HAZLETON AREA SCHOOL DISTRICT

SCIENCE DEPARTMENT

CHEMISTRY CURRICULUM:
CHEMISTRY 1A & CHEMISTRY 1B

MAY 2016

Chemistry 1A & 1B

* The scientific method will be introduced at the beginning of the course.

Unit 1: Matter and Measurement

Part I: Introduction to Chemistry and Matter

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
A.1.1.2 Classify observations as qualitative and/or quantitative.
B.1.2.2 Apply the law of definite proportions to the classification of elements and compounds as pure substances.
A.1.2.2 Differentiate between homogenous and heterogeneous mixtures.
A.1.1.1 Classify physical or chemical changes within a system in terms of matter and/or energy.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe patterns of forms and events that guide organization and classification, and then prompt questions about relationships and the factors that influence them.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemistry is the study of matter and the changes it undergoes</td><td>ESSENTIAL QUESTIONS
• Why do we study chemistry?
• What is stuff made of and how do we know?
• How and why do we classify in chemistry?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• Chemistry
• Branches of Chemistry
• Matter
• Mass
• Volume
• Qualitative
• Quantitative
• Pure Substance
• Element
• Compound
• Chemical Formula</td><td>Students will be skilled at…
• Investigating how the branches of chemistry apply to different scenarios (2,3)
• Classifying observations as qualitative or quantitative (2)
• Classifying matter (2)
• Differentiating between physical properties and physical and chemical changes (2,3)</td></tr>
</table>

	• Mixture • Homogeneous • Heterogeneous • Solid • Liquid • Gas • Plasma • Physical Properties • Physical Change • Chemical Changes • Precipitate	

Stage 2 - Evidence

Evaluative Criteria	**Assessment Evidence**
• Observation • Lab Report Rubric • Poster Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Analysis of M&Ms (scientific method) • LifeSaver Scientific Method Lab • Phase Changes Lab (Heating Curve) • Adopt an Element Project • Physical and Chemical Changes Lab
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

LESSON PLAN IDEAS

- State of Classroom Observation Activity – After several days, students must recall general characteristics of classroom without being able to see the classroom
- History of Chemistry – Students will create a timeline of key historical events that helped to develop chemistry as a field of science
- Elemental Friend or Foe Article – Students will read article about the roles that various elements play in daily lives in order to answer reading comprehension questions
- Cleaning a Penny Lab – Students will follow a simple procedure to perform a chemical reaction to make old pennies look new

- Career in Chemistry Job Advertisement – Students generate an advertisement based on their investigation of a specific chemistry related career
- "Who Dung It?" Branches of Chemistry Activity – Students will role play as a specific chemist in order to analyze a sample
- States of Matter Foldable – Students will create a foldable in order to organize the properties of solids, liquids, gases, and plasma
- Classification of Matter Foldable - Students will create a foldable in order to organize the properties of elements, compounds, and mixtures
- Separating a Mixture Activity – Students will design a procedure to separate a mixture of iron, salt, sand, and water
- Meet the Newest Element article – Students will read article about the properties of the most newly discovered element in order to answer reading comprehension questions

Part II: Measurement

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
A.1.1.2 Classify observations as qualitative and/or quantitative.
A.1.1.3 Utilize significant figures to communicate the uncertainty in a quantitative observation</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemistry is the study of matter and the changes it undergoes.</td><td>ESSENTIAL QUESTIONS
• Why do we use a universal system of measurement?
• What types of measurements do we make in chemistry?
• Why do all measurements have error?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• International System of Units (SI system)
• Density
• D = m/V
• Percent Error
• Significant Figures
• Uncertainty
• Accuracy
• Precision</td><td>Students will be skilled at…
• Classifying observations as qualitative or quantitative (1,2)
• Identifying the appropriate units of measurement (2)
• Converting units within the SI system (1)
• Applying the concept of density to experimental data (3,4)
• Calculating values and maintaining their uncertainty using significant figures (2)
• Critiquing data by calculating percent error (3)
• Citing factors that affect uncertainty in scientific measurement (3)
• Differentiate between accuracy and precision (3)</td></tr>
<tr><td colspan="3">Stage 2 - Evidence</td></tr>
</table>

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Measurement/Significant Figure Lab • Density of Penny Lab • Density of Irregular Object Lab • Microdensity of Plastics Lab (SIM) • Density of Cardboard Box Lab • Density of Unknown Liquid Lab (Water) • Density of Aluminum Lab • Meltemps Lab (SIM) • Percent Error Lab (SIM)
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

LESSON PLAN IDEAS

- What is Measurement Lab – Students will measure the mass, length and volume of various objects
- Halloween Dimensional Analysis Lab – Students will take measurements of several different objects and convert to different units of measurement

Unit 2: The Atom

Stage 1 Desired Results

ESTABLISHED GOALS

A.2.1.1 Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
A.1.1.4 Relate the physical properties of matter to its atomic or molecular structure.
A.2.1.2 Differentiate between the mass number of an isotope and the average atomic mass of an element.
A.2.3.1 Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.

Transfer

Students will be able to independently use their learning to…

Investigate or design new systems or structures that require a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Meaning

UNDERSTANDINGS

Atomic theory is the foundation for the study of chemistry.

ESSENTIAL QUESTIONS

- What is an atom and what does it look like?
- What is an atom made from and how are they different from each other?
- Why is the periodic table useful?

Acquisition

Students will know…

- Atom
- Proton
- Electron
- Neutron
- Nucleus
- Atomic Number
- Atomic Mass
- Mass Number
- Isotope
- **Ion**
- Periodicity
- Metal
- Nonmetal
- Metalloid

Students will be skilled at…

- Comparing and contrasting the models of the atom (3)
- Analyzing how experiments led to the development of the current model of the atom (4)
- Determining that the atomic number identifies a particular element and its characteristics (1,2)
- Citing evidence as to how the periodic table has evolved (3)
- Determining the number of subatomic particles for an element using the periodic table (1)
- Calculating atomic mass for isotopic data and analyzing results (2,3)
- Categorizing an element based on its

		location on the periodic table (2)

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Lycopodeum Powder Lab • Beanium/Candium Isotope Lab • Penny Isotope Lab
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

LESSON PLAN IDEAS

- Atomic Theory Timeline Activity – Students will create a timeline in order to organize various scientists contributions to the development of the current model of the atom
- Vocabulary Index Card Activity – Students will practice pertinent vocabulary terms and their definitions by creating matches with a set of pre-labeled index cards
- Build-An-Atom Online Activity- (phet.colorado.edu) Students will perform an online simulation to use subatomic particles to build an atom
- Online Isotope Tutorial - (phet.colorado.edu) Students will perform an online simulation to visualize different isotopes
- Properties of Metals, Nonmetals, and Metalloids Lab – Various elemental samples are used to demonstrate the differences in properties
- Specific Heat of Lead – Students will experimentally determine the specific heat of lead shot
- Molar Heat of Fusion of Ice Lab – Students will melt a piece of ice and calculate the molar heat of fusion
- History of Periodic Table – Students will outline the development of the periodic table including a minimum of 4 historical figures
- Penny Hoarder Article (corresponds with Density of Pennies Lab)– Students will read the article in order to answer a series of comprehension questions

Unit 3: Chemical Formulae and Reactions

Part I: Nomenclature and Formula Writing

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
A.1.1.5 Apply a systemic set of rules (IUPAC) for naming compounds and writing chemical formulas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe different patterns at each of the scales at which a system is studied and provide evidence for causality in explanations of phenomena.

Understand that much of science deals with constructing explanations of how things change and how they remain stable.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemical reactions are predictable.</td><td>ESSENTIAL QUESTIONS
• Why are a common set of rules needed to name chemical compounds and write their formulas?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• Chemical Formula
• Ionic Compound
• Molecular Compound
• Ion
• Cation
• Anion
• Polyatomic Ion
• Diatomic Element
• Molecule
• Formula Unit</td><td>Students will be skilled at…
• Differentiating between ionic and molecular compounds (3)
• Relate position of an element on the periodic table to its ionic charge (2)
• Applying IUPAC rules while writing chemical names and chemical formulas (2,3)
• Relating a chemical compound’s basic properties to its chemical formula (2)
• Recognizing the 7 diatomic elements (1)</td></tr>
<tr><th colspan="3">Stage 2 - Evidence</th></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>• Observation
• Analysis Questions</td><td colspan="2">SUGGESTED PERFORMANCE TASK(S):
• Bond with a Classmate Activity</td></tr>
</table>

• Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	• Naming Compounds Race • Naming Compounds Flow Chart
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

LESSON PLAN IDEAS

- Food Label Activity – Students will analyze a food label in order to write the formulas of compounds that they know based on the ingredient label.
- Ion Cut Outs - Students will work to create ionic compounds using the puzzle pieces.
- Ion Go Fish – Students will play a card game using the rules of go fish by asking for certain ions to create compounds.

Part II: Chemical Reactions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
B.2.1.5 Balance chemical equations by applying the Law of Conservation of Matter.
B.2.1.3 Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
B.2.1.4 Predict products of simple chemical reactions</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe different patterns at each of the scales at which a system is studied and provide evidence for causality in explanations of phenomena.

Understand that much of science deals with constructing explanations of how things change and how they remain stable.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemical reactions are predictable.</td><td>ESSENTIAL QUESTIONS
What is a chemical equation and what does it represent?
What does it mean to balance a chemical equation?
How do you classify chemical reactions?
How do you predict the products of a chemical reaction?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Law of Conservation of Matter
Balanced Chemical Equation
Abbreviations and symbols in a chemical reaction
Reactant
Product
Synthesis Reaction
Decomposition Reaction
Single Replacement
Double Replacement
Combustion Reaction
Catalyst</td><td>Students will be skilled at…
Applying the law of conservation of matter in order to balance a chemical equation (3,4)
Formulating chemical equations from word equations (3)
Classifying chemical equations (2)
Predicting the products of a chemical equation using the activity series and solubility rules (2,3)</td></tr>
</table>

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Poster Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Double Replacement Reaction Lab (Precipitation Lab) • Single Replacement Lab • Activity Series Lab
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

LESSON PLAN IDEAS

- Chemical Reaction Cartoons – Students will work to create comic strips to describe single replacement, double replacement, synthesis, and decomposition reactions.
- Reaction Type Demos – The teacher will do several scientific demonstrations to show students the properties of the various types of reactions. (eg. silver nitrate and copper, elephants toothpaste, magnesium oxide, etc)
- Build a Reaction Balancing Activity – Students will use the molecular model kits to help visualize how atoms in a chemical reaction are equal.
- Pennies Alchemy Lab-Students will react pennies with water in a basic solution using zinc in order to make “silver” and “gold” pennies.

Part III: Energy Changes

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">3.2.10.A4. Describe chemical reactions in terms of atomic rearrangement and/or electron transfer. Predict the amounts of products and reactants in a chemical reaction using mole relationships. Explain the difference between endothermic and exothermic reactions. Identify the factors that affect the rates of reactions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe that changes of energy and matter in a system can be described in terms of energy and matter flowing into, out of, and within that system.

Understand that energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemical reactions involve a transfer of energy.</td><td>ESSENTIAL QUESTIONS
How are heat and energy related and how are they calculated?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Heat
Energy
Law of Conservation of Energy
System and Surroundings
Exothermic
Endothermic
Enthalpy</td><td>Students will be skilled at…
Calculating heat and energy for a system (2)
Explaining and applying the phenomena of the Law of Conservation of Energy in terms of heat and energy (3,4)</td></tr>
<tr><th colspan="3">Stage 2 - Evidence</th></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>Observation
Lab Report Rubric
Analysis Questions
Peer Evaluation
Self-Evaluation
Lab Practicum
Skills Demonstration</td><td colspan="2">SUGGESTED PERFORMANCE TASK(S):
Specific Heat of Lead
Molar Heat of Fusion of Ice Lab</td></tr>
</table>

• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Proper Use of Bunsen Burners – Students will be instructed on how to properly use Bunsen burners.
- Combustion of a Candle – Students will calculate the heat of the combustion reaction.
- Temperature Change of a Cup of Water (Heat Capacity) – Students will compare the amount of heat needed to heat a cup of water versus a larger container of water

Unit 4: The Mole, Stoichiometry and Gas Laws

Part I: The Mole

Stage 1 Desired Results

ESTABLISHED GOALS

B.1.1.1 Apply the mole concept to representative particles.

B.1.2.1 Determine the empirical and molecular formulas of compounds.

Transfer

Students will be able to independently use their learning to…

To assume that science views the universe as a vast single system in which basic laws are consistent.

Meaning

UNDERSTANDINGS

Students will understand that…

Chemistry is a quantitative science.

ESSENTIAL QUESTIONS

- How do we count particles that are too small to see?
- What is a mole and what does it represent?
- How are chemical formulas determined from an experiment?

Acquisition

Students will know…

- Representative Particle
- Avogadro's Number
- Mole
- Molar Mass/Formula Mass/Formula Weight
- Empirical Formula
- Molecular Formula
- Percent Composition

Students will be skilled at…

- Identifying the appropriate representative particles for a substance (1,2)
- Counting by measuring with appropriate units (2)
- Calculating molar mass/formula mass/ formula weight (2)
- Using the mole concept for conversion (2,3)
- Differentiating between empirical and molecular formula (2)
- Calculating empirical and molecular formula from data (2,3)
- Calculating percent composition (2)

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Heating of Magnesium to form Magnesium Oxide • M&M Percent Composition • Percent of Water in Popcorn
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Determining the Moles/Molecules of Sugar in Bubble Gum – Students will determine the moles and molecules of sugar in a piece of bubble gum through loss of mass after chewing.
- Determining the Moles/Atoms in a Metal Sample – Students will determine the moles and atoms of metal through mass conversions.
- The Case of the Deceased Mole – Students will calculate the empirical formula of several compounds in order to solve a mock crime.

Part II: Stoichiometry

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS
B.2.1.1 Describe the roles of limiting and excess reactants in chemical reactions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Understand that the total amount of energy and matter in closed systems is conserved.

To assume that science views the universe as a vast single system in which basic laws are consistent.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemistry is a quantitative science.</td><td>ESSENTIAL QUESTIONS
• How are the quantities in a chemical reaction related to one another?
• What determines the amount of product that is formed in a chemical reaction?
• Why are real life experimental results different than theoretical results?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• Stoichiometry
• Limiting Reagent
• Excess Reagent
• Percent Yield</td><td>Students will be skilled at…
• Solving stoichiometric calculations involving moles, mass and volume (2,3)
• Applying the concepts of limiting reagent, excess reagent, and percent yield to stoichiometric calculations (3,4)</td></tr>
<tr><th colspan="3">Stage 2 - Evidence</th></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>• Observation
• Lab Report Rubric
• Analysis Questions
• Peer Evaluation</td><td colspan="2">SUGGESTED PERFORMANCE TASK(S):
• The Case of Deceased Mole
• Preparation of NaCl (Percent Yield Lab)</td></tr>
</table>

• Self-Evaluation • Lab Practicum • Skills Demonstration	
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Cookie Recipe Lab – Students will practice conversion calculations to covert mole units to traditional baking units (cup, teaspoons, tablespoons)
- Stoichiometry Relay Race – Students will compete in groups of 4-5 to solve several stoichiometry problems. The handout will be passed among group members as the "baton".
- Balloon Races Lab (Alka-Seltzer or Baking Soda and Vinegar) – Students will react varying amounts of baking soda with a constant volume of vinegar; the carbon dioxide gas will be collected within the balloon. Students will determine the limiting reagent in the reaction.

Part III: The Behavior of Gases

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
B.2.2.1 Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system.
B.2.2.2 Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Determine when empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Define the boundaries and initial conditions of the system when investigating or describing a system.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemistry is a quantitative science.</td><td>ESSENTIAL QUESTIONS
• How are gases unique?
• How do we study and measure gases?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• Gas
• Kinetic Theory
• Absolute Scale
• Properties of Gas
  ○ Pressure
  ○ Volume
  ○ Temperature
  ○ Number of Particles
  ○ Characteristics
• Standard Pressure and Temperature
• Molar Volume
• Gas Laws (Dalton, Boyle, Charles, Gay-Lussac, Avogadro, Combined, Ideal)</td><td>Students will be skilled at…
• Relate the behavior of gases to kinetic theory (2,3)
• Applying the appropriate gas law to calculate changes in a gaseous system (2,3)</td></tr>
<tr><th colspan="3">Stage 2 - Evidence</th></tr>
<tr><th>Evaluative Criteria</th><th colspan="2">Assessment Evidence</th></tr>
</table>

• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGUESTED PERFORMANCE TASK(S): • Ideal Gas Law (Alka-Seltzer) • Gas Law Poster Project (Practical Application of a Gas Law) • Gas Disease Assignment (Hypoxia, Nitrogen Narcosis, Oxygen Toxicity, Bends)
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Boyle's Law Syringe Lab – Students will graph the relationship between pressure and volume in a syringe in order to study Boyle's Law.
- Dry Ice Demo – Various demos
- Online Gas Law Simulations (Graphing) – Students will simulate various gas laws using phet.edu
- Crush the Can Demo – Students will observe the atmospheric pressure crushing a soda can (Boyle's Law)
- Egg in the Bottle Demo – Students will observe the differences in pressure between the atmosphere and bottle (Gay Lussac)
- Cartesian Diver Demo – Students will observe the effect of pressure on volume (Boyle's Law)
- Vernier Gas Law Labs (STEM/SIM) – Students will observe Boyle's Law and Charles' Law using Vernier software. Graphing will be reinforced.
- Molar Volume of a Gas – Students will experimentally determine molar volume at STP by reacting magnesium with acid
- Ideal Gas Law Lab – Students will use the Ideal Gas Law to determine the moles of carbon dioxide gas produced when Alka-Seltzer reacts with water
- The Science of Popcorn – Students will apply the ideal gas law to determine the volume of water vapor needed pop a kernel of corn
- Rocket Balloons – Students design a balloon rocket made from a balloon and a straw to determine how to make the rocket travel the furthest distance
- ACS Joseph Priestly Article – Students will read about Joseph Priestly and the discovery of oxygen in order to answer comprehension questions.
- Mt. Everest article – Students will read about how the Sherpa guides help mountain climbers adjust to the atmospheric pressure changes at high altitudes

Unit 5: Quantum Theory and the Periodic Table

Part I: Quantum Mechanics

Stage 1 Desired Results

ESTABLISHED GOALS

A.2.2.1 Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system.

A.2.2.4 Relate the existence of quantized energy levels to atomic emission spectra

A.2.2.3 Explain the relationship between electron configuration and the atomic structure of a given atom or ion

A.2.2.2 Predict characteristics of an atom or an ion based on its location on the periodic table

Transfer

Students will be able to independently use their learning to…

Use models (e.g., physical, mathematical, computer models) to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Meaning

UNDERSTANDINGS

Students will understand that…

Quantum Theory provides the framework for the prediction of periodic properties and trends.

ESSENTIAL QUESTIONS

- Does the submicroscopic world behave in the same way as the "real world"?
- How are matter and energy related?
- What are the properties of waves?
- How could light behave as both a wave and a particle?
- How do we describe the location of moving particles that we cannot see?

Acquisition

Students will know…

- Quantum
- Orbital
- Ground State vs. Excited State
- Wavelength
- Frequency
- Electromagnetic Radiation/Spectrum
- Speed of Light
- Photon
- Electron Configuration
- Aufbau Principle

Students will be skilled at…

- Comparing and contrasting the concept of quantized vs. continuous states (2)
- Applying quantized vs. continuous to energy levels (3)
- Differentiating between the various types of orbitals and their geometries and properties (2,3)
- Explaining atomic emission spectra in terms of electronic structure (3)

	• Hund's Rule • Pauli Exclusion Principle • Orbital Diagram • Atomic Emission Spectra • Wave Particle Duality	• Performing and analyzing EMR calculations and results (2,3) • Writing electron configurations and drawing orbital diagrams (1,2)

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Book Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • The Case of Deceased Mole • Web Quest Electromagnetic Spectrum Book • Wavelength Lab with Diffraction Grating
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Materials

- Fireworks Article – Students will read about the physical and chemical changes that occur within fireworks as well as the different elements used to create the firework colors.
- Wintergreen Mint Demo – Students will observe the production of light when one bites into a wintergreen mint.
- Seltzer Water Demo – Students will observe the luminescence of quinine in seltzer water when exposed to UV light.
- Hog Hilton – Students will simulate the arrangement of electrons in the atomic orbitals.
- Flame Tests Lab (online activity) – Students will observe the colors produced by the burning of metal salts. Students can calculate the frequency and energy of the characteristic colors of light.
- Slinky Activity – Students can observe the properties of waves such as wavelength, amplitude, crest, node, and frequency looking at the waves produced by a slinky.

Part II: Periodic Trends

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
A.2.3.2 Compare and/or predict the properties</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe patterns of forms and events that guide organization and classification, and then prompt questions about relationships and the factors that influence them.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Quantum Theory provides the framework for the prediction of periodic properties and trends.</td><td>ESSENTIAL QUESTIONS
• What kind of information does the periodic table contain?
• Why does the periodic table look the way that it does?
• What are the periodic trends?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• Periodic law
• Periodicity
• Electron Affinity
• Ionization Energy
• Electronegativity
• Atomic Radius</td><td>Students will be skilled at…
• Predicting and analyzing the periodic trends (2,3)
• Citing evidence from quantum theory explaining periodic trends (3,4)</td></tr>
<tr><th colspan="3">Stage 2 - Evidence</th></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>• Observation
• Lab Report Rubric
• Analysis Questions
• Peer Evaluation
• Self-Evaluation
• Lab Practicum
• Skills Demonstration</td><td colspan="2">SUGGESTED PERFORMANCE TASK(S):
• Periodic Trends Graphing Activity</td></tr>
<tr><td>• Observation</td><td colspan="2">OTHER EVIDENCE:</td></tr>
</table>

• Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	• Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Mystery Element Activity – Students will identify elements based on their knowledge of periodic trends
- Web Quests – Students will be able to draw conclusions about the periodic trends looking at numerical values for atomic radius, ionization energy, and electronegativity.
- World of Chemistry in the Mechanical Universe – Various video clips of topics relating to the periodic table
- Potassium Iodide in Radiation Emergencies (Tro Book) – Article on uses of potassium iodide to treat radiation

Unit 6: Chemical Bonding

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
B.1.3.1 Explain how atoms combine to form compounds through ionic and covalent bonding.
B.1.4.2 Utilize Lewis dot structures to predict the structure and bonding in simple compounds
B.1.4.1 Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound
B.1.3.2 Classify a bond as being polar covalent, non-polar covalent or ionic
B.1.3.3 Use illustrations to predict the polarity of a molecule</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe patterns of forms and events that guide organization and classification, and then prompt questions about relationships and the factors that influence them.

Investigate or design new systems or structures that require a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
Chemical bonding occurs as a result of attractive forces between particles.</td><td>ESSENTIAL QUESTIONS
Why do atoms form bonds?
What are bonds and what types exist?
Why do molecules form certain structures and shapes?
How are forces and molecules related?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Bond
Ionic
Covalent
Valence Electrons
Metallic
Multiple Bonds
Bond energy and length
Polarity
Lewis dot structure
Molecular geometry
VSEPR Theory
Intermolecular Forces</td><td>Students will be skilled at…
Relating the number of the valence electrons to the arrangement of the periodic table (1,2)
Differentiating differences between bond types (2,3)
Illustrating how ionic bonds and covalent bonds are formed as related to electron structure (2,3)
Connecting the concept of VSEPR theory to molecular geometry and polarity (3,4)
Predicting and comparing the properties of compounds based on</td></tr>
</table>

		their intermolecular forces (3,4)

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • VSEPR Theory Online Activity/ Simulation • Molecules and Medicine Research Activity • Molecular Model Lab
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Rubber Band Demo (Bond Strength) – The teacher will demonstrate bond strength between single, double, and triple bonds using rubber bands.
- Oil and Water Demo – Students will observe immiscible solutions and an example of the “like dissolves like” rule
- Conductivity Demo – Students will observe the conductivity properties of ionic compounds

Unit 7: Solutions and Kinetic Theory

Part I: Solutions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
A.1.2.1 Compare properties of solutions containing ionic or molecular solutes
A.1.2.4 Describe various ways that concentration can be expressed and calculated.
A.1.2.3 Describe how factors can affect solubility.
A.1.2.5 Describe how chemical bonding can affect whether a substance dissolves in a given liquid</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe patterns of forms and events that guide organization and classification, and then prompt questions about relationships and the factors that influence them.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
The concept of equilibrium can be applied to various types of chemical and physical processes.</td><td>ESSENTIAL QUESTIONS
What is a solution?
What is concentration?
What makes things dissolve?
How do properties of substances change when they are mixed together?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Solute
Solvent
Solution
Solubility
Dissociation
Electrolyte
Concentration
Molarity
Molality
Mole Fraction
Percentage
Colligative Properties</td><td>Students will be skilled at…
Explaining and predicting the factors that affect solubility (2)
Describing the process of solvation and dissociation (3)
Selecting and applying the appropriate measure for determining and calculating the concentration of a solution (3,4)
Assessing and analyzing how colligative properties affect solutions (3,4)
Applying the concept of molecular structure to solubility and colligative properties (4)
Design a method for preparing</td></tr>
</table>

		solutions with specified concentrations (4)

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Heat Of Vaporization Lab • Colligative Properties Lab • UV Spec Lab • Make a Solution Lab(M/m) • Serial Dilution Lab (Salt/Kool Aid Lab)
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- Shrinking Liquid Demo (Hydrogen Bonding) – Students will observe the hydrogen bond disruption of water by alcohol.
- Surface Tension Demo (Milk Activity, Drops on a Penny, Paper Clip, Water in Cup) – Students will observe the properties of water and the effects of a surfactant on these properties.
- Water Olympics – Students will observe the properties of water in several activities.
- Ice Cream Lab – Students will make ice cream in order to demonstrate freezing point depression.
- Pipette Practicum - Students will demonstrate proper pipetting techniques.

Part II: Kinetics and Equilibrium

Stage 1 Desired Results

ESTABLISHED GOALS

3.2.10.A.4. Describe chemical reactions in terms of atomic rearrangement and/or electron transfer. Predict the amounts of products and reactants in a chemical reaction using mole relationships. Explain the difference between endothermic and exothermic reactions. Identify the factors that affect the rates of reactions.

3.2.12.A5 Use VSEPR theory to predict the molecular geometry of simple molecules

Transfer

Students will be able to independently use their learning to…

Observe different patterns at each of the scales at which a system is studied and provide evidence for causality in explanations of phenomena.

Understand that much of science deals with constructing explanations of how things change and how they remain stable.

Meaning

UNDERSTANDINGS

Students will understand that…

The concept of equilibrium can be applied to various types of chemical and physical processes.

ESSENTIAL QUESTIONS

- What is rate?
- How do we measure rates of a chemical reaction?
- What affects rate?
- Is change always visible?

Acquisition

Students will know…

- Rate of Reaction
- Collision Theory
- Activation Energy
- Reaction Energy Diagram
- Equilibrium
  - Dynamic Equilibrium
  - Static Equilibrium
- Le Chatelier's Principle
- Equilibrium Constant (K_{eq})

Students will be skilled at…

- Representing the rate of a chemical reaction (2)
- Explaining the factors that affect the rate of chemical reaction in terms of kinetic theory (3)
- Constructing an appropriate equilibrium expression (3)
- Interpreting the results of equilibrium calculations (3)
- Creating and analyzing energy diagrams (3,4)
- Explaining the factors that affect the equilibrium position (3,4)

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Rate of Reaction with Alka Seltzer Tablets • Penny Equilibrium Lab
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- PhET Online Reaction Rates and Reversible Reactions Interactive Activities– Students will observe interactive simulations on these topics
- Le Chatelier's Principle (SIM) – Students will complete a laboratory activity to predict the changes observed in an equilibrium system involving cobalt complexes and to explain the changes in terms of Le Chatelier's principle.

Part III: Acids and Bases

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS
3.2.12.A.4 Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Observe different patterns at each of the scales at which a system is studied and provide evidence for causality in explanations of phenomena.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
The concept of equilibrium can be applied to various types of chemical and physical processes.</td><td>ESSENTIAL QUESTIONS
What makes something an acid or a base?
How can things be an acid and base at the same time?
How are acids and bases classified?
How is the strength of an acid or base measured?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Acid
Base
Amphoteric
Mono/Polyprotic Acids
Arrhenius Theory
Brønsted-Lowry Theory
Lewis Theory
pH/pOH
Autoionization of water
K_w
Indicator
Dissociation
Titration
Buffers</td><td>Students will be skilled at…
Comparing and contrasting the properties of acids and bases (2)
Predicting the products of acid-base reactions (2)
Assessing the merits of all acid-base theories (3)
Applying the appropriate acid-base theory(s) for a given situation (3)
Connecting the major concepts of pH and pOH to acid-base theories (4)
Applying the appropriate formulas for calculating the pH and pOH of a solution (3,4)</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
• Observation • Lab Report Rubric • Analysis Questions • Peer Evaluation • Self-Evaluation • Lab Practicum • Skills Demonstration	SUGGESTED PERFORMANCE TASK(S): • Heat Of Vaporization Lab • Colligative Properties Lab • UV Spec Lab • Make a Solution Lab (M/m) • Serial Dilution Lab (Salt/Kool Aid Lab) • Acid-Base Pamphlet
• Observation • Self-Reflection • Multiple Choice • Open Ended • Teacher Developed Answer Key	OTHER EVIDENCE: • Formative Assessment (PDN, exit slips, discussion, informal questioning, etc) • Quizzes • Summative tests

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

- pH of Households (SIM) – Students will test the pH levels and determine the acidity/ basicity of various household objects using a variety of indicators
- Titration Lab – Students will determine the concentration of an acid through the technique of titration