/ Base Titration Basics Worksheet	X			
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.					Strength of Acids POGIL	X			
					RedOx AP POGIL	X			
					RedOx Practice Worksheet #1	X			

WINTHROP HIGH SCHOOL

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.	RedOx Practice Worksheet #2	X			
	Solutions POGIL	X			
	Solutions Practice Worksheet	X			
	Preparing a Glucose Solution from Serial Dilution		X		
	Spectrophotometric Analysis of Food Dyes		X		X
	Vitamin C in Fruit Juices by RedOx Titration		X	X	

Unit	Topic	Ch.'s	Time	WK #	Activities/ Labs	Student Centered	Hands on Lab	Inquiry based Lab	Virtual
3	**Gas Laws** **Interactions of Matter**	5 11	3 wks	9-11	Gas Law Problems	X			
					Maxwell-Boltzman POGIL	X			
					Deviations from the Ideal Gas Law POGIL	X			
					Gas Law Stoich Problems	X			
BIG IDEAS					Phase Diagrams of CO_2	X			
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 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.					IMF Worksheet	X			
					Molar Volume of Hydrogen Gas LAB - Collecting a Gas Over Water		X		
					IMF Lab		X		X

WINTHROP HIGH SCHOOL

Unit	Topic	Ch.'s	Time	WK #	Activities/ Labs	Student Centered	Hands on Lab	Inquiry based Lab	Virtual
4	**Thermochemistry**	6 18	4 wks	12-15	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			
BIG IDEAS					Calorimetry Worksheet #1	X			
Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.					Hess' Law Worksheet	X			
					Heat of Formation POGIL	X			
					Enthalpy of Reaction Worksheet	X			
					Bond Energy POGIL	X			
					Average Bond Energies Worksheet	X			
					Gibbs Free Energy POGIL	X			
					Thermodynamics Worksheet	X			
					Ch 6 & 18 AP Review Problems	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	
					Engineering Design Challenge - Design Your Own Calorimeter		X	X	

WINTHROP HIGH SCHOOL

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5	**Kinetics-The Study of Reaction Rate**	14	4 wks	16-19	Reaction Rates - POGIL	X			
					Rate Law Problems Worksheet #1	X			
					Rate-Law Expressions Worksheet #2	X			
					Integrated Rate Law Problems Worksheet #3	X			
BIG IDEAS					Molecularity Notes	X			
Big Idea 4: Rates of chemical reactions are determined by details of the molecular collisions.					Kinetics Worksheet Worksheet #4	X			
					U5 Study Questions	X			
					Bluffers - Study Guide	X			
					Crystal Violet Fading		X	X	

Unit	Topic	Ch.'s	Time	WK #	Activities/ Labs	Student Centered	Hands on Lab	Inquiry based Lab	Virtual
6	**Equilibrium**	15	2 wks	20-21	Equilibrium POGIL	X			
					Chemical Equilibrium Problem Set #1	X			
					Reaction Quotient POGIL	X			
					Chemical Equilibrium Problem Set #2	X			
BIG IDEAS					Chemical Equilibrium Problem Set #3	X			
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.					Work, Equilibrium and Free Energy POGIL	X			
					Equilibrium Study Questions	X			
Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.					Unit 6 - Bluffer Guide	X			
					Le Chatelier's Principle - Activity - Equilibrium Doesn't Equal		X		X
					Beyond Benign Equilibrium Lab		X		

WINTHROP HIGH SCHOOL

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7	**Acid and Base Chemistry**	16-17	4 wks	22-25	Conjugate Acid/ Base Pair Practice Worksheet	X			
					Acids and Bases POGIL	X			
					Strength of Acids POGIL	X			
					Acid-Base pH Practice #1	X			
BIG IDEAS					Acid-Base pH Calculations #2	X			
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 3:** Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons. **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.					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		

WINTHROP HIGH SCHOOL

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8	**Electrochemistry**	19	2 wks	26-27	Electrochemical Cell Voltage POGIL	X			
					Electrochemistry Free Response Questions	X			
BIG IDEAS					Batteries POGIL	X			
Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.□ **Big Idea 4:** Rates of chemical reactions are determined by details of the molecular collisions.□ **Big Idea 5:** The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.					Electrochemistry AP Free Response Questions	X			
					Electrochemical Cells LAB		X	X	

Weeks 28-31 will be devoted to review for the AP Exam.

The AP chemistry exam is given the first Monday of May.

Following the AP Exam students will continue to work on inquiry based labs provided by the Chemistry Olympiad as well as participate in a unit of study on nuclear chemistry with a field trip to the MIT Nuclear Reactor.

AP Chemistry students will also produce 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.