

Catasauqua Area School District Planned Course of Study

Course Title: College Prep Chemistry/Honors Chemistry I

Grade Level(s): 10/11/12

Text: Inspire Chemistry 1st Edition

COURSE DESCRIPTION

This course provides an in-depth study in which the principles of matter and energy, chemical changes and chemical reactions are explained. The concepts included are: Matter and change, the structure and nature of the atom, formula writing and reaction equation writing, mass and volume relationships, the behavior of gasses, and solutions (acidic and basic included). The class includes extensive lab work. Honors Chemistry I includes more emphasis on mathematical analysis and Inquiry Based Learning than College Prep Chemistry I does, although the same topics of discussion are covered.

Essential Questions & Competencies

Big Ideas:

1. Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.
2. Interactions between any two objects can cause changes in one or both of them.

Essential Questions:

1. Interactions between any two objects can cause changes in one or both of them.
2. How is energy transferred and conserved?

Concepts:

1. Stable forms of matter are those in which the electric potential energy is minimized
2. A stable molecule has lower energy, by an amount known as the binding energy, than the same set of atoms separated; this energy must be provided to break the bond.
3. Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements in increasing number of protons and places those with similar chemical properties in columns.
4. The solubility of solutions depends on their properties and other factors. e.g., dissolving, dissociating
5. The fact that atoms are conserved, together with knowledge of chemical properties of the elements involved, can be used to describe and predict chemical reactions and calculate quantities of reactants and products.
6. The mole, as a fundamental unit, is used to represent a specific quantity of atomic particles such as atoms, ions, formula units, and molecules.
7. The kinetic molecular theory and Gas Laws are used to explain and predict the behavior of gases.
8. Properties of chemical compounds are related to electrostatic interaction between particles.
9. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. Properties of chemical compounds are related to electrostatic interaction between particles.
10. Chemical processes, their rates, and energy changes can be understood in terms of the arrangement and energy of colliding particles and the subsequent rearrangements of atoms.
11. The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
12. In many situations, a dynamic and condition-dependent balance between the rates of a forward and the reverse reaction determines the concentration of reaction components.
13. Nuclear processes, including fusion, fission, and radioactive decays involve changes in unstable nuclei. The total number of neutrons plus protons does not change in any nuclear process.
14. Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the maximum ages of rocks and other materials from the isotope ratios present.
15. Acids and bases are identified by their characteristics and interactions. pH scale is a log scale that reflects the concentration of protons in a solution.

Competencies:

1. Construct models showing that stable forms of matter are those with minimum electrical field energy.
2. Construct models showing that energy is needed to break bonds and overcome intermolecular forces and that energy is released when bonds form
3. Use the atomic model and the periodic table to predict and explain trends in properties of elements.
4. Develop a model showing the likely position of electrons as determined by the quantized energy levels of atoms.
5. Develop explanations and/or mathematical expressions comparing solutions made from ionic and covalent solutes and how various factors affect the solubility of these solutions

6. Analyze and interpret data sets, using the mole concept, to mathematically determine amounts of representative particles in macroscopic measurable quantities.
7. Analyze and interpret data to apply the laws of definite proportions and multiple proportions, to determine empirical and molecular formulas of compounds, percent composition and mass of elements in a compound.
8. Utilize mathematical relationships to predict changes in the number of particles (moles), the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's Law, Charles' Law, Avogadro's Law, Dalton's Law of partial pressures, the combined gas law, and the ideal gas law).
9. Use Lewis Structures and VSEPR to predict and explain charge distribution across a particle (atom, ion, molecule or formula unit)
10. Analyze and interpret data obtained from measuring the bulk properties of various substances to explain the relative strength of the interactions among particles in the substance.
11. Use models to understand the effect of concentration, temperature, and surface area on frequency of collisions and subsequently rate. Describe the function of catalysts.
12. Develop and use models to explain that atoms (and therefore mass) are conserved during a chemical reaction. Models can include computer models, ball and stick models, and drawings.
13. Develop a model for chemical systems to support/predict changes in reaction conditions limited to simple equilibrium reactions
14. Use system models (computers or drawings) to construct molecular-level explanations to predict the behavior of systems where a dynamic and condition dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.
15. Construct models to explain changes in nuclei during the processes of fission, fusion, and radioactive decay and the subatomic interactions that determine nuclear stability.
16. Using models, differentiate between acid and bases and acid-base systems. Determine neutralization point of a reaction. Determine pH of a solution. Show understanding of log scale.
17. Apply a systematic set of rules (IUPAC) for naming compounds and writing chemical formulas (e.g., binary covalent, binary ionic, ionic compounds containing polyatomic ions)
18. Utilize significant figures to communicate the precision in a quantitative observation Accuracy discussion: Calculate error and percent error given experimental data and the accepted value.

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Course Syllabus

Course Content	Tentative Timeframe	Assessment Anchors	State Standards
<p><u>Module 1: Introduction to Chemistry</u></p> <p>I. The Central Science</p> <ul style="list-style-type: none"> A. What is Chemistry? B. Scientific Method C. Matter & Energy D. Physical & Chemical Changes E. Law of Conservation of Matter <p>II. Measurement</p> <ul style="list-style-type: none"> A. MKS System B. Dimensional Analysis C. Significant Figures D. Scientific Notation E. Uncertainty, Reliability <ul style="list-style-type: none"> 1. Precision 2. Accuracy F. III. Laboratory Usage G. Laboratory Safety H. Laboratory Equipment I. Laboratory Techniques 	2 weeks	S11.A.1.1.1 Thru S11A.1.1.5 S11A.2.2.1	3.1.10 A & E 3.2.10 A & B 3.7.10.B 3.8.10.B
<p><u>Module 2: Matter - Properties & Changes</u></p> <p>I. Properties of Matter</p> <ul style="list-style-type: none"> A. Properties of Solids B. Properties of Liquids C. Properties of Gases <p>II. Changes in Matter</p> <ul style="list-style-type: none"> A. States of Matter B. Physical Properties & Changes C. Chemical Properties & Changes D. Conservation of Matter <p>III. Elements and Compounds</p> <ul style="list-style-type: none"> A. Law of Definite Proportions B. Law of Multiple Proportion <p>IV. Mixtures of Matter</p>	1.5 weeks	S.11.C.2.1.1 S.11.C.2.1.2	3.4.10.A & B 4.1.10B 4.6.10.A

<ul style="list-style-type: none"> A. Heterogeneous/Homogeneous B. Separating Mixtures 			
<p><u>Modules 3 & 4 - Structure of the Atom/ Electrons in Atoms</u></p> <ul style="list-style-type: none"> I. Early Ideas about Atoms <ul style="list-style-type: none"> A. Theorist B. Models II. Defining the Atom - Modern Atomic Theory <ul style="list-style-type: none"> A. Quantum Atomic Model B. Defining the Atom - Subatomic Particles <ul style="list-style-type: none"> 1. Protons 2. Neutrons 3. Electrons III. How Atoms Differ <ul style="list-style-type: none"> A. Electron Configuration B. Heisenberg Uncertainty Theory C. Light & Quantized Energy IV. Unstable Nuclei & Radioactive Decay <ul style="list-style-type: none"> A. Nuclear Particle Emission and Nuclear Equations B. Half Lives C. Fission and Fusion D. Nuclear Reactors 	<p>2 weeks</p>	<p>S11.C.1.1.1 S11.C.1.1.2 S11A.3.2.3 S11A.3.2.2 S11A.#.2.1</p> <p>S11.B.3.2.3</p>	<p>3.4.10 A & B 4.6.10.A 3.1.10B 3.2.10B</p> <p>3.1.10C 4.2.10D</p>
<p><u>Module 5 - The Periodic Table & Periodic Law</u></p> <ul style="list-style-type: none"> I. Development of the Modern Periodic Table <ul style="list-style-type: none"> A. Newlands, Meyer, Mendeleev, Moseley B. Groups, Periods C. Metals, NonMetals, Metalloids II. Classification of the Elements <ul style="list-style-type: none"> A. Valence Electrons B. s, p, d & f blocks III. Periodic Trends <ul style="list-style-type: none"> A. Atomic Radius B. Ionic Radius C. Ionization Energy D. Electronegativity 	<p>1.5 weeks</p>	<p>S.11.A.3.3.1 S.11.A.3.3.2 S.11.C.1.1.4</p>	<p>3.1.10.C 3.4.10.A 3.2.10.B</p>
<p><u>Modules 6 & 7 - Ionic & Covalent Bonding</u></p> <ul style="list-style-type: none"> I. Ion Formation <ul style="list-style-type: none"> A. Electron Dot Diagrams 	<p>3 weeks</p>	<p>S.11.C.1.1.3</p>	<p>3.4.10A</p>

<ul style="list-style-type: none"> B. Pseudo Noble Gas Configurations C. Cations & Anions II. Ionic Bonds & Compounds <ul style="list-style-type: none"> A. Physical Structures B. Physical Properties C. Lattice Energy III. Names & Formulas <ul style="list-style-type: none"> A. Oxidation Numbers B. Ionic Compounds C. Molecular Compounds IV. Metallic Bonds & Properties of Metals V. Covalent Bonds <ul style="list-style-type: none"> A. Single Covalent Bonds B. Double Covalent Bonds C. Triple Covalent Bonds D. Pi & Sigma Bonds E. Bond Strength and Energy VI. Molecular Shapes & Structures <ul style="list-style-type: none"> A. Modeling B. Exceptions to Octet Rule C. VSPER Theory D. Hybridization VII. Electronegativity & Polarity <ul style="list-style-type: none"> A. Polar Covalent Bond B. Non-Polar Covalent Bonds C. Intra and Inter Molecular Forces 			
<p>Module 8 - Chemical Reactions</p> <ul style="list-style-type: none"> I. Reactions & Equations <ul style="list-style-type: none"> A. Representing Chemical Reactions B. Balancing Chemical Equations II. Classifying Chemical Reactions <ul style="list-style-type: none"> A. Synthesis B. Decomposition C. Single Replacement D. Double Replacement E. Combustion * Honors Only III. Reactions in Aqueous Solutions <ul style="list-style-type: none"> A. Molecular Compounds in Solution B. Ionic Equations C. Reactions that form Water D. Reactions that form Gases 	3 weeks	S11.C.2.1.2 S11.C.2.1.3 S11.C.1.1.6	3.4.10 A & B
<p>Modules 9 & 10 - The Mole & Stoichiometry</p> <ul style="list-style-type: none"> I. Measuring Matter II. Mass and the Mole III. Moles of Compounds IV. Empirical & Molecular Formulas V. Formulas of Hydrates 	3 weeks	S11.A.2.1.1	3.7.10B 3.8.10B

VI. Stoichiometric Calculations A. Mass to Mole/ Mole to Mass B. Mass to Mass C. Mass to Volume D. Volume to Volume VII. Limiting Reagents VIII. Percent Yield			
<u>Modules 11 & 12 - States of Matter & The Gas Laws</u> I. The Kinetic Molecular Theory of Solids, Liquids & Gases II. Forces of Attraction III. Phase Changes & Heat Diagrams IV. Boyle's, Charles', and Gay-Lussac's Laws V. Ideal Gas and Combined Gas Laws VI. The Behavior of Real Gases VII. Dalton's Law of Partial Pressure VIII. Graham's Laws of Diffusion and Effusion IX. Avagadro's Law and Henry's Law	2 weeks	S11.C.1.1.5	3.4.10A

Teaching Strategies Utilized

Lecture
 Classroom Discussion
 Independent Research (iPads, Online Resources)
 Cooperative Learning
 Videos
 Laboratory Activities and Demonstrations
 Modeling
 Nepris Interactions
 POGIL - Process Oriented Guided Inquiry Learning

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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>					
<u>Module 1: Introduction to Chemistry</u>					
Explain and put into practice the basic safety rules required within the laboratory.	K, AP	Teacher oriented lecture	Quizzes*	S11.A.1.1.1 Thru S11A.1.1.5	3.1.10 A & E
Identify the metric units of measurement used in Chemistry	K, AP *AP, M	Teacher designed projects	Tests*	S11A.2.2.1	3.2.10 A & B
Use the rules of Significant Figures and Scientific Notations to complete calculations and collect data.	K, AW *AP	POGIL* *Independent Activity for Honors	Homework		3.7.10.B
Use dimensional analysis and conversion factors to solve problems	K, AP *M	Laboratory activities* *Inquiry Based for Honors	Graded Activities and Assignments		3.8.10.B
Explain what causes uncertainty in measurement.	AW	Class Discussion	Lab Reports		
Compare Accuracy and Precision	K *AP	Class/Group work* *Student led for Honors		* Quizzes & Tests will require higher level thinking skills in the Honors class.	
Explain why knowledge of Chemistry is central to scientific and human knowledge.	AW	Mythbuster Video			
List and describe the steps of the Scientific Method.	K, AP				
Name the basic forms of energy.	K				
Identify the states of matter	K, AW				
Compare physical and chemical properties of matter	K, AP *M				

State the Laws of Conservation of Mass and Energy	K				
Explain the difference between elements and compounds.	K, AP				

Resources/Materials

Textbook, iPad, Online Resources (PBS Chem Matters, Crash Course Chemistry, Khan Academy)
 Teacher Prepared Student Study Guide
 Calculators
 Laboratory Equipment
 Chemicals
 Worksheets & Lab Manuals
 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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<i>The student will be able to:</i>					
<u>Module 2: Matter - Properties & Changes</u>					
Name and describe the 4 states of matter.	K, AP	Teacher oriented lecture	Quizzes*	S.11.C.2.1.1	3.4.10.A & B
Compare physical and chemical properties of matter.	K, AP	Teacher designed projects	Tests*	S.11.C.2.1.2	4.1.10B
State the Law of Conservation of Matter, Definitie & Multiple Proportions	AW *AP	POGIL* *Independent Activity for Honors	Graded Activities and Assignments		4.6.10.A
Compare heterogeneous and homogeneous mixtures.	K, AP	Laboratory activities* *Inquiry Based for Honors	Lab Report		
Describe several techniques to separate mixtures.	K, AW *AP	Homework Class Discussion			
Use a Phase Change Diagram to identify changes in matter based on temperature and energy.	AW, K *AP	Class/Group work* *Student led for Honors			
Describe the solubility properties of various solutes and solvents including Acidic and Basic Solutions	AW, K *AP	Mythbuster Video			
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<i>The student will be able to:</i>					
<u>Modules 3 & 4 - Structure of the Atom/ Electrons in Atoms</u>					
Discuss the contribution of the theorists involved in developing the current atomic model including Democritus, Dalton, LaVoisier, Thompson, Milikan, Bohr, and Chadwick.	AW, K *M	Teacher oriented lecture Teacher designed projects POGIL* *Independent Activity for Honors	Quizzes* Tests* Homework Graded Activities and Assignments	S11.C.1.1.1 S11.C.1.1.2 S11A.3.2.3 S11A.3.2.2 S11A.#.2.1	3.4.10 A & B 4.6.10.A 3.1.10B 3.2.10B
Define the term “atom”	K	Laboratory activities* *Inquiry Based for Honors	Lab Report		
Name and describe the subatomic particles of the atom.	K, AP *M	Homework			
Calculate the number of protons, neutrons and electrons in an atom or ion.	K, AP	Class Discussion			
Define atomic number, atomic mass, isotope and ion.	K, AP *M	Class/Group work* *Student led for Honors	* Quizzes & Tests will require higher level thinking skills in the Honors class.		
Place electrons in orbitals and complete electron configurations for the elements according to the Aufbau Principle and Pauli’s Exclusion Principle.	K, AP *M	Fat Man & Little Boy Video PBS Chem Matters Activities			
Discuss Heisenberg’s Uncertainty Principle.	AW *AP				
Differentiate between fission and fusion reactions.	AW *K				
Complete Transmogrification Calculations.	K, AP				
Relate Half-Life to Radioactive Decay.	K, AP				

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<i>The student will be able to:</i>					
<u>Module 5 - The Periodic Table & Periodic Law</u>					
State the Periodic Law	AW	Teacher oriented lecture	Quizzes*	S.11.A.3.3.1	3.1.10.C
Discuss the contributions of Mendeleev, Moseley, Dobereiner, and Newlands.	AW	Teacher designed projects	Tests*	S.11.A.3.3.2	3.4.10.A
Explain why elements in the same group have similar properties.	AW, K *AP	POGIL* *Independent Activity for Honors	Homework	S.11.C.1.1.4	3.2.10.B
Identify the s, p, d, and f blocks of the Periodic Table,	K, AP	Laboratory activities* *Inquiry Based for Honors	Graded Activities and Assignments		
Define "Periodic Trend"	AW, K	Homework	Lab Report		
Identify the following periodic trends based on the electron configuration of the elements: Electron Affinity Electronegativity Atomic Size/Radii Ionization Energy	K, AP *M	Class Discussion Class/Group work* *Student led for Honors	* Quizzes & Tests will require higher level thinking skills in the Honors class.		
Compare the properties and behaviors of the elements.	K, AP	Hunting the Elements Video			
Give examples of uses of the elements.	AW *AP				
Identify unique properties of Hydrogen	K				
Predict the properties of an element based on its location on the table.	K, AP *M				

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<i>The student will be able to:</i>					
<u>Modules 6 & 7 - Ionic & Covalent Bonding</u>					
Describe the characteristics of an Ionic Bond.	K, AP	Teacher oriented lecture	Quizzes*	S.11.C.1.1.3	3.4.10A
State the Octet Rule	K	Teacher designed projects	Tests*		
Describe the characteristics of a Covalent Bond.	K, AP	POGIL* <i>*Independent Activity for Honors</i>	Homework Graded Activities and Assignments		
Describe the differences between polar and nonpolar bonds.	K, AP	Laboratory activities* <i>*Inquiry Based for Honors</i>	Lab Report		
Describe single, double, triple, and coordinate covalent bonds	K	Homework			
Predict the type of bond based on electronegativities.	K, AP	Class Discussion Class/Group work* <i>*Student led for Honors</i>	<i>* Quizzes & Tests will require higher level thinking skills in the Honors class.</i>		
Draw models of bonds using Lewis Dot Structures and Molecular Models	K, AP <i>*M</i>				
Predict molecular formulas based on their structures.	K, AP <i>*M</i>				
Write the formulas for Ionic and Covalent Compounds.	K, AP <i>*M</i>				
Name Ionic and Covalent Compounds from their chemical formulas.	K, AP <i>*M</i>				
Name Binary and Polyprotic Acids.	AW, K <i>*AP</i>				

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<i>The student will be able to:</i>					
Module 8 - Chemical Reactions					
Describe the characteristics of a chemical reaction.	K *AP	Teacher oriented lecture	Quizzes*	S11.C.2.1.3	3.4.10 A & B
Distinguish between endothermic and exothermic reactions	K, AP	Teacher designed projects	Tests*	S11.C.1.1.6	
Compare heat and temperature	K, AP	PBS Chem Matters Activities	Homework		
Explain the Kinetic Theory of Matter and Energy	K *M	POGIL* *Independent Activity for Honors	Graded Activities and Assignments		
Describe the processes involving Activation Energy in a chemical reaction	AW, K *AP	Laboratory activities* *Inquiry Based for Honors	Lab Report		
Describe the characteristics of a chemical reaction	K *AP	Homework	* Quizzes & Tests will require higher level thinking skills in the Honors class.		
Write a balanced chemical equation.	K, AP *M	Class Discussion			
Classify Chemical Reactions as: Synthesis Decomposition Single Displacement Double Displacement	K, AP *M	Class/Group work* *Student led for Honors			

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<i>The student will be able to:</i>						
<u>Modules 9 & 10 - The Mole & Stoichiometry</u>						
Define a mole and its importance	K	Teacher oriented lecture	Quizzes*	S11.A.2.1.1	3.7.10B 3.8.10B	
Identify and use Avagadro's Number	K, AP	Teacher designed projects	Tests* Homework			
Define molar mass and explain how it relates the mass of a substance to the number of particles	K, AP *M	PBS Chem Matters Activities	Graded Activities and Assignments			
Convert from moles to mass and back.	K, AP *M	POGIL* *Independent Activity for Honors	Lab Report			
Describe molar volume and use it in problem solving.	K, AP	Laboratory activities* *Inquiry Based for Honors				
Find the Percent Composition of a formula	K, AP *M	Homework Class Discussion	* Quizzes & Tests will require higher level thinking skills in the Honors class.			
Use percent composition to find the formula of an unknown substance,	K, AP	Class/Group work* *Student led for Honors				
Find empirical and molecular formulas	K, AP *M					
Define Stoichiometry and describe its importance	AW, K					
Relate storichometry to balanced chemical equations	K, AP					
Determine the limiting reagent of a chemical reaction.	K, AP					
Calculate the amount of product formed in a chemical reaction when	K, AP					

reactants are present in non stoichiometric proportions					
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<p><i>The student will be able to:</i></p> <p><u>Modules 11 & 12 - States of Matter & The Gas Laws</u></p> <p>Describe the behavior of solids, liquids and gases defined 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>Draw and interpret Heat Curves and Phase Diagrams</p>	<p>AW, K *AP</p> <p>K, AP *M</p> <p>K, AP</p> <p>AW, K</p> <p>K, AP</p>	<p>Teacher oriented lecture</p> <p>Teacher designed projects</p> <p>PBS Chem Matters Activities</p> <p>POGIL* *Independent Activity for Honors</p> <p>Laboratory activities* *Inquiry Based for Honors</p> <p>Homework</p> <p>Class Discussion</p> <p>Class/Group work* *Student led for Honors</p> <p>Absolute Zero Video</p>	<p>Quizzes*</p> <p>Tests*</p> <p>Homework</p> <p>Graded Activities and Assignments</p> <p>Lab Report</p> <p>* Quizzes & Tests will require higher level thinking skills in the Honors class.</p>	<p>S11.C.1.1.5</p>	<p>3.4.10A</p>
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