The Mission of the Chardon Local Schools is High Achievement for All Students, Where Learning is Our Most Important Work.

Science Course of Study:

AP CHEMISTRY

Revised March 2022

CHARDON LOCAL SCHOOLS

#WeAreChardon

AP Chemistry

Committee Member: Jeanne Clark

AP Chemistry

<table>
<tr>
<td>Learning Standards: Unit 1 - Atomic Structure and Properties
Calculate quantities of a substance or its relative number of particles using dimensional analysis and the mole concept. (1.9, 3.1-3.3))
Explain the quantitative relationship between the mass spectrum of an element and the masses of the element’s isotopes (2.1-2.3, 3.1)
Explain the quantitative relationship between the elemental composition by mass and the empirical formula of a pure substance.(2.6)
Explain the quantitative relationship between the elemental composition by mass and the composition of substances in a mixture.(3.5)
Represent the electron configuration of an element or ions of an element using the Aufbau principle. (7.8-7.9)
Explain the relationship between the photoelectron spectrum of an atom or ion and: a. The electron configuration of the species. b. The interactions between the electrons and the nucleus. (handouts)
Explain the relationship between trends in atomic properties of elements and electronic structure and periodicity (8.3-8.5)</td>
<td>How Taught?
Teaching activities may include, but are not limited to:
Students closely read select passages from documents to analyze text structure. development, and consequent meanings.
Teacher provides direct instruction, give feedback, and model critical thinking
Small group and class discussions.
Pogil Activities
Cooperative learning groups
Students analyze video content related to standards that provide a broader global perspective of content.
Design and conduct lab-based investigations that connect content to real-life experiences.
Inquiry Labs
Analysis of lab results, with focus on sources of error and how experimental designs may be improved.
Small groups - White board problem solving and sharing
Investigating alternative approaches to problem solving.
Using technology and mathematics to improve investigations and communications.
Utilize data to impact instruction</td>
</tr>
<tr>
<td rowspan="2">Materials:
Board adopted AP Edition Chemistry Worktext
Board adopted Laboratory Experiments for AP Chemistry Worktext
AP Chemistry Classroom
Lab equipment and chemicals
Vernier probes and Labquests
AP Chem Solution Worksheets
Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)
Gradecam/Google Forms
Calculators</td>
<td>How Assessed?
Assessments may include, but are not limited to:
Pre-Assessments (pre-tests, observation, questioning, diagnostics)
Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports
Summative Assessments (free response questions, using rubrics, multiple choice questions)</td>
</tr>
<tr>
<td>How Re-Taught?</td>
</tr>
</table>

	Re-teaching activities may include, but are not limited to: ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Unit 2 - Molecular and Ionic Compound Structure and Properties ● **Explain the relationship between the type of bonding and the properties of the elements participating in the bond.** ● **Represent the relationship between potential energy and distance between atoms, based on factors that influence the interaction strength.** ● **Represent the relationship between potential energy and distance between atoms, based on factors that influence the interaction of the constituent ions.** ● **Represent a metallic solid and/or alloy using a model to show essential characteristics of the structure and interactions present in the substance.** ● **Represent a molecule with a Lewis diagram.** ● **Represent a molecule with a Lewis diagram that accounts for resonance between equivalent structures or that uses formal charge to select between nonequivalent structures.** ● **Based on the relationship between Lewis diagrams, VSEPR theory, bond orders, and bond polarities: a. Explain structural properties of molecules. b. Explain electron properties of molecules.**	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing ● Investigating alternative approaches to problem solving. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction

Materials: ● **Board adopted AP Edition Chemistry Worktext** ● **Board adopted Laboratory Experiments for AP Chemistry Worktext** ● **AP Chemistry Classroom** ● **Lab equipment and chemicals** ● **Vernier probes and Labquests** ● **AP Chem Solution Worksheets** ● **Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)** ● **Gradecam/Google Forms** ● **Calculators**	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports ● Summative Assessments (free response questions, using rubrics, multiple choice questions)
	How Re-Taught? **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Unit 3 - Intermolecular Forces and Properties ● Explain the relationship between the chemical structures of molecules and the relative strength of their intermolecular forces when: a. The molecules are of the same chemical species. b.	**How Taught?** **Teaching activities may include, but are not limited to:**

The molecules are of two different chemical species. ● Explain the relationship among the macroscopic properties of a substance, the particulate-level structure of the substance, and the interactions between these particles. ● Represent the differences between solid, liquid, and gas phases using a particulate level model. ● Explain the relationship between the macroscopic properties of a sample of gas or mixture of gasses using the ideal gas law. ● Explain the relationship between the motion of particles and the macroscopic properties of gasses with: a. The kinetic molecular theory (KMT). b. A particulate model. c. A graphical representation. ● Explain the relationship among non-ideal behaviors of gasses, interparticle forces, and/or volumes. ● Calculate the number of solute particles, volume, or molarity of solutions. ● Using particulate models for mixtures: a. Represent interactions between components. b. Represent concentrations of components. ● Using particulate models for mixtures: a. Represent interactions between components. b. Represent concentrations between particles. ● Explain the relationship between the solubility of ionic and molecular compounds in aqueous and nonaqueous solvents, and the intermolecular interactions between particles. ● Explain the relationship between a region of the electromagnetic spectrum and the types of molecular or electronic transitions associated with that region. ● Explain the properties of an absorbed or emitted photon in relationship to an electronic transition in an atom or molecule. ● Explain the amount of light absorbed by a solution of molecules or ions in relationship to the concentration, path length, and molar absorptivity	● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing ● Investigating alternative approaches to problem solving. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
Materials: ● **Board adopted AP Edition Chemistry Worktext** ● **Board adopted Laboratory Experiments for AP Chemistry Worktext** ● **AP Chemistry Classroom** ● **Lab equipment and chemicals** ● **Vernier probes and Labquests** ● **AP Chem Solution Worksheets** ● **Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)** ● **Gradecam/Google Forms**	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports

● **Calculators**	● Summative Assessments (free response questions, using rubrics, multiple choice questions)
	How Re-Taught? **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different way**s**

Learning Standards: Unit 4 - Chemical Reactions ● **Identify evidence of chemical and physical changes in matter.** ● **Represent changes in matter with a balanced chemical or net ionic equation: a. For physical changes. b. For given information about the identity of the reactants and/or product. c. For ions in a given chemical reaction.** ● **Represent a given chemical reaction or physical process with a consistent particulate model.** ● **Explain the relationship between macroscopic characteristics and bond interactions for: a. Chemical processes. b. Physical processes.** ● **Explain changes in the amounts of reactants and products based on the balanced reaction equation for a chemical process.** ● **Identify the equivalence point in a titration based on the amounts of the titrant and**	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved.

<table>
<tr>
<td>analyte, assuming the titration reaction goes to completion.
● Identify a reaction as acid base, oxidation-reduction, or precipitation.
● Identify species as BrønstedLowry acids, bases, and/or conjugate acid-base pairs, based on proton-transfer involving those species.
● Represent a balanced redox reaction equation using half-reactions.</td>
<td>● Small groups - White board problem solving and sharing
● Investigating alternative approaches to problem solving.
● Using technology and mathematics to improve investigations and communications.
● Utilize data to impact instruction</td>
</tr>
<tr>
<td rowspan="2">Materials:
● Board adopted AP Edition Chemistry Worktext
● Board adopted Laboratory Experiments for AP Chemistry Worktext
● AP Chemistry Classroom
● Lab equipment and chemicals
● Vernier probes and Labquests
● AP Chem Solution Worksheets
● Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)
● Gradecam/Google Forms
● Calculators</td>
<td>How Assessed?
Assessments may include, but are not limited to:
● Pre-Assessments (pre-tests, observation, questioning, diagnostics)
● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports
● Summative Assessments (free response questions, using rubrics, multiple choice questions)</td>
</tr>
<tr>
<td>How Re-Taught?
Re-teaching activities may include, but are not limited to:
● descriptive feedback on original task/assessment
● student examples of expectations
● modeling
● student self assessments
● manipulatives
● presenting the information again in a different way
● review sessions
● graphic organizers
● small-group instruction
● practice activities
● computer tutorials / programs
● peer tutoring
● breaking down concept into smaller components
● cooperative learning
● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways</td>
</tr>
</table>

Learning Standards: Unit 5 - Kinetics ● **Explain the relationship between the rate of a chemical reaction and experimental parameters.** ● **Represent experimental data with a consistent rate law expression.** ● **Identify the rate law expression of a chemical reaction using data that show how the concentrations of reaction species change over time** ● **Represent an elementary reaction as a rate law expression using stoichiometry** ● **Explain the relationship between the rate of an elementary reaction and the frequency, energy, and orientation of molecular collisions.** ● **Represent the activation energy and overall energy change in an elementary reaction using a reaction energy profile.** ● **Identify the components of a reaction mechanism.** ● **Identify the rate law for a reaction from a mechanism in which the first step is rate determining.** ● **Identify the rate law for a reaction from a mechanism in which the first step is not rate limiting.** ● **Represent the activation energy and overall energy change in a multistep reaction with a reaction energy profile.** ● **Explain the relationship between the effect of a catalyst on a reaction and changes in the reaction mechanism.**	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing ● Investigating alternative approaches to problem solving. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
Materials: ● **Board adopted AP Edition Chemistry Worktext** ● **Board adopted Laboratory Experiments for AP Chemistry Worktext** ● **AP Chemistry Classroom** ● **Lab equipment and chemicals** ● **Vernier probes and Labquests** ● **AP Chem Solution Worksheets** ● **Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)** ● **Gradecam/Google Forms** ● **Calculators**	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports ● Summative Assessments (free response questions, using rubrics, multiple choice questions)

	How Re-Taught? **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Unit 6 - Thermodynamics ● **Explain the relationship between experimental observations and energy changes associated with a chemical or physical transformation.** ● **Represent a chemical or physical transformation with an energy diagram.** ● **Explain the relationship between the transfer of thermal energy and molecular collisions.** ● **Calculate the heat q absorbed or released by a system undergoing heating/ cooling based on the amount of the substance, the heat capacity, and the change in temperature.** ● **Explain changes in the heat q absorbed or released by a system undergoing a phase transition based on the amount of the substance in moles and the molar enthalpy of the phase transition.** ● **Calculate the heat q absorbed or released by a system undergoing a chemical reaction in relationship to the amount of the reacting substance in moles and the molar enthalpy of reaction.** ● **Calculate the enthalpy change of a reaction based on the average bond energies of bonds broken and formed in the reaction.** ● **Calculate the enthalpy change for a chemical or physical process based on the standard**	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing ● Investigating alternative approaches to problem solving. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction

enthalpies of formation. ● **Represent a chemical or physical process as a sequence of steps.** ● **Explain the relationship between the enthalpy of a chemical or physical process and the sum of the enthalpies of the individual steps.**	
Materials: ● **Board adopted AP Edition Chemistry Worktext** ● **Board adopted Laboratory Experiments for AP Chemistry Worktext** ● **AP Chemistry Classroom** ● **Lab equipment and chemicals** ● **Vernier probes and Labquests** ● **AP Chem Solution Worksheets** ● **Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)** ● **Gradecam/Google Forms** ● **Calculators**	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports ● Summative Assessments (free response questions, using rubrics, multiple choice questions)
	How Re-Taught? **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Unit 7 -Equilibrium ● Explain the relationship between the occurrence	**How Taught?**

of a reversible chemical or physical process, and the establishment of equilibrium, to experimental observations. ● Explain the relationship between the direction in which a reversible reaction proceeds and the relative rates of the forward and reverse reactions. ● Represent the reaction quotient Qc or Qp , for a reversible reaction, and the corresponding equilibrium expressions Kc = Qc or K p = Qp ● Calculate Kc or K p based on experimental observations of concentrations or pressures at equilibrium. ● Explain the relationship between very large or very small values of K and the relative concentrations of chemical species at equilibrium. ● Represent a multistep process with an overall equilibrium expression, using the constituent K expressions for each individual reaction. ● Identify the concentrations or partial pressures of chemical species at equilibrium based on the initial conditions and the equilibrium constant. ● Identify the response of a system at equilibrium to an external stress, using Le Châtelier's principle. ● Explain the relationships between Q, K, and the direction in which a reversible reaction will proceed to reach equilibrium. ● Calculate the solubility of a salt based on the value of ● K sp for the salt. ● Identify the solubility of a salt, and/or the value of Ksp for the salt, based on the concentration of a common ion already present in solution. ● Identify the qualitative effect of changes in pH on the solubility of a salt. ● Explain the relationship between the solubility of a salt and changes in the enthalpy and entropy that occur in the dissolution process.	**Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing ● Investigating alternative approaches to problem solving. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
Materials: ● **Board adopted AP Edition Chemistry Worktext** ● **Board adopted Laboratory Experiments for AP Chemistry Worktext** ● **AP Chemistry Classroom** ● **Lab equipment and chemicals** ● **Vernier probes and Labquests** ● **AP Chem Solution Worksheets** ● **Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)** ● **Gradecam/Google Forms** ● **Calculators**	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports

	● Summative Assessments (free response questions, using rubrics, multiple choice questions)
	How Re-Taught? **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Unit 8 - Acids and Bases ● Calculate the values of pH and pOH, based on Kw and the concentration of all species present in a neutral solution of water. ● Calculate pH and pOH based on concentrations of all species in a solution of a strong acid or a strong base. ● Explain the relationship among pH, pOH, and concentrations of all species in a solution of a monoprotic weak acid or weak base. ● Explain the relationship among the concentrations of major species in a mixture of weak and strong acids and bases. ● Explain results from the titration of a mono- or polyprotic acid or base solution, in relation to the properties of the solution and its components. ● Explain the relationship between the strength of an acid or base and the structure of the molecule or ion. ● Explain the relationship between the predominant form of a weak acid or base in solution at a given pH and the pKa of the conjugate acid or the pKb	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing

<table>
<tr>
<td>of the conjugate base.
● Explain the relationship between the ability of a buffer to stabilize pH and the reactions that occur when an acid or a base is added to a buffered solution.
● Identify the pH of a buffer solution based on the identity and concentrations of the conjugate acid-base pair used to create the buffer.
● Explain the relationship between the buffer capacity of a solution and the relative concentrations of the conjugate acid and conjugate base components of the solution.</td>
<td>● Investigating alternative approaches to problem solving.
● Using technology and mathematics to improve investigations and communications.
● Utilize data to impact instruction</td>
</tr>
<tr>
<td rowspan="2">Materials:
● Board adopted AP Edition Chemistry Worktext
● Board adopted Laboratory Experiments for AP Chemistry Worktext
● AP Chemistry Classroom
● Lab equipment and chemicals
● Vernier probes and Labquests
● AP Chem Solution Worksheets
● Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)
● Gradecam/Google Forms
● Calculators</td>
<td>How Assessed?
Assessments may include, but are not limited to:
● Pre-Assessments (pre-tests, observation, questioning, diagnostics)
● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports
● Summative Assessments (free response questions, using rubrics, multiple choice questions)</td>
</tr>
<tr>
<td>How Re-Taught?
Re-teaching activities may include, but are not limited to:
● descriptive feedback on original task/assessment
● student examples of expectations
● modeling
● student self assessments
● manipulatives
● presenting the information again in a different way
● review sessions
● graphic organizers
● small-group instruction
● practice activities
● computer tutorials / programs
● peer tutoring
● breaking down concept into smaller components
● cooperative learning
● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways</td>
</tr>
</table>

Learning Standards: Unit 9 - Applications of Thermodynamics ● **Identify the sign and relative magnitude of the entropy change associated with chemical or physical processes.** ● **Calculate the entropy change for a chemical or physical process based on the absolute entropies of the species involved in the process.** ● **Explain whether a physical or chemical process is thermodynamically favored based on an evaluation of ∆G** ● **Explain, in terms of kinetics, why a thermodynamically favored reaction might not occur at a measurable rate.** ● **Explain whether a process is thermodynamically favored using the relationships between K, ΔGo , and T.** ● **Explain the relationship between external sources of energy or coupled reactions and their ability to drive thermodynamically unfavorable processes** ● **Explain the relationship between the physical components of an electrochemical cell and the overall operational principles of the cell.** ● **Explain whether an electrochemical cell is thermodynamically favored, based on its standard cell potential and the constituent half-reactions within the cell.** ● **Explain the relationship between deviations from standard cell conditions and changes in the cell potential.** ● **Calculate the amount of charge flow based on changes in the amounts of reactants and products in an electrochemical cell.** ●	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure. development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions. ● Pogil Activities ● Cooperative learning groups ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Inquiry Labs ● Analysis of lab results, with focus on sources of error and how experimental designs may be improved. ● Small groups - White board problem solving and sharing ● Investigating alternative approaches to problem solving. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
Materials: ● **Board adopted AP Edition Chemistry Worktext** ● **Board adopted Laboratory Experiments for AP Chemistry Worktext** ● **AP Chemistry Classroom** ● **Lab equipment and chemicals** ● **Vernier probes and Labquests** ● **AP Chem Solution Worksheets** ● **Online resources (pHet,Chemteam, Crash Course Chemistry, Bozeman Videos)** ● **Gradecam/Google Forms** ● **Calculators**	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (mini analysis assignments, group work, discussions, homework/classwork, ap chem solutions worksheets, ap classroom videos and guided notes for videos, observations,quizzes, conferences, rubrics, study guides, progress checks from (AP Classroom), lab reports

	• Summative Assessments (free response questions, using rubrics, multiple choice questions)
	How Re-Taught? **Re-teaching activities may include, but are not limited to:** • descriptive feedback on original task/assessment • student examples of expectations • modeling • student self assessments • manipulatives • presenting the information again in a different way • review sessions • graphic organizers • small-group instruction • practice activities • computer tutorials / programs • peer tutoring • breaking down concept into smaller components • cooperative learning • Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

AP Chemistry Course of Study