POCONO MOUNTAIN SCHOOL DISTIRCT

COURSE: Chemistry	**GRADE(S): 10-12**
UNIT 1: Section 1: Introduction and Overview of Chemistry	**TIMEFRAME: ~ 10 days**

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:

3.2.10.A1
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar covalent bonds

3.2.12.A1
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:

3.2.10.A2
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- **Determine percent compositions, empirical formulas, and molecular formulas.**

3.2.12.A2
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy

3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

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.

3.2.C.A4

- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.

- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes

3.2.10.A5.

- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.

- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.

- Use VSPER theory to predict the molecular geometry of simple molecules.\Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry

- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions.
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>

CHEM.A.1. – Properties and Classification of Matter

- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.

    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).

CHEM.A.1. 2. Compare the properties of mixtures.

    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).
    - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
    - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
    - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
    - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2. – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
    - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
    - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
    - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
    - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
    - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
    - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
    - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
    - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1. – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
    - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
    - Determine the empirical and molecular formulas of compounds.
    - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
    - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
    - Explain how atoms combine to form compounds through ionic and covalent bonding.
    - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
    - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
    - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
    - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2. – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - Describe the roles of limiting and excess reactants in chemical reactions.
  - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Define Chemistry
   - Chemistry is the study of the composition, structure, and properties of matter, the processes that matter undergoes, and the energy changes that accompany these processes.
2. List examples of the branches of chemistry
   - Organic Chemistry is the study of most carbon-containing compounds
   - Inorganic Chemistry is the study of non-organic substances, many which have organic fragments bonded to metals (organometallics)
   - Physical Chemistry is the study of the properties and changes of matter and their relation to energy
   - Analytical Chemistry is the identification of the components and composition of materials
   - Biochemistry is the study of substances and processes occurring in living things
   - Theoretical Chemistry is the use of mathematics and computers to understand the principles behind observed chemical behavior and to design and predict properties of new compounds
3. Compare and contrast basic research, applied research, and technological development.
   - Basic research is conducted for the sake of knowledge only and not to meet practical goals
   - Applied research is conducted to meet goals defined by specific needs
   - Technology employs existing knowledge to make life easier and more convenient.
4. Recognize the general steps scientists use in solving problems
   - Scientific thinking involves observations that enable us to clearly define both a problem and the construction and evaluation of possible explanations or solutions to the problem
5. Define and describe the scientific method
   - Scientific methods are systematic approaches to problem solving
   - Qualitative data describes an observation
   - Qualitative data use numbers
   - Independent variables are changed in an experiment
   - Dependent variable change in response to the independent variable
6. Investigate and explain that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data
   - Data tables are used to record and organize measurements.
   - Algebraic equations represent relationships between dependent and independent variable.
   - Graphs are used to summarize the relationship between the independent and dependent variable.
   - Graphed data gives a picture of a relationship
   - Scientific questions drive new technologies that allow discovery of additional data and generate better questions. New tools and instruments provide an increased understanding of matter at the atomic, nano, and molecular scale
   - Constant reevaluation in the light of new data is essential to keeping scientific knowledge curren In this fashion, all forms of scientific knowledge remain flexible and may be revised as new data and new ways of looking at existing data become available

7. Explain the difference between a theory and a scientific law
   - A theory is a hypothesis that is supported by many experiments
   - A scientific law is a concise statement that summarizes the results of many observations and experiments
8. List important rules for laboratory safety
   - Lab safety is the responsibility of everyone in the lab setting
   - Procedures are followed for the safe use of chemicals and equipment
   - There are proper responses to emergency situations
   - MSDS sheets provide valuable information which should be reviewed prior to use of chemicals

ACTIVITIES:

1. Identify, locate, and know how to use laboratory safety equipment, including aprons, goggles, fire extinguishers, fire blanket, safety shower, eye wash, broken glass container and fume hood.
2. Summarize Material Safety Data Sheets (MSDS) considering warnings, including handling chemicals, lethal dose (LD), hazards, disposal, and chemical spill cleanup.
3. Design a demonstration or watch a video that provides students with an opportunity to observe and identify laboratory safety concerns.
4. Present a set of lab scenarios to the students, and review in relation to each scenario the prevention of accidents in the lab and proper responses to accidents when they happen. These scenarios should include the following: acid/chemical splashing into eyes; hair/clothes catching on fire; broken glass is cutting the skin with active bleeding; disposal of broken glassware; disposal of used and unused chemicals; and lab clean up.
5. Compare and contrast scientific theories, scientific laws, and beliefs
6. Analyze and explain how to verify the accuracy of scientific facts, principles, theories, and laws
7. Use appropriate quantitative and/or qualitative data to describe or interpret change in systems
8. Critique the elements of an experimental design using the scientific method (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
9. Critique the elements of the design process using the scientific method (e.g., identify the problem, understand criteria, create solutions, select solution,

ASSESSMENTS:

- ATBs/Closure Activities
- Daily Participation
- Daily Classwork
- Homework
- Group Discussions
- Group Projects
- Individual Projects
- Cooperative Learning Activities
- Model Creations
- Writing Prompts
- Reading Guides
- Demonstrations
- Lab Participation
- Lab Reports
- Online Research
- Group Presentations
- Individual Presentations
- Quizzes
- Unit Tests
- Final Exams

REMEDIATION:

- Class Notes
- Graphic Organizers
- Chunking of Information
- Oral Questioning
- Group Discussion
- Small Lab Group Participation
- Reinforcement Videos and Animations
- Computer Simulation/Modeling Projects
- Web-based Reinforcement Activities
- Cooperative Learning Groups
- Peer Tutoring
- Individualized Assistance
- Small Group Assistance
- Review Games
- Content Review

ENRICHMENT:

- Class Presentations
- Project-Based Assignments
- Online Research
- Group Discussions
- Online Review Games
- Independent Investigations
- Individualized Teacher Support

test/evaluate and communicate results) applicable to a specific technological design.

10. Use data to make inferences, predictions; and to draw conclusions
11. Apply experimental design used in scientific investigation: perform and design experiments to test predictions; predict outcomes when a variable is changed
    - Use graphs to show the relationships of the data: Dependent variable (vertical axis)
    - Independent variable (horizontal axis)
    - Scale and units of graph
    - Regression lines
12. Graph data utilizing the following:
    - independent variable (horizontal axis)
    - dependent variable (vertical axis)
    - scale and units of a graph
    - Regression line (best fit curve.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 1]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

- Peer Tutoring
- Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTIRCT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 1: Section 2: Matter	TIMEFRAME: ~ 20 days

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Properties of Matter:

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- covalent bonds

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  Compare and contrast the unique properties of water to other liquids.

Structure of Matter:

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- Compare and contrast different bond types that result in the formation of molecules and compounds.
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Matter & Energy

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- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
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- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

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- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

3.2.10.A4

- Describe chemical reactions in terms of atomic rearrangement and/or electron transfer.
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- Explain the difference between endothermic and exothermic reactions.
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- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
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- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

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- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

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- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
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- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

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- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry

- Compare and contrast scientific theories.
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- Evaluate experimental information for relevance and adherence to science processes.
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CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>

CHEM.A.1 – Properties and Classification of Matter

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  - Classify physical or chemical changes within a system in terms of matter and/or energy.
  - Classify observations as qualitative and/or quantitative.
  - Utilize significant figures to communicate the uncertainty in a quantitative observation.
  - Relate the physical properties of matter to its atomic or molecular structure.
  - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
  - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving,

dissociating).
    - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
    - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
    - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
    - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
    - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
    - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
    - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
    - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
    - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
    - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
    - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
    - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
    - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
    - Determine the empirical and molecular formulas of compounds.
    - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
    - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
    - Explain how atoms combine to form compounds through ionic and covalent bonding.
    - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
    - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
    - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
    - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
    - Describe the roles of limiting and excess reactants in chemical reactions.
    - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
    - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.

- Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
- Balance chemical equations by applying the Law of Conservation of Matter.

- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Define matter, mass, volume.
   - Matter is anything that has mass and takes up space (volume).
   - Mass is the measure of the amount of matter the object contains.
   - Volume is a measure of the space occupied by an object.
2. Explain how energy, temperature, and extensive/intensive properties affect matter.
   - Energy may act on matter through kinetic energy and potential energy. Kinetic energy focuses on the energy of motion where as potential energy is stored energy in an object.
   - Temperature is a measure of the average kinetic of particles in matter; it determines the direction of heat transfer. As temperature increases, the particles in the object move faster which increases kinetic energy and decreases potential energy. As temperature decreases, the particles in the object move slower which decreases kinetic energy and increases potential energy.
   - Extensive properties are properties that depend on the amount of matter in a sample (i.e. mass and volume).
   - Intensive properties are properties that depend on the type of matter in a sample (not the amount of matter).
3. Explain the gas, liquid, and solid in terms of particles
   - Matter in the solid state has definite volume and definite shape. Particles in solids are packed together in relatively fixed positions.
   - Matter in the liquid state has a definite volume but an indefinite shape. A liquid assumes the shape of its container. The particles in a liquid are close together but can move past one another. The particles in a liquid move more rapidly than those a solid.
   - Matter in the gas state has neither a definite volume nor shape. The particles in a gas move very rapidly and are at great distances from each other compared to solids and liquids. Gases have mass and occupy space. Gas particles are in constant, rapid, random motion and exert pressure as they collide with the walls of their containers. Gas molecules with the lightest mass travel fastest. Relatively large distances separate gas particles from each other.
4. Diagram and explain phase changes in matter
   - A phase change is a transition of matter from one state to another (solid to liquid, liquid to gas, gas to liquid, solid to gas, and vice versa). Solid, liquid, and gas phases of a substance have different energy content. Pressure, temperature, and volume changes can cause a change in physical state. Specific amounts of energy are absorbed or released during phase changes.
   - As the temperature and pressure change, most substances undergo a change from one state (or phase) to another.
5. Explain how the law of conservation of energy, matter, and mass applies to changes of matter
   - During any chemical or physical change mass is conserved, it is neither created nor destroyed.
   - During any chemical or physical change energy is always involved, although energy can be absorbed or released in a change, it is not destroyed or created. It simply assumes a different form.
6. Distinguish between the physical properties and chemical properties of matter
   - Physical properties refer to the condition or quality of a substance that can be observed or measured without changing the substance's composition. Important physical properties are density, conductivity, melting point, boiling point, malleability, and ductility.
   - Chemical properties are observed by changing the substance into different substances (burning of coal, rusting of iron, etc.).
7. Classify changes of matter as physical or chemical
   - Matter is classified by its chemical and physical properties.
   - Physical properties refer to the condition or quality of a substance that can be observed or measured without changing the substance's composition. Important physical properties are

density, conductivity, melting point, boiling point, malleability, and ductility.

- During a physical change some properties of a material change but the composition of the material does not change.
- Physical changes can be classified as reversible or irreversible.
- During a chemical change the composition of matter always changes.
- Chemical properties refer to the ability of a substance to undergo chemical reaction and form a new substance. Terms such as decompose, explode, rust, oxidize, corrode, tarnish, ferment, burn, or rot generally refer to chemical reactions.
- The substances that react in a chemical change are called the reactants.
- The substances that are formed by the chemical change are called the products.

8. Distinguish between a mixture and a pure substance
   - A mixture is a blend of two or more kinds of matter, each of which retains its own identity and properties.
   - Homogeneous mixtures are uniform in composition and have the same proportions of components through-out. The particles of a homogeneous mixture are molecule-sized so the mixture appears uniform, even under a microscope.
   - Homogeneous mixtures are often called solutions, which are made up of a solute (dissolving material) and a solvent (material that does the dissolving).
   - Heterogeneous mixtures not uniform throughout. The particles are large enough to see under a microscope.
   - Mixtures can be separated by physical means. Common separation techniques include decanting, filtration, screening, magnetism, evaporation, distillation, crystallization, sublimation, and chromatography
   - A pure substance is homogeneous in which every sample of a given pure substance has exactly the same characteristic properties and the same composition. EX: Pure water is always 11.2% hydrogen and 88.8% oxygen by mass.
9. Distinguish between solutions, suspension and colloids.
   - A solution is a clear, homogeneous mixture of two or more substances uniformly dispersed throughout a single phase
   - A suspension is a heterogeneous mixture in which particles of a material are more or less evenly dispersed throughout a liquid or gas. In a suspension, the particles may remain fixed with the liquid while the liquid is being stirred but later they will settle to the bottom.
   - A colloid is a cloudy, homogeneous mixture consisting of tiny particles that are intermediate in size between those in solutions and those in suspensions and that are suspended in a solid, liquid or gas.
10. Classify and label all the parts of a chemical reaction.
    - Reactants are all of the elements, compounds, and molecules found to the left of the yield sign.
    - Products are all of the elements, compounds, and molecules found to the right of the yield sign.
    - Yield is to change chemically. It is the arrow in the chemical reaction.
    - Coefficients are the large numbers in front of the reactants and products.
    - Subscripts are the lowered number inside the compounds
    - Elements are the simplest form that can be found on the periodic table.
    - Compounds are a combination of elements. They are represented by two or more elements.

ACTIVITIES:	**ASSESSMENTS:**
1. Create models indicating the particle arrangements of solids, liquids and gases 2. Demonstrate state of matter phase changes using water in solid state, heat to melt to liquid- heat to change to gas 3. Design and implement a lab to demonstrate the phase changes of water. 4. Create a video or PowerPoint presentation to explain and illustrate the concept of Conservation of Mass or Energy 5. Identify provided visuals of common items as homogeneous or heterogeneous mixtures	ATBs/Closure Activities Daily Participation Daily Classwork Homework Group Discussions Group Projects Individual Projects Cooperative Learning Activities Model Creations Writing Prompts Reading Guides Demonstrations Lab Participation Lab Reports

6. Identify provided visuals of common items as substances or mixtures 7. Identify provided visuals of common items as solutions, colloids, and suspensions. 8. Separate mixtures using common separation techniques that may include filtration, distillation, screening, magnetism, evaporation, crystallization and chromatography 9. Design a concept may that summarizes the relationships among matter, mixtures, pure substances and homogeneous and heterogeneous mixtures 10. Model how to label the different parts of a chemical reaction 11. Discuss the physical and chemical properties of common objects 12. Given examples, identify changes in matter as chemical or physical 13. Distinguish between physical and chemical properties of metals and nonmetals 14. Describe the results of a physical change and list three examples of physical change 15. Describe the results of a chemical change and list four indicators of chemical change 16. Design and implement a lab to demonstrate a chemical change 17. Maintain a science log of all vocabulary terms and related notes **RESOURCES:** 1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 2, 13, and 15]** 2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc). **Web Resources:** https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true http://streaming.discoveryeducation.com/ http://www.studyisland.com/web/index/ http://www.khanacademy.org/ http://www.teachertube.com/ http://www.sciencegeek.net/ http://www.webelements.com/ http://www.chemmybear.com/ http://www.ck12.org/chemistry/	Online Research Group Presentations Individual Presentations Quizzes Unit Tests Final Exams **REMEDIATION:** Class Notes Graphic Organizers Chunking of Information Oral Questioning Group Discussion Small Lab Group Participation Reinforcement Videos and Animations Computer Simulation/Modeling Projects Web-based Reinforcement Activities Cooperative Learning Groups Peer Tutoring Individualized Assistance Small Group Assistance Review Games Content Review **ENRICHMENT:** Class Presentations Project-Based Assignments Online Research Group Discussions Online Review Games Independent Investigations Individualized Teacher Support Peer Tutoring Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 2: Section 1: Scientific Measurement	TIMEFRAME: ~20 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:

3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:

3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

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.

3.2.C.A4.

- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.

- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes

3.2.10.A5.

- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.

- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.

- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry

- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>

CHEM.A.1 – Properties and Classification of Matter

- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
  - Classify physical or chemical changes within a system in terms of matter and/or energy.
  - Classify observations as qualitative and/or quantitative.
  - Utilize significant figures to communicate the uncertainty in a quantitative observation.
  - Relate the physical properties of matter to its atomic or molecular structure.
  - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
  - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving,

dissociating).
- Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
- Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
- Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
- Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
    - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
    - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
    - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
    - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
    - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
    - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
    - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
    - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
    - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
    - Determine the empirical and molecular formulas of compounds.
    - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
    - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
    - Explain how atoms combine to form compounds through ionic and covalent bonding.
    - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
    - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
    - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
    - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
    - Describe the roles of limiting and excess reactants in chemical reactions.
    - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
    - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.

- Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
- Balance chemical equations by applying the Law of Conservation of Matter.

- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

ACTIVITIES:

1. Read measurements and record data, reporting the significant digits of the measuring equipment.
2. Demonstrate precision (reproducibility) in measurement.
3. Recognize accuracy in terms of closeness to the true value of a measurement.
4. Determine the mean of a set of measurements.
5. Use data collected to calculate percent error.
6. Discover and eliminate procedural errors.
7. Use common SI prefixes and their values (milli-, centi-, kilo-) in measurements and calculations.
8. Demonstrate the use of scientific notation, using the correct number of significant digits with powers of ten notations for the decimal place.
9. Graph data utilizing the following:
   - independent variable (horizontal axis)
   - dependent variable (vertical axis)
   - scale and units of a graph
   - regression line (best fit curve).
10. Perform calculations according to significant digits rules.
11. Convert measurements using dimensional analysis.
12. Use graphing calculators to solve chemistry problems.
13. Read a measurement from a graduated scale, stating measured digits plus the estimated digit.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 3]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

REMEDIATION:

Class Notes
Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
Small Lab Group Participation
Reinforcement Videos and Animations
Computer Simulation/Modeling Projects
Web-based Reinforcement Activities
Cooperative Learning Groups
Peer Tutoring
Individualized Assistance
Small Group Assistance
Review Games
Content Review

ENRICHMENT:

Class Presentations
Project-Based Assignments
Online Research
Group Discussions
Online Review Games
Independent Investigations
Individualized Teacher Support
Peer Tutoring
Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 3: Section 1: Atoms and Atomic Structure	TIMEFRAME: ~15 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:

3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:

3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy

3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

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.

3.2.C.A4.

- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.

- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes

3.2.10.A5.

- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.

- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.

- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry

- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

Module A – STRUCTURE and PROPERTIES of MATTER

CHEM.A.1 – Properties and Classification of Matter

- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
  - Classify physical or chemical changes within a system in terms of matter and/or energy.
  - Classify observations as qualitative and/or quantitative.
  - Utilize significant figures to communicate the uncertainty in a quantitative observation.
  - Relate the physical properties of matter to its atomic or molecular structure.
  - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
  - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).
  - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
  - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
  - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
  - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - Determine the empirical and molecular formulas of compounds.
  - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - Relate the percent composition and mass of each element present in a compound.

- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - Explain how atoms combine to form compounds through ionic and covalent bonding.
  - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - Describe the roles of limiting and excess reactants in chemical reactions.
  - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Explain the emergence of modern theories based on historical development. For example, students should be able to explain the origin of the atomic theory beginning with the Greek atomists and continuing through the most modern quantum models.
   - Discovery of atom, theory of atom, parts of an atom (proton, electron, neutrons, nucleus, electron clouds, and energy levels)
   - Important scientists to include (Democritus, John Dalton, JJ Thomson, Lord Kelvin, Ernest Rutherford, James Chadwick, Niels Bohr, Erwin Schrödinger, Werner Heisenberg, Otto Hahn, and Robert Oppenheimer.
   - Crooke's tubes/cathode rays, gold foil experiment, plum pudding experiment, energy levels.
2. Explain Dalton's Atomic Theory and its importance to the atom
   - All elements are composed of tiny indivisible particles called atoms
   - Atoms of the same elements are identical.
   - Atoms of different elements are different.
   - Atoms can physically mix together or chemically combine in simple-whole number ratios to form compounds.
   - Chemical reactions occur when atoms are separated, joined, or rearranged.
3. Define atom
   - An atom is the smallest particle of an element that retains the chemical properties of that element.
   - All atoms are made of a nucleus containing protons and neutrons; and an electron cloud where electrons move around the nucleus.
4. List the properties of protons, neutrons, and electrons and compare the three subatomic particles in terms of location in the atom, mass, and relative charge
   - Electron Cloud – negatively charged, has little mass, but contains the largest volume of an atom.
   - Electron – has little mass and is negatively charged. They are located outside the nucleus in the electron cloud/orbitals.

- Nucleus - positively charged, dense central portion of an atom that contains nearly all the atom's mass but takes up a very small fraction of it volume. It contains the protons and neutrons.
- Proton- subatomic particle of the nucleus that has a positive charge.
- Neutron – subatomic particle of the nucleus that has no charge.
- Protons and neutrons are located in the nucleus of the atom and comprise most of its mass.

5. Explain isotopes
    - An isotope is an atom that has the same number of protons as another atom of the same element but has a different number of neutrons. Some isotopes are radioactive; many are not.
    - Half-life is the length of time required for half of a given sample of a radioactive isotope to decay.
    - Identifying an isotope requires knowing either the name, atomic number/protons of the element, or mass of the isotope.
6. Define atomic number, average atomic mass, and mass number
    - The atomic number of an element is the number of protons of each atom of that element. In a neutral atom, the number of electrons is the same as the number of protons. All atoms of an element have the same number of protons.
    - The mass number is the total number of protons and neutrons that make up the nucleus of an isotope.
    - The average atomic mass for each element is the weighted average of that element's naturally occurring isotopes.
    - The mass number of an element is the sum of the number of protons and neutrons. It is different for each element's isotopes.
7. Calculate the average atomic mass of an element in relation to isotopes, relative atomic mass, and percent abundance of isotopes.
8. Describe electron configurations, and valence electrons
    - Electron configuration is the arrangement of electrons around the nucleus of an atom based on their energy level.
    - Electrons are added one at a time to the lowest energy levels first (Aufbau Principle). Electrons occupy equal-energy orbitals so that a maximum number of unpaired electrons results (Hund's Rule).
    - Energy levels are designated 1–7. Orbitals are designated s, p, d, and f according to their shapes and relate to the regions of the Periodic Table. An orbital can hold a maximum of two electrons (Pauli Exclusion Principle).
    - Atoms can gain, lose, or share electrons within the outer energy level.
    - Loss of electrons from neutral atoms results in the formation of an ion with a positive charge (cation). Gain of electrons by a neutral atom results in the formation of an ion with a negative charge (anion)
    - Lewis dot diagrams are used to represent valence electrons in an element. Structural formulas show the arrangements of atoms and bonds in a molecule and are represented by Lewis dot structures.

ACTIVITIES:

1. Determine the atomic number, atomic mass, the number of protons, and the number of electrons of any atom of a particular element using a periodic table.
2. Determine the number of neutrons in an isotope given its mass number.
3. Perform calculations to determine the "weighted" average atomic mass.
4. Differentiate between the major atom components (proton, neutron and electron) in terms of location, size, and charge.
5. Relate the position of an element on the periodic table to its electron configuration.
6. Determine the number of valence electrons and possible oxidation numbers from an element's electron configuration.
7. Write the electron notations for the first 20 elements of the periodic table.
8. Identify key contributions of principal scientists including:
    a. Atomos, initial idea of atom – Democritus
    b. First atomic theory of matter, solid sphere model – John Dalton
    c. Discovery of the electron using the cathode ray tube experiment, plum pudding model – J. J. Thomson
    d. Discovery of the nucleus using the gold foil experiment, nuclear model – Ernest Rutherford
    e. Discovery of charge of electron using the oil drop experiment – Robert Millikan
    f. Energy levels, planetary model – Niels Bohr
    g. Periodic table arranged by atomic mass – Dmitri Mendeleev
    h. Periodic table arranged by atomic number – Henry Moseley

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 4 and 5]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

REMEDIATION:

Class Notes
Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
Small Lab Group Participation
Reinforcement Videos and Animations
Computer Simulation/Modeling Projects
Web-based Reinforcement Activities
Cooperative Learning Groups
Peer Tutoring
Individualized Assistance
Small Group Assistance
Review Games
Content Review

ENRICHMENT:

Class Presentations
Project-Based Assignments
Online Research
Group Discussions
Online Review Games
Independent Investigations
Individualized Teacher Support
Peer Tutoring
Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 3: Section 2: Nuclear Chemistry	TIMEFRAME: ~5 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:

3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:

3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy

3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes

3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

Module A – STRUCTURE and PROPERTIES of MATTER

CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).

  - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
  - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
  - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
  - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - Determine the empirical and molecular formulas of compounds.
  - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - Explain how atoms combine to form compounds through ionic and covalent bonding.
  - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - Describe the roles of limiting and excess reactants in chemical reactions.
  - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.

- Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
- Balance chemical equations by applying the Law of Conservation of Matter.

- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Explain isotopes
   - An isotope is an atom that has the same number of protons as another atom of the same element but has a different number of neutrons. Some isotopes are radioactive; many are not.
   - Half-life is the length of time required for half of a given sample of a radioactive isotope to decay.
   - Identifying an isotope requires knowing both the name or atomic number of the element and mass of the isotope
2. Describe the relationship between unstable nuclei and radioactive decay
   - Radioactive atoms emit radiation because their nuclei are unstable. Unstable atoms gain stability by losing energy.
   - Radioactive decay is a spontaneous process where unstable nuclei lose energy by emitting radiation
   - The primary factor in determining an atom's stability is its ratio of neutrons to protons. Atoms that contain either too many or too few neutrons are unstable and lose energy through radioactive decay to form a stable nucleus
3. Identify the three main types of radioactive decay and compare their properties
   - Alpha radiation- Charge of 2+ (attracted to negatively charged plate)
   - Beta radiation- Charge 1- (attracted to positively charged plate)
4. Gamma radiation- No charge (neutral) Explain how elements differ from compounds
   - An element is a pure substance that cannot be separated into simpler substances by physical or chemical means.
   - On Earth, over 90 elements occur naturally
   - Each element has a unique chemical name and symbol.
   - An element's chemical symbol consists of one, two or three letters; the first letter is always capitalized and the remaining letter(s) are always lowercase
   - A compound is made up of two or more different elements that are combined chemically.
   - Compounds can be broken down into simpler substances by chemical means.
   - The properties of a compound are different from those of its component elements.
5. Calculate various half –life word problems
   - Determine half-life of the reactant: Set up half-life table and divide sample by two.
   - Calculate half-life: Divide time by half-life time.
   - Calculate product produced: Take starting sample and subtract final sample from it.
6. Discuss nuclear fission, nuclear fusion, and transmutations.
   - Nuclear fission is the splitting of a nucleus into smaller fragments, accompanied by the release of neutrons and a large amount of energy.
   - Nuclear fusion is the process of combining nuclei to produce a nucleus of greater mass.
   - Transmutation is the conversion of an atom of one element to an atom of another element.
7. Write the seven nuclear decays for transmutations.
   - Alpha decay

     $${}^{A}_{Z}X \Rightarrow {}^{4}_{2}He + {}^{A-4}_{Z-2}X_n$$

   - Beta decay

     $${}^{A}_{Z}X \Rightarrow {}^{0}_{-1}e + {}^{A}_{Z+1}X_n$$

   - Alpha decay with photon of light

     $${}^{A}_{Z}X \Rightarrow {}^{4}_{2}He + {}^{A-4}_{Z-2}X_n + {}^{0}_{0}\gamma$$

   - Positron production

$$^{A}_{Z}X \Rightarrow {}^{0}_{1}e + {}^{A}_{Z-1}X_n$$

- Electron capture with photon of light

$$^{A}_{Z}X + {}^{0}_{-1}e \Rightarrow {}^{A}_{Z-1}X_n + {}^{0}_{0}\gamma$$

- Alpha kicks neutron

$$^{A}_{Z}X + {}^{4}_{2}He \Rightarrow {}^{A+3}_{Z+2}X_n + {}^{1}_{0}n$$

- Neutron kicks electron

$$^{A}_{Z}X + {}^{1}_{0}n \Rightarrow {}^{A+1}_{Z+1}X_n + {}^{0}_{-1}e$$

ACTIVITIES:

1. Perform calculations involving the half-life of a radioactive substance.
2. Explore half-life through a penny lab activity
3. Model half-life through a penny lab activity.
4. Graph half-life through a set of data obtained in lab or half-life calculations.
5. Differentiate between alpha, beta, and gamma radiation with respect to mass, symbol, penetrating power, shielding, and composition.
6. Define, explain, model, and compare/contrast nuclear fusion, nuclear fission, and transmutation.
7. Write the seven nuclear decays (alpha, beta, alpha with photon, positron, electron capture, alpha kicks neutron, and neutron kicks electron) for elements.
8. Differentiate between the major atom components (proton, neutron and electron) in terms of location, size, and charge.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 25]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
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ENRICHMENT:

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Online Review Games
Independent Investigations

	Individualized Teacher Support Peer Tutoring Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 4: Section 1: Periodic Table Properties	TIMEFRAME: ~10 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:
3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:
3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy
3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions
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.

3.2.C.A4.

- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.

- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes

3.2.10.A5.

- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.

- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.

- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry

- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>

CHEM.A.1 – Properties and Classification of Matter

- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving,

dissociating).
  - o Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
  - o Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
  - o Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
  - o Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - o Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - o Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - o Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - o Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - o Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - o Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - o Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - o Determine the empirical and molecular formulas of compounds.
  - o Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - o Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - o Explain how atoms combine to form compounds through ionic and covalent bonding.
  - o Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - o Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - o Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - o Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - o Describe the roles of limiting and excess reactants in chemical reactions.
  - o Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - o Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.

  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Use a periodic table to name elements, given their symbols and to write the symbols of elements, given their names
   - Each element has a unique symbol.
   - Element symbols are often related to the English (modern) names of elements; however, some symbols are derived from the element's older names which were often in Latin or German
2. Describe the arrangement of the periodic table
   - The periodic table is arranged in order of increasing atomic numbers
   - Columns on the table represent groups or families of elements that have similar chemical properties.
   - The Periodic Law states that when elements are arranged in order of increasing atomic numbers, their physical and chemical properties show a periodic pattern
   - Periodicity is regularly repeating patterns or trends in the chemical and physical properties of the elements arranged in the periodic table.
   - The names of groups and periods on the periodic chart are alkali metals, alkaline earth metals, transition metals, halogens, and noble gases.
   - Metalloids have properties of metals and nonmetals. They are located between metals and nonmetals on the periodic table. Some are used in semiconductors.
3. Describe the periodic trends of the elements on the periodic table.
   - Periods and groups are named by numbering columns and rows. Horizontal rows called periods have predictable properties based on an increasing number of electrons in the outer energy levels. Vertical columns called groups or families have similar properties because of their similar valence electron configurations.
   - Atomic radius is the measure of the distance between radii of two identical atoms of an element. Atomic radius decreases from left to right and increases from top to bottom within given groups.
   - Electronegativity is the measure of the attraction of an atom for electrons in a bond. Electronegativity increases from left to right within a period and decreases from top to bottom within a group.
   - Shielding effect is constant within a given period and increases within given groups from top to bottom
   - Ionization energy is the energy required to remove the most loosely held electron from a neutral atom. Ionization energies generally increase from left to right and decrease from top to bottom of a given group
4. List the characteristics that distinguish metals, nonmetals, metalloids and noble gases
   - Metals tend to be shiny, malleable, and ductile and tend to be good conductors. At room temperature, most metals are solids.
   - Nonmetals tend to be brittle and tend to be poor conductors. Many nonmetals are gases at room temperature.
   - Metalloids have some characteristics of metals and some characteristics of nonmetals. They tend to be semiconductors of electricity.
   - The noble gases are located in group 18 of the periodic table. These elements are generally unreactive

ACTIVITIES:

1. Distinguish between a group and a period.
2. Identify key groups, periods, and regions of elements on the periodic table.
3. Identify solids, liquids, and gases on the periodic table.
4. Identify metals, nonmetals, and metalloids on the periodic table.
5. Compare and contrast metals, nonmetals, and metalloids.
6. Discuss and identify the different periodic table families.
7. Identify and explain trends in the periodic table as they relate to ionization energy, electronegativity, shielding effect, and relative sizes.
8. Compare an element's reactivity to the reactivity of other elements in the table.
9. Determine the number of valence electrons and possible oxidation numbers from an element's electron configuration.
10. Distinguish between physical and chemical properties of metals and nonmetals.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 6]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
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Group Discussion
Small Lab Group Participation
Reinforcement Videos and Animations
Computer Simulation/Modeling Projects
Web-based Reinforcement Activities
Cooperative Learning Groups
Peer Tutoring
Individualized Assistance
Small Group Assistance
Review Games
Content Review

ENRICHMENT:

Class Presentations
Project-Based Assignments
Online Research
Group Discussions
Online Review Games
Independent Investigations
Individualized Teacher Support
Peer Tutoring
Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 4: Section 2: Chemical Bonding	TIMEFRAME: ~10 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:
3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:
3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy
3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions
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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes
3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>
CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
  - Classify physical or chemical changes within a system in terms of matter and/or energy.
  - Classify observations as qualitative and/or quantitative.
  - Utilize significant figures to communicate the uncertainty in a quantitative observation.
  - Relate the physical properties of matter to its atomic or molecular structure.
  - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
  - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).

  - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
  - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
  - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
  - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - Determine the empirical and molecular formulas of compounds.
  - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - Explain how atoms combine to form compounds through ionic and covalent bonding.
  - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - Describe the roles of limiting and excess reactants in chemical reactions.
  - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single

replacement, double replacement, combustion).
    - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
    - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
    - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Define chemical bonding
    - A chemical bond is a mutual electrical attraction between the nuclei and valence electrons of different atoms that binds the atoms together
    - Bonds form between atoms to achieve stability
2. Define ion, anion and cation
    - An ion is an atom, radical, or molecule that has gained or lost one or more electrons and has a negative or positive charge
    - Anion-an ion with a negative charge
    - Cation-an ion with a positive charge
    - Elements with low ionization energy form positive ions (cations) easily
    - Elements with high ionization energy form negative ions (anions) easily
3. Describe the Octet Rule
    - Atoms react by gaining or losing electrons so as to acquire the stable electron structure of a noble gas, usually eight valence electrons
    - Atoms of metals tend to lose their valence electrons, leaving a complete octet in the next-lowest energy level.
    - Atoms of some non-metals tend to gain electrons or to share electrons with another non-mental to achieve a complete octet
4. Explain how ionic bonds, covalent bonds and metallic are formed
    - Covalent bonds involve the sharing of electrons between atoms
    - Ionic bonds involve the transfer of electrons between ions.
    - Metallic bonding is generally viewed as the result of the mutual sharing of many electrons by many atoms. Each atom contributes its valence electrons to a region surrounding the atoms. These electrons are then free to move about the mostly vacant outer orbitals of all the metal atoms. The mobile electrons are often referred to as an electron sea
5. Classify bonding type according to electronegativity
    - Electronegativity is the ability of an atom of an element to attract electrons when the atom is in a compound. In general, electronegativity values tend to increase from left to right across a period
    - The degree to which bonding between atoms of two elements is ionic or covalent can be estimated by calculating the difference in the element's electronegativity
    - A large difference in electronegativity between two atoms in a bond will result in ionic bonding
    - A small difference in electronegativity between two atoms will result in covalent bonding
6. Explain how a polar covalent bond differs from a nonpolar covalent bond
    - A polar-covalent bond is a covalent bond in which the bonded atoms have an unequal attraction for the shared electrons
    - A nonpolar-covalent bond is a covalent bond in which the bonding electrons are shared equally by the bonded atoms resulting in a balanced distributions of electrical charge
    - Polar bonds form between elements with very different electronegativity
    - Non-polar bonds form between elements with similar electronegativity
7. Explain how the VSEPR theory is used to classify molecules
    - The shapes of molecules are classified based on the number of bonding electron pairs and lone pairs that surround a molecule's central atom

ACTIVITIES:

1. Determine if a compound is ionic or covalent.
2. Compare and contrast ionic and covalent bonding.
3. Discuss how valence electrons transfer in ionic bonds.
4. Discuss how valence electrons are shared in covalent bonds.
5. Discuss how chemical bonding occurs according to the octet rule as it applies to metals and nonmetals when they bond.
6. Discuss, explain, identify, and label ionic, metallic, and covalent bonding.
7. Predict, draw, and name molecular shapes (bent, linear, trigonal planar, tetrahedral, and trigonal pyramidal).
8. Draw Lewis dot diagrams to represent valence electrons in elements and draw Lewis dot structures to show covalent bonding.
9. Use valence shell electron pair repulsion (VSEPR) model to draw and name molecular shapes (bent, linear, trigonal planar, tetrahedral, and trigonal pyramidal).
10. Recognize polar molecules and non-polar molecules.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 7 and 8]**
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Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

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Class Notes
Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
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POCONO MOUNTAIN SCHOOL DISTRICT

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UNIT 5: Section 1: Nomenclature	**TIMEFRAME: ~10 days**

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- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

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- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
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- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
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    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).

- Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
- Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
- Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
- Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - Determine the empirical and molecular formulas of compounds.
  - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - Explain how atoms combine to form compounds through ionic and covalent bonding.
  - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - Describe the roles of limiting and excess reactants in chemical reactions.
  - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.

  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Explain chemical names and formulas for ionic compounds
   - A positive ion is identified as a cation.
   - A negative ion is identified as an anion.
   - A positive or negative ionic group is identified as a polyatomic ion.
   - A positive monatomic ion is identified by the name of the appropriate element.
   - A positive ion that has more than one change is identified by the name of the appropriate element followed by a roman numeral to designate the charge on the element.
   - A negative monatomic ion is named by dropping parts of the ending of the elements name and adding *–ide* to the root.
   - The charge of each ion in an ionic compound may be used to determine the simplest chemical formula for the compound.
   - Binary compounds are composed of two elements.
   - Binary ionic compounds are named by combining the names of the positive and negative ions.
   - Ionic compounds are named by combining the names of the cation and anion. The cation and anion may be a polyatomic ion.
2. Writing and naming acids
   - Acid naming rules depends on the anion of the acid
     - Ide Anion: Write hydro + anion – ide + ic Acid
     - Ate Anion: Anion – ate + ic Acid
     - Ite Anion: Anion – ite + ous Acid
   - Writing acid rules
     - All acids start with a hydrogen ion.
     - Write the anion based on the name of the acid.
     - Balance the charges as subscripts.
3. Writing and naming molecular formulas
   - Molecular naming rules
     - First Greek prefix (never mono) + first element + second Greek prefix + second element by dropping parts of the ending of the element name and adding *–ide* to the root.
     - Greek prefixes: mono = 1, di = 2, tri = 3, tetra = 4, penta = 5, hexa = 6, hepta = 7, octa = 8, nona = 9, deca = 10.
   - Writing molecular formulas
     - Write the first element.
     - Write the first Greek prefix as a subscript after the first element.
     - Write the second element.
     - Write the second Greek prefix as a subscript after the second element.
4. Determine chemical formulas
   - Chemical formulas are used to represent compounds.
   - A chemical formula indicates the relative numbers of atoms of each kind in a chemical compound by using atomic symbols and numerical subscripts.
   - An empirical formula shows the simplest whole-number ratio of atoms in a given compound
   - Empirical formulas indicate how many atoms of each element are combined in the simplest unit of a chemical compound
   - A molecular formula shows the types and numbers of atoms in a single molecule of a molecular compound
   - A molecular formula can be found from the empirical formula if the molar mass is measured

ACTIVITIES:
1. Balance cation and anion charges to write ionic compounds.
2. Name ionic compounds by naming the cation and anion.
3. Balance hydrogen ion with an anion to write an acid formula.
4. Name acid compound by using the acid rules for naming the anions.
5. Write the molecular compound based on the elements and subscripts in the compound.
6. Name molecular compounds using Greek prefixes and naming rule.

RESOURCES:
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Web Resources:
https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

ASSESSMENTS:
ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

REMEDIATION:
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Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
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POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 5: Section 2: Chemical Reactions	TIMEFRAME: ~20 days

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- Compare and contrast the unique properties of water to other liquids.

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3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy

3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes
3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>
CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving,

dissociating).
    - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
    - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
    - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
    - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
    - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
    - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
    - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
    - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
    - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
    - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
    - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
    - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
    - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
    - Determine the empirical and molecular formulas of compounds.
    - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
    - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
    - Explain how atoms combine to form compounds through ionic and covalent bonding.
    - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
    - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
    - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
    - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
    - Describe the roles of limiting and excess reactants in chemical reactions.
    - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
    - Classify reactions as synthesis, decomposition, single replacement, double replacement, or

combustion.
  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Determine chemical formulas
   - Chemical formulas are used to represent compounds.
   - A chemical formula indicates the relative numbers of atoms of each kind in a chemical compound by using atomic symbols and numerical subscripts.
   - An empirical formula shows the simplest whole-number ratio of atoms in a given compound
   - Empirical formulas indicate how many atoms of each element are combined in the simplest unit of a chemical compound
   - A molecular formula shows the types and numbers of atoms in a single molecule of a molecular compound
   - A molecular formula can be found from the empirical formula if the molar mass is measured
2. Describing chemical reactions
   - Chemical reactions can be written from word equations by writing the chemical compounds.
   - Skeleton equations are equations that are written with the chemical compounds where the equation is not balanced with coefficients
   - Equations are balanced with coefficients when the reactants equal the products.
   - Chemical reactions can be classified into five types: synthesis, decomposition, single replacement, double replacement, and combustion reactions.
   - Based on the reactants, the type of chemical reactions can predict the chemical products.
   - The solubility of the chemical compound will determine if the compound is solid, liquid, gas, or aqueous.
   - Net ionic equations can be written based on the solubility of the compounds in the chemical reaction.

ACTIVITIES:

1. Balance cation and anion charges to write ionic compounds
2. Name ionic compounds
3. Name and write the formula for acid compounds.
4. Name and write the formula for molecule compounds.
5. Explain the law of the conservation of mass, definite proportions, and multiple proportions
6. Balance the chemical reaction.
7. Explore balancing equations.
8. Label the parts of a chemical reaction.
9. Discuss and identify the five types of chemical reactions (synthesis, decomposition, single replacement, double replacement, and combustion).
10. Write and predict the products for the five types of chemical reactions (synthesis, decomposition, single replacement, double replacement, and combustion).
11. Explore the five types of chemical reactions (synthesis, decomposition, single replacement, double replacement, and combustion).

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

12. Determine the solubility of each compound by following the solubility rules. 13. Write net ionic equations. **RESOURCES:** 1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 11]** 2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc). **Web Resources:** https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true http://streaming.discoveryeducation.com/ http://www.studyisland.com/web/index/ http://www.khanacademy.org/ http://www.teachertube.com/ http://www.sciencegeek.net/ http://www.webelements.com/ http://www.chemmybear.com/ http://www.ck12.org/chemistry/	**REMEDIATION:** Class Notes Graphic Organizers Chunking of Information Oral Questioning Group Discussion Small Lab Group Participation Reinforcement Videos and Animations Computer Simulation/Modeling Projects Web-based Reinforcement Activities Cooperative Learning Groups Peer Tutoring Individualized Assistance Small Group Assistance Review Games Content Review **ENRICHMENT:** Class Presentations Project-Based Assignments Online Research Group Discussions Online Review Games Independent Investigations Individualized Teacher Support Peer Tutoring Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 6: Section 1: Chemical Quantities and Stoichiometry	TIMEFRAME: ~30 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:
3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:
3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy
3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions
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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes
3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>
CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
  - Classify physical or chemical changes within a system in terms of matter and/or energy.
  - Classify observations as qualitative and/or quantitative.
  - Utilize significant figures to communicate the uncertainty in a quantitative observation.
  - Relate the physical properties of matter to its atomic or molecular structure.
  - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
  - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).
  - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can

be separated).
    - o Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
    - o Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
    - o Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
    - o Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
    - o Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
    - o Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
    - o Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
    - o Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
    - o Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
    - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
    - o Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
    - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
    - o Determine the empirical and molecular formulas of compounds.
    - o Apply the law of definite proportions to the classification of elements and compounds as pure substances.
    - o Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
    - o Explain how atoms combine to form compounds through ionic and covalent bonding.
    - o Classify a bond as being polar covalent, nonpolar covalent, or ionic.
    - o Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
    - o Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
    - o Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
    - o Describe the roles of limiting and excess reactants in chemical reactions.
    - o Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
    - o Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
    - o Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).

- Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Determine chemical formulas
   - Chemical formulas are used to represent compounds.
   - A chemical formula indicates the relative numbers of atoms of each kind in a chemical compound by using atomic symbols and numerical subscripts.
   - An empirical formula shows the simplest whole-number ratio of atoms in a given compound
   - Empirical formulas indicate how many atoms of each element are combined in the simplest unit of a chemical compound
   - A molecular formula shows the types and numbers of atoms in a single molecule of a molecular compound
   - A molecular formula can be found from the empirical formula if the molar mass is measured
2. Calculate the formula mass, molar mass and percent composition of any given compound
   - Formula mass, molar mass, and percentage composition can be calculated from the chemical formula for a compound
   - The formula mass of any molecule, formula unit, or ion is the sum of the average atomic masses of all atoms represented in its formula
   - The molar mass of a compound is calculated by summing the masses of the elements present in a mole of the molecules or formula units that make up the compound.
   - A compound's molar mass is numerically equal to its formula mass
   - Molar mass is used as a conversion factor between amount in moles and mass in grams of a given compound or element
   - The percentage composition of a compound is the percentage by mass of each element in the compound
   - To calculate the percentage of an element in a compound determine how many grams of the element are present in one mole of the compound then divide this value by the molar mass of the compound and multiply by 100
3. Describing chemical reactions
   - Chemical reactions can be written from word equations by writing the chemical compounds.
   - Skeleton equations are equations that are written with the chemical compounds where the equation is not balanced with coefficients
   - Equations are balanced with coefficients when the reactants equal the products.
   - Chemical reactions can be classified into five types: synthesis, decomposition, single replacement, double replacement, and combustion reactions.
   - Based on the reactants, the type of chemical reactions can predict the chemical products.
   - The solubility of the chemical compound will determine if the compound is solid, liquid, gas, or aqueous.
   - Net ionic equations can be written based on the solubility of the compounds in the chemical reaction.
4. The Arithmetic of Equations with Stoichiometry
   - Balanced chemical equations apply to both chemistry and everyday life.
   - Balance chemical equations can be interpreted in terms of moles, representative particles, mass, and gas volume at STP.
   - Chemical quantities are always conserved in chemical reactions due to the law of conservation of matter/mass.
   - Mole ratios from balanced chemical equations can be applied in stoichiometric calculations.
   - Stoichiometric quantities from balanced chemical equations can be used to determine units of moles, mass, representative particles, and volumes of gases at STP.
   - Limiting reactants (reagents that are used up) and excess reactants (reagents that remain) can be calculated through stoichiometry.
   - Theoretical yield, actual yield, and percent yield can be calculated through stoichiometry.

ACTIVITIES:

1. Calculate the molar mass for each compound.
2. Calculate the percent composition for each element in the compound.
3. Calculate and write the empirical formula for compounds.
4. Perform conversions between mass, volume, particles, and moles of a substance.
5. Calculate mole to mass, mass to mole, mole to atom, atom to mole, atom to mass, and mass to atom problems.
6. Perform and calculate stoichiometric calculations involving the following relationships:
    - mole-mole
    - mass-mass
    - mole-mass
    - mass-volume
    - mole-volume
    - volume-volume
    - mole-particle
    - mass-particle
    - volume-particle
7. Identify the limiting reactant (reagent) in a reaction.
8. Identify the excess reactant (reagent) in a reaction.
9. Calculate limiting and excess reactants.
10. Calculate percent yield of a reaction.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 10 and 12]**

2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

REMEDIATION:

Class Notes
Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
Small Lab Group Participation
Reinforcement Videos and Animations
Computer Simulation/Modeling Projects
Web-based Reinforcement Activities
Cooperative Learning Groups
Peer Tutoring
Individualized Assistance
Small Group Assistance
Review Games
Content Review

ENRICHMENT:

Class Presentations
Project-Based Assignments
Online Research
Group Discussions
Online Review Games
Independent Investigations
Individualized Teacher Support
Peer Tutoring
Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 7: Section 1: Solutions	TIMEFRAME: ~10 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:

3.2.10.A1.

- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.

- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.

- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:

3.2.10.A2.

- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.

- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.

- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy

3.2.10.A3

- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.

- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.

- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions

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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes
3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

Module A – STRUCTURE and PROPERTIES of MATTER
CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving,

dissociating).
  - o Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
  - o Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
  - o Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
  - o Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - o Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - o Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - o Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - o Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - o Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - o Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - o Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - o Determine the empirical and molecular formulas of compounds.
  - o Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - o Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - o Explain how atoms combine to form compounds through ionic and covalent bonding.
  - o Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - o Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - o Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - o Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - o Describe the roles of limiting and excess reactants in chemical reactions.
  - o Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - o Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.

  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Describe properties of solutions
   - Solutions are homogeneous mixtures; any mixture that is homogeneous on a microscopic level is a solution. However, most people using the term solution are referring to a liquid mixture.
   - Mixtures are classified as solutions, suspensions, or colloids depending on the size of the solute particles in the mixture.
   - The primary ingredient in a solution is called the solvent, and the other ingredients are the solutes which is the dissolved substance.
   - Solution in which water is the solvent are called aqueous solutions.
   - Solutions can consist of solutes and solvents that are solids, liquid, or gases.
   - Suspensions settle out upon standing.
   - Colloid is a mixture consisting of tiny particles that are intermediate in size between those in solutions and those in suspensions and that are suspended in a liquid, solid or gas.
   - Most ionic solutes and some molecular solutes form aqueous solutions that conduct an electric current. These solutes are call electrolytes.
   - Nonelectrolytes are solutes that dissolve in water to form solutions that do not conduct electric current.
2. Explain the factors that affect rate of at which a solid solute dissolves in a liquid solution
   - A solute dissolves at a rate that depends on the surface area of the solute, how vigorously the solution is mixed, and the temperature of the solvent.
   - The solubility of a substance indicates how much of that substance will dissolve in a specified amount of solvent under certain conditions.
   - The solubility of a substance depends on the temperature.
   - The solubility of gases in liquids increases with increases in pressure and deceases with increases in temperature.
   - The overall energy absorbed as heat by the system when a specified amount of solute dissolved during solution formation is called the enthalpy of solution.
3. Calculate solution concentration using common units
   - Concentrations can be expressed in many forms including molarity (M), molality (*m*), dilutions, and parts per million (ppm).
   - Molarity is a concentration unit of a solution expressed as moles of solute dissolved per liter of solution. This application would be appropriate in solution stoichiometry calculations.
   - To calculate the molarity of a solution, divide the moles of solute by the volume of the solution in liters.
   - The molal concentration of a solution represents the ratio of moles of solute to kilograms of solvent.
   - Diluting a solution does not change the total number of moles of solute in solution. $M_1V_1=M_2V_2$.
   - The concentration of a solution in percent is the ratio of the volume of the solute to the volume of the solution times 100% or the ratio of the mass of the solute to the mass of the solution times 100%.
   - The concentration of a solution is the amount of a particular substance in a given quantity of solution.
   - Dilute indicates that there is a relatively small amount of solute in a solvent.
4. Explain solution equilibrium and distinguish among saturated, unsaturated and supersaturated solutions
   - Solution equilibrium is the physical state in which the opposing processes of dissolution and crystallization of a solute occur at equal rates.
   - The solubility of a substance is the amount of solute that dissolves in a given quantity of a solute at a specified temperature and pressure to produce saturated solution.

- When a solution contains as much solute as will dissolve at a constant temperature and pressure is said to be saturated.
- A solution that has not met reached the limit of solute that will dissolve is said to be unsaturated.
- When a solid is dissolved to the saturation limit at an elevated temperature and then allowed to cool, ass the solid may remain dissolved. This type of solution is called supersaturated. A supersaturated solution is very unstable.

5. Distinguish between weak and strong electrolytes
    - Substances that yield ions and conduct electric current in solution are electrolytes.
    - Substances that do not yield ion and do not conduct an electric current in solution are nonelectrolytes.
    - A strong electrolyte is any compound whose dilute aqueous solutions conduct electricity well; this is due to the presence of all or almost the entire dissolved compound in the form of ions.
    - The distinguishing feature of strong electrolytes is that to whatever extent they dissolve in water, they yield only ions.
    - A weak electrolyte is any compound whose dilute aqueous solutions conduct electricity poorly; this is due to the presence of a small amount of the dissolved compound in the form of ions.
    - Strong and weak electrolytes differ in the degree of ionization or dissociation. Concentrated and dilute solutions differ in the amount of solute dissolved in a given quantity of a solvent.
6. Describe and perform calculation involving the Colligative Properties of Solutions
    - Colligative properties of solutions depend only on the total number of solute particles present. Boiling-point elevation, freezing-point depression, vapor-pressure lowering, and osmotic pressure are colligative properties.
    - The molal boiling-point and freezing-point constants are used to calculate boiling-point elevations and freezing-point depressions of solvents containing nonvolatile solutes.
    - Electrolytes have a greater effect on the freezing and boiling points of solvents than nonelectrolytes do.
    - Except in very dilute solutions, the values of colligative properties of electrolyte solutions are less than expected because of the attraction between ion in solution.

ACTIVITIES:

1. Understand the difference between a solute and a solvent and list them when given a solution.
2. Compare the properties of suspensions, colloids, and solutions.
3. Distinguish between electrolytes and nonelectrolytes.
4. List and explain three factors that affect the rate at which a solid solute dissolves in a liquid solvent.
5. Distinguish between saturated, unsaturated, and supersaturated solutions.
6. Explain the meaning of "like dissolves like" in terms of polar and non-polar substances.
7. Compare the effects of temperature and pressure on solubility.
8. Define molarity, molality, and dilutions.
9. Describe how a solute affects the freezing point and boiling point of a solution.
10. Given the mass of a solute and volume of a solvent, calculate the concentration of a solution.
11. Calculate the volume to which a sample of a given concentration should be diluted to prepare a solution of a known molarity.
12. Perform conversions between mass, volume, particles, and moles of a substance.
13. Perform stoichiometric calculations involving

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

REMEDIATION:

Class Notes
Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
Small Lab Group Participation

the following relationships:

- mole-mole
- mass-mass
- mole-mass
- mass-volume
- mole-volume
- volume-volume
- mole-particle
- mass-particle
- volume-particle

14. Identify the limiting reactant (reagent) in a reaction.
15. Calculate percent yield of a reaction.
16. Perform calculations involving the molarity of a solution, including dilutions.
17. Interpret solubility curves.
18. Use solubility curves to distinguish among saturated, supersaturated and unsaturated solutions.
19. Calculate the prepared concentration and the standard concentration for a given solution.
20. Determine the concentration at saturation from a solubility graph.
21. Determine if the solution is saturated or unsaturated through data and the solubility graph.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 16]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

Reinforcement Videos and Animations
Computer Simulation/Modeling Projects
Web-based Reinforcement Activities
Cooperative Learning Groups
Peer Tutoring
Individualized Assistance
Small Group Assistance
Review Games
Content Review

ENRICHMENT:

Class Presentations
Project-Based Assignments
Online Research
Group Discussions
Online Review Games
Independent Investigations
Individualized Teacher Support
Peer Tutoring
Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	**GRADE(S): 10-12**
UNIT 7: Section 2: Acids and Bases	**TIMEFRAME: ~10 days**

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:
3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:
3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy
3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions
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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes
3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

Module A – STRUCTURE and PROPERTIES of MATTER
CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).
    - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can

be separated).
    - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
    - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
    - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table
- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
    - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
    - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
    - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
    - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
    - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
    - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
    - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
    - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>
CHEM.B.1 – The Mole and Chemical Bonding
- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
    - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
    - Determine the empirical and molecular formulas of compounds.

    - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
    - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
    - Explain how atoms combine to form compounds through ionic and covalent bonding.
    - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
    - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
    - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
    - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions
- CHEM.B.2. 1. Predict what happens during a chemical reaction.
    - Describe the roles of limiting and excess reactants in chemical reactions.
    - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
    - Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
    - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single

replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions
   - Acids are electrolytes (usually liquids or gases) that can be defined as strong or weak depending upon whether they dissociate completely or partially. Strong electrolytes dissociate completely. Weak electrolytes dissociate partially. Non-electrolytes do not dissociate.
   - According to the Arrhenius theory, acids are characterized by their sour taste, low pH, and the fact that they turn litmus paper red.
   - Bases are another class of electrolytes (usually solids) that can be defined as strong or weak. A strong base ionizes completely in a solvent and a weak base releases few hydroxide ions in aqueous solution. According to the Arrhenius theory, bases are characterized by their bitter taste, slippery feel, high pH, and the fact that they turn litmus paper blue.
   - According to the Bronsted-Lowry theory, acids are hydrogen-ion donors and bases are hydrogen-ion acceptors. A Bronsted-Lowry **acid** is a molecule or ion that is a proton donor and a Bronsted-Lowry **base** is a molecule or ion that is a proton acceptor.
   - In a Bronsted-Lowry acid-base reaction protons are transferred from one reactant (the acid) to another (the base)
2. Identify acid-base conjugate pairs
   - A conjugate acid-base pair consists of two substances related by the loss or gain of a single hydrogen ion
   - A strong acid has a weak conjugate base; a strong base has a weak conjugate acid
   - When an acid gives up its proton, what remains is called the conjugate base of that acid
   - When a base accepts a proton, the resulting chemical is called the conjugate acid of that original base
3. Explain the difference between strong and weak acids
   - A strong acid is one that ionizes completely in aqueous solution-a strong acid is a strong electrolyte
   - Among the standard acids commonly encountered in aqueous solutions, six are strong: hydrochloric acid, hydrobromic acid, hydroiodic acid; nitric acid; perchloric acid;
   - An acid that releases few hydrogen ions in aqueous solution is a weak acid- the aqueous solution of a weak acid contains hydronium ions, anions, and dissolved acid molecules
4. Calculate the pH of strong and weak acids and bases
   - The pH of a solution can be measured using either a pH meter or acid-base indicators
   - Acid-base indicators are compounds whose colors are sensitive to pH
   - A solution in which H^+ is greater than 1×10^{-7} has a pH less than 7.0 and is acidic
   - The pH of pure water or a neutral aqueous solution is 7.0
   - A solution with a pH greater than 7 is basic and has a H^+ of less than 1×10^{-7}
   - On the pH scale, which ranges from 0 to 14, neutral solution have a pH of 7, a pH of 0 is strongly acidic and a pH of 14 is strongly basic
5. Explain how buffers work and calculate the pH of a buffer solution.
6. Explain the techniques and procedures associated with titrations and sketch titration curves.
7. Explain the way in which indicators work, and suggest suitable indicators for particular titrations.
8. Explain the hydrolysis of salts and its effect on pH.
9. Explain the meaning of the term "equivalence point".
10. Describe monoprotic, diprotic, and polyprotic acids and the acid-base properties of oxides.

ACTIVITIES:	ASSESSMENTS:
1. Define and list the properties of acids.	ATBs/Closure Activities
2. Define and list the properties of bases.	Daily Participation
3. Write and name acids and bases.	Daily Classwork
4. Compare and contrast acids and bases.	Homework
5. Explore acids and bases.	Group Discussions

6. Identify acids and bases by the formula, name, and properties. 7. Discuss and define indicators. 8. Compare and contrast indicators. 9. Explore indicators. 10. Discuss and define titrations and buffers. 11. Explore titrations and buffers. 12. Calculate various titration problems. 13. Discuss, identify, and compare/contrast Arrhenius theory with Bronsted-Lowry theory. 14. Relate pH,[H+], pOH, [OH-], and determining acid, base, and neutrals. 15. Calculate pH, [H+], pOH, and [OH-]. **RESOURCES:** 1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 19]** 2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc). **<u>Web Resources:</u>** https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true http://streaming.discoveryeducation.com/ http://www.studyisland.com/web/index/ http://www.khanacademy.org/ http://www.teachertube.com/ http://www.sciencegeek.net/ http://www.webelements.com/ http://www.chemmybear.com/ http://www.ck12.org/chemistry/	Group Projects Individual Projects Cooperative Learning Activities Model Creations Writing Prompts Reading Guides Demonstrations Lab Participation Lab Reports Online Research Group Presentations Individual Presentations Quizzes Unit Tests Final Exams **REMEDIATION:** Class Notes Graphic Organizers Chunking of Information Oral Questioning Group Discussion Small Lab Group Participation Reinforcement Videos and Animations Computer Simulation/Modeling Projects Web-based Reinforcement Activities Cooperative Learning Groups Peer Tutoring Individualized Assistance Small Group Assistance Review Games Content Review **ENRICHMENT:** Class Presentations Project-Based Assignments Online Research Group Discussions Online Review Games Independent Investigations Individualized Teacher Support Peer Tutoring Small Group Enrichment Instruction

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Chemistry	GRADE(S): 10-12
UNIT 8: Section 1: Gases and Gas Laws	TIMEFRAME: ~10 days

PA ACADEMIC SECONDARY STATE STANDARDS FOR CHEMISTRY

Properties of Matter:
3.2.10.A1.
- Predict properties of elements using trends of the periodic table
- Identify properties of matter that depend on sample size.
- Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.

3.2.C.A1.
- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electro-negativity, atomic size, and classification of elements.
- Use electro-negativity to explain the difference between polar and nonpolar
- covalent bonds

3.2.12.A1.
- Compare and contrast colligative properties of mixtures
- Compare and contrast the unique properties of water to other liquids.

Structure of Matter:
3.2.10.A2.
- Compare and contrast different bond types that result in the formation of molecules and compounds.
- Explain why compounds are composed of integer ratios of elements.

3.2.C.A2.
- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.

3.2.12.A2.
- Distinguish among the isotopic forms of elements
- Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus.
- Explain how light is absorbed or emitted by electron orbital transitions.

Matter & Energy
3.2.10.A3
- Describe phases of matter according to the kinetic molecular theory.

3.2.C.A3.
- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Identify the three main types of radioactive decay and compare their properties.
- Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope. Compare and contrast nuclear fission and nuclear fusion

3.2.12.A3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation $E=mc^2$.

Reactions
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.

3.2.C.A4.
- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

3.2.12.A4.
- Apply oxidation/reduction principles to electrochemical reactions.
- Describe the interactions between acids and bases.

Unifying Themes
3.2.10.A5.
- Describe the historical development of models of the atom and how they contributed to modern atomic theory.
- Apply the mole concept to determine number of particles and molar mass for elements and compounds.

3.2.C.A5.
- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

3.2.12.A5.
- Use VSPER theory to predict the molecular geometry of simple molecules.
- Predict the shift in equilibrium when a system is subjected to a stress.

Science as Inquiry
- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

CHEMISTRY KEYSTONE ASSESSMENT ANCHORS

<u>Module A – STRUCTURE and PROPERTIES of MATTER</u>
CHEM.A.1 – Properties and Classification of Matter
- CHEM.A.1. 1. Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.
    - Classify physical or chemical changes within a system in terms of matter and/or energy.
    - Classify observations as qualitative and/or quantitative.
    - Utilize significant figures to communicate the uncertainty in a quantitative observation.
    - Relate the physical properties of matter to its atomic or molecular structure.
    - 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).
- CHEM.A.1. 2. Compare the properties of mixtures.
    - Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving,

dissociating).
  - Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).
  - Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
  - Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).
  - Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2 – Atomic Structure and the Periodic Table

- CHEM.A.2. 1. Explain how atomic theory serves as the basis for the study of matter.
  - Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
  - Differentiate between the mass number of an isotope and the average atomic mass of an element.
- CHEM.A.2. 2. Describe the behavior of electrons in atoms.
  - Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
  - Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
  - Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
  - Relate the existence of quantized energy levels to atomic emission spectra.
- CHEM.A.2. 3. Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.
  - Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
  - Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

<u>Module B – The MOLE CONCEPT and CHEMICAL INTERACTIONS</u>

CHEM.B.1 – The Mole and Chemical Bonding

- CHEM.B.1. 1. Explain how the mole is a fundamental unit of chemistry.
  - Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).
- CHEM.B.1. 2. Apply the mole concept to the composition of matter.
  - Determine the empirical and molecular formulas of compounds.
  - Apply the law of definite proportions to the classification of elements and compounds as pure substances.
  - Relate the percent composition and mass of each element present in a compound.
- CHEM.B.1. 3. Explain how atoms form chemical bonds.
  - Explain how atoms combine to form compounds through ionic and covalent bonding.
  - Classify a bond as being polar covalent, nonpolar covalent, or ionic.
  - Use illustrations to predict the polarity of a molecule.
- CHEM.B.1. 4. Explain how models can be used to represent bonding.
  - Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball and stick models, graphical models, solid/sphere models, structural formulas, skeletal formulas, Lewis dot structures).
  - Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.B.2 – Chemical Relationships and Reactions

- CHEM.B.2. 1. Predict what happens during a chemical reaction.
  - Describe the roles of limiting and excess reactants in chemical reactions.
  - Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.
  - Classify reactions as synthesis, decomposition, single replacement, double replacement, or

combustion.
  - Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
  - Balance chemical equations by applying the Law of Conservation of Matter.
- CHEM.B.2. 2. Explain how the kinetic molecular theory relates to the behavior of gases.
  - Utilize mathematical relationships to predict changes in the number of particles, the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's law, Charles's law, Dalton's law of partial pressures, the combined gas law, and the ideal gas law).
  - Predict the amounts of reactants and products involved in a chemical reaction using molar volume of a gas at STP.

UNIT OBJECTIVES:

1. Use kinetic molecular theory (KMT) to explain rates of reactions and the relationships among temperature, pressure, and volume of a substance.
   - KMT is a model for predicting and explaining gas behavior.
   - Gases have mass and occupy space. Gas particles are in constant, rapid, random motion and exert pressure as they collide with the walls of their containers. Gas molecules with the lightest mass travel fastest. Relatively large distances separate gas particles from each other.
   - Equal volumes of gases at the same temperature and pressure contain an equal number of particles. Pressure units include atm, kPa, and mm Hg.
   - Pressure is force per unit area. What we observe as the pressure of a gas is the force of collisions as the particles strike the walls of the container. If these collisions occur frequently, the gas pressure is high. If the collisions don't occur very often, the pressure is low. Any change in the conditions that results in more frequent collisions will increase the pressure.
   - KMT for an ideal gas states all gas particles:
     - Are in random, constant, straight-line motion:
     - Are separated by great distances relative to their size; the volume of gas particles is considered negligible
     - Have no attractive forces between them
     - Have collisions that may result in a transfer of energy between particles but the total energy of the system remains constant
   - The behavior of most gases is nearly ideal except at very high pressures and low temperatures.
   - The average kinetic energy of a gas is proportional to its absolute temperature.
2. Describe the properties of gases
   - Gases are easily compressed because of the space between particles in a gas.
   - The amount of gas (*n*), volume (*V*), and temperature (*T*) are factors that affect gas pressure (*P*).
   - The sum of the partial pressures of all the components in a gas mixture is equal to the total pressure of a gas mixture (Dalton's law of partial pressures).
   - Equal volumes of gases at the same temperature and pressure contain an equal number of particles.
3. Predict the behavior of gases though the application of laws (i.e., Ideal Gas Law, Boyle's law, Charles' law, or ideal gas law)
   - The Ideal Gas Law is the complete statement of the relations between *P,V,T*, and *n* in a quantity of a gas. The ideal gas constant (*R*) has the values of 8.31 (L• kPa)/(K•mol), 0.0821 (atm•L)/(mol•K), and 62.4 (mm Hg•L)/(mol•K). The ideal gas constant (*R*) is dependent on the value of pressure. The ideal gas law can be written as follows $P \times V = n \times R \times T$
   - Avogadro's Law states that at constant temperature and pressure, the number of moles of gas and the volume are directly proportional. "Constant temperature" means that the average speed stays the same. "Constant pressure" means that the rate at which the particles strike the wall stays the same. If the number of moles and the volume are directly proportional, an increase in the number of moles will lead to an increase in the volume. If the particles travel the same speed and hit the wall at the same rate, yet there are more particles, they must spread out more and traveling farther to reach the wall. A greater distance is the same as an increase in volume. Therefore number of particles and volume must be directly proportional. $V_1/n_1 = V_2/n_2$
   - Boyle's law states that for a given mass of gas at constant temperature, the volume of the gas varies with pressure. If the pressure and volume are inversely proportional, an increase in volume will lead to a decrease in pressure. $P_1 \times V_1 = P_2 \times V_2$
   - Charles law states that the volume of a fixed mass of gas is directly proportional to its Kelvin

temperature if the pressure is kept constant. $V_1/T_1 = V_2/T_2$

- Gay-Lussac's law states that the pressure of a gas is directly proportional to the Kelvin temperature if the volume remains constant. $P_1/T_1 = P_2/T_2$
- The Combined Gas Law ($P_1 x V_1/T_1 = P_2 x V_2/T_2$) or ($P_1 x V_1/n_1 x T_1 = P_2 x V_2/n_2 x T_2$) is a statement of the relationships among pressure, volume and temperature at constant amount of gas.

ACTIVITIES:

1. Explain the gas laws in terms of KMT
2. Solve problems, using the combined gas laws convert temperatures in Celsius degrees (°C) to kelvins (K), and kelvins to Celsius degrees
3. Describe the concentration of particles and rates of opposing reactions in an equilibrium system
4. Use collision theory to explain how various factors, such as temperature, surface area, and concentration, influence the rate of reaction
5. Solve problems and interpret graphs involving the gas laws.
6. Identify how hydrogen bonding in water plays an important role in many physical, chemical, and biological phenomena.
7. Interpret vapor pressure graphs.
8. Graph and interpret a heating curve (temperature vs. time).
9. Interpret a phase diagram of water.
10. Calculate energy changes, using molar heat of fusion and molar heat of vaporization.
11. Calculate energy changes, using specific heat capacity.
12. Calculate values by using the equations for Dalton's law, Boyle's law, Charles' law, Avogadro's law, Gay-Lussac's law, combined gas law, and ideal gas law.
13. Calculate the gas stoichiometry of certain gases.

RESOURCES:

1. Prentice Hall Chemistry text and supporting teacher resources (ISBN 0-13-251210-6) **[Chapter 14]**
2. Previously purchased Chemistry Textbooks and supporting teacher resources (World of Chemistry, Conceptual Chemistry, etc).

Web Resources:

https://www.pearsonsuccessnet.com/snpapp/login/login.jsp?showLoginPage=true
http://streaming.discoveryeducation.com/
http://www.studyisland.com/web/index/
http://www.khanacademy.org/
http://www.teachertube.com/
http://www.sciencegeek.net/
http://www.webelements.com/
http://www.chemmybear.com/
http://www.ck12.org/chemistry/

ASSESSMENTS:

ATBs/Closure Activities
Daily Participation
Daily Classwork
Homework
Group Discussions
Group Projects
Individual Projects
Cooperative Learning Activities
Model Creations
Writing Prompts
Reading Guides
Demonstrations
Lab Participation
Lab Reports
Online Research
Group Presentations
Individual Presentations
Quizzes
Unit Tests
Final Exams

REMEDIATION:

Class Notes
Graphic Organizers
Chunking of Information
Oral Questioning
Group Discussion
Small Lab Group Participation
Reinforcement Videos and Animations
Computer Simulation/Modeling Projects
Web-based Reinforcement Activities
Cooperative Learning Groups
Peer Tutoring
Individualized Assistance
Small Group Assistance
Review Games
Content Review

ENRICHMENT:

Class Presentations
Project-Based Assignments
Online Research
Group Discussions
Online Review Games
Independent Investigations
Individualized Teacher Support
Peer Tutoring
Small Group Enrichment Instruction