CHEMISTRY

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Rationale and Philosophy

In order to prepare for global competition and high expectations for all, Morris School District students must have increased opportunities for chemistry experiences that extend critical thinking and reasoning. Solving chemistry problems using algebra and is essential to developing conceptual knowledge. Chemistry is a course that provides an important entry point for this pathway to success by extending students' understanding and application of the skills, concepts, and language of Chemistry.

Key considerations:

- ***State and National Expectations***

  The 2009 New Jersey Core Curriculum Content Standards (NJCCCS) Standard 5.2 is Physical Science. This standard encompasses both Chemistry and Physics topics. While all sciences are interrelated, this district values Chemistry problem solving that goes beyond the NJCCCS. There has been great activity on the state and national level in terms of expectations for the skills, knowledge and expertise students should master in mathematics to succeed in work and life in the 21st century, and the National Research Council has published a preliminary framework for science education. The framework has four Physical Science Core Ideas matter, forces, energy transfer, and waves. There are separate engineering core ideas in the preliminary framework. The document highlights the similarities and divergence between engineering and scientific practices. Chemistry is a pure science with many real world applications. Chemistry principles can be learned through experimentation. The Chemistry curriculum will address all of the New Jersey State Expectations, and the National Framework Standards in Physical Science that are relevant to Chemistry.

- ***Equity and Access to Chemistry***

  That all students have access to chemistry is a goal of the Morris School District. Because low expectations and bias are critical elements that can have a negative impact on student learning and success, the curriculum addresses equity issues by granting all students the opportunity to learn Chemistry.

Goals and Objectives (outcomes):

Chemistry is the study of matter and how it interacts with other matter. In teaching and learning Chemistry, it is important for teachers and students to comprehend the following concepts and to establish connections and applications to real world scenarios. Concepts in physics, such as electrical forces, energy conservations in collisions are building blocks for chemistry concepts like gases and chemical kinetics. Concepts in chemistry like pH, bonding and intermolecular forces will be used to study biology.

- ***Atomic Structure and Periodic Relationships***
  Understanding of atomic structure is the basis for modern chemistry. The current model of the atom has been developed from its infancy in ancient Greece to modern quantum mechanics. Our model of understanding has changed as new experimental and theoretical evidence becomes available. Thus, atomic structure is important for two reasons. First, to provide the foundation from which we can build an understanding of molecular structure, but also to see how the a science is a dynamic process by which models of understanding are constantly reevaluated for accuracy and validity.

- ***Chemical Bonding and Intermolecular Forces***
  Matter is composed of atoms of elements, most of which are bonded in different but predictable ways. Utilizing understanding of electronic arrangements in atoms allows us to predict how they will be joined in chemical substances. This in turn, allows the prediction of three dimensional molecular geometry, and chemical and physical properties of the substance.

- ***Mathematical Relationships in Chemical Reactions***
  Molecular structure changes during chemical reactions. How matter interacts with other matter is sometimes predictable, and students can predict products of some chemical processes based on molecular structure. Students will also explore the concept that matter and therefore mass is conserved in chemical processes.

- ***States of Matter***
  Molecular structure makes it possible to predict the how molecules of the same substance will interact with each other. The state of matter a substance assumes is based on this interaction along with the temperature and the pressure of the

substance. The arrangement of matter in solids, liquids and gases differ, and there are energy changes associated with disrupting attractive forces between molecules, or by bringing molecules of the same type close to each other.

- ***Thermodynamics in Chemistry***
  Energy is conserved in chemical processes, and some chemical potential energy is stored in molecules. Chemical processes convert energy to heat or work as chemical bonds break and form. Alternatively energy surrounding a chemical process may be absorbed in order to make chemical processes occur.

- ***Chemical Kinetics and Equilibrium, and Entropy***
  During the study of chemical kinetics, students will explore factors that affect the rate of a chemical reaction. Understanding that individual molecules must collide with a certain amount of energy to react can explain how concentration, temperature and surface area can affect the reaction rate. Chemical equilibrium is achieved when the rate of a forward and reverse chemical process are equal. Although no observable changes are made while a system is at equilibrium, molecules continue to react.

- ***Acids and Bases***
  Many acids and bases contain covalent bonds but may undergo reactions (e.g., reactions with water) that result in the production of an ionic species. Acids create a surplus of the hydronium ion while bases produce a surplus of the hydroxide ion. The concentration of these ions affect the pH, which governs chemical reactivity in many laboratory and biological situations.

Units of Study:

- ***Atomic Structure and Periodic Relationships***
- ***Chemical Bonding and Intermolecular Forces***
- ***Mass Relationships in Chemical Reactions***
- ***Chemical Bonding and Intermolecular Forces***
- ***Thermodynamics in Chemistry***
- ***Chemical Kinetics and Equilibrium***
- ***Acids and Bases***

Mastery Objectives:

MASTERY OBJECTIVES

(NJCCCS)

Chemistry is correlated to the **New Jersey Physical Science Standards of 2009.**

New Jersey Physical Science Standards covered in Chemistry

Science Practice Standards:

Standard 5.1 Science Practices All students will understand that science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

Strand A. Understand Scientific Explanations: Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.

CPI	Content Statement	Cumulative Progress Indicator	Unit Covered

5.1.12.A.1	Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.	Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.	All units
5.1.12.A.2	Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations.	Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories	All units
5.1.12.A.3	Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.	Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence.	All units

Strand B. Generate Scientific Evidence Through Active Investigations: Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims.

CPI	Content Statement	Cumulative Progress Indicator	Unit Covered
5.1.12.B.1	Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations.	Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data.	All units
5.1.12.B.2	Mathematical tools and technology are used to gather, analyze, and communicate results.	Build, refine, and represent evidence-based models using mathematical, physical, and computational tools.	All units
5.1.12.B.3	Empirical evidence is used to construct and defend arguments	Revise predictions and explanations using evidence, and connect explanations/arguments	All units

		to established scientific knowledge, models, and theories.	
5.1.12.B.4	Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.	Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations.	All units

Strand C. Reflect on Scientific Knowledge : Scientific knowledge builds on itself over time.

CPI	Content Statement	Cumulative Progress Indicator	Unit Covered
5.1.12.C.1	Refinement of understandings, explanations, and models occurs as new evidence is incorporated.	Reflect on and revise understandings as new evidence emerges.	All units
5.1.12.C.2	Data and refined models are used to revise predictions and explanations.	Use data representations and new models to revise predictions and explanations.	All units
5.1.12.C.3	Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges.	Consider alternative theories to interpret and evaluate evidence-based arguments.	All units

Strand D. Participate Productively in Science : The growth of scientific knowledge involves critique and communication, which aresocial practices that are governed by a core set of values and norms.

CPI	Content Statement	Cumulative Progress Indicator	Unit Covered
5.1.12.D.1	Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and experiences.	All units
5.1.12.D.2	Science involves using language,	Represent ideas using literal	All units

	both oral and written, as a tool for making thinking public.	representations, such as graphs, tables, journals, concept maps, and diagrams.	
5.1.12.D.3	Ensure that instruments and specimens are properly cared for and that animals, when used, are treated humanely, responsibly, and ethically.	Demonstrate how to use scientific tools and instruments and knowledge of how to handle animals with respect for their safety and welfare.	All units

Standard 5.2 Physical Science: All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

A. Properties of Matter : All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.

Content Statement	CPI #	Cumulative Progress Indicator	Unit Covered
Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.	5.2.12.A.1	Use atomic models to predict the behaviors of atoms in interactions.	Atomic Structure
Differences in the physical properties of solids, liquids, and gases are explained by the	5.2.12.A.2	Account for the differences in the physical properties of solids, liquids, and gases.	States of Matter

ways in which the atoms, ions, or molecules of the substances are arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules.			
In the Periodic Table, elements are arranged according to the number of protons (the atomic number). This organization illustrates commonality and patterns of physical and chemical properties among the elements.	5.2.12.A.3	Predict the placement of unknown elements on the Periodic Table based on their physical and chemical properties.	Atomic Structure
In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.	5.2.12.A.4	Explain how the properties of isotopes, including half-lives, decay modes, and nuclear resonances, lead to useful applications of isotopes.	Atomic Structure
Solids, liquids, and gases may dissolve to form solutions. When combining a solute and solvent to prepare a solution, exceeding a particular concentration of solute will lead to precipitation of the solute from the solution. Dynamic equilibrium occurs in	5.2.12.A.5	Describe the process by which solutes dissolve in solvents.	Chemical Bonding and Intermolecular forces Mass relations in Chemical Reactions Chemical Equilibrium

saturated solutions. Concentration of solutions can be calculated in terms of molarity, molality, and percent by mass.			
Acids and bases are important in numerous chemical processes that occur around us, from industrial to biological processes, from the laboratory to the environment.	5.2.12.A.6	Relate the pH scale to the concentrations of various acids and bases.	Acids and Bases

B. Changes in Matter : Substances can undergo physical or chemical changes to form new substances. Each change involves energy. Performance expectations:

Content Statement	CPI #	Cumulative Progress Indicator	Unit Covered
An atom's electron configuration, particularly of the outermost electrons, determines how the atom interacts with other atoms. Chemical bonds are the interactions between atoms that hold them together in molecules or between oppositely charged ions.	5.2.12.B.1	Model how the outermost electrons determine the reactivity of elements and the nature of the chemical bonds they tend to form.	Atomic Structure Chemical Bonding
A large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. In other	5.2.12.B.2	Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions that have an impact on the environment, such as corrosion	Mathematical Relationships in Chemical Reactions

chemical reactions, atoms interact with one another by sharing electrons to create a bond.		and the burning of fuel.	
The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept.	5.2.12.B.3	Balance chemical equations by applying the law of conservation of mass.	Mathematical Relationships Chemical Reactions

C. Forms of Energy : Knowing the characteristics of familiar forms of energy, including potential and kinetic energy, is useful in coming to the understanding that, for the most part, the natural world can be explained and is predictable.

Content Statement	CPI #	Cumulative Progress Indicator	Unit Covered
Gas particles move independently and are far apart relative to each other. The behavior of gases can be explained by the kinetic molecular theory. The kinetic molecular theory can be used to explain the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample. There is a natural tendency for a system to move in the direction of disorder or entropy.	5.2.12.C.1	Use the kinetic molecular theory to describe and explain the properties of solids, liquids, and gases.	Bonding and Intermolecular Forces States of Matter
Heating increases the energy of	5.2.12.C.2	Account for any trends in the	States of Matter

the atoms composing elements and the molecules or ions composing compounds. As the kinetic energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a pure solid increases the vibrational energy of its atoms, molecules, or ions. When the vibrational energy of the molecules of a pure substance becomes great enough, the solid melts.		melting points and boiling points of various compounds.	

D. Energy Transfer and Conservation : The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.

Content Statement	CPI #	Cumulative Progress Indicator	Unit Covered
The driving forces of chemical reactions are energy and entropy. Chemical reactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).	5.2.12.D.2	Describe the potential commercial applications of exothermic and endothermic reactions.	States of Matter Thermodynamics in Chemistry
Nuclear reactions (fission and fusion) convert very small amounts of matter into energy.	5.2.12.D.3	Describe the products and potential applications of fission and fusion reactions.	Atomic Structure Chemical Kinetics Thermodynamics in Chemistry

Chemical equilibrium is a dynamic process that is significant in many systems, including biological, ecological, environmental, and geological systems. Chemical reactions occur at different rates. Factors such as temperature, mixing, concentration, particle size, and surface area affect the rates of chemical reactions.	5.2.12.D.5	Model the change in rate of a reaction by changing a factor.	Chemical Kinetics and Equilibrium

National Standards

In July, 2011 the National Research Council (NRC) published *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Their Board Members included many prominent science educators and scientists from around the country. The framework represents the first step in a process to create new standards in K-12 science education. The document states that the goal of the framework is to finish with a set of National Standards in Science that will complement the Common Core in Mathematics and Language Arts. The framework is based on current research about how children learn science, and it was heavily influenced by the American Academy for the Advancement of Science (AAAS) project 2061, and by Achieve, an group responsible for the American Diploma Project. The standards also highlight the importance of engineering design, and it illustrates the overlap and distinctions between science and engineering practices. Morristown High School Chemistry Curriculum was designed to meet both state and future National expectations in a high school chemistry course. Below are the Physical Science Standards illustrated in the Framework. As these standards pertain to both Chemistry and Physics, not all of the standards are covered within this course.

Core and Component Ideas in the Physical Sciences

Core Idea PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter (Morristown High School Units: Atomic Structure and Matter and Intermolecular Forces)
PS1.B: Chemical Reactions (Morristown High School Unit: Chemical Reactions)
PS1.C: Nuclear Processes (Morristown High School Unit: Atomic Structure)

Core Idea PS2: Motion and Stability: Forces and Interactions
PS2.A: Forces and Motion (Morristown High School Physics)
PS2.B: Types of Interactions (Morristown High School Physics. Morristown High School Chemistry Unit: Matter and Intermolecular Forces)
PS2.C: Stability and Instability in Physical Systems (Morristown High School Physics. Morristown High School Chemistry: Thermodynamics in Chemistry
Core Idea PS3: Energy
PS3.A: Definitions of Energy (Morristown High School Physics. Morristown High School Chemistry Unit: Thermodynamics in Chemistry)
PS3.B: Conservation of Energy and Energy Transfer (Morristown High School Physics. Morristown High School Chemistry Unit: Thermodynamics in Chemistry)
PS3.C: Relationship Between Energy and Forces
PS3.D: Energy in Chemical Processes and Everyday Life (Morristown High School Physics. Morristown High School Chemistry Units: Thermodynamics in Chemistry, Atomic Structure)
Core Idea PS4: Waves and Their Applications in Technologies for Information Transfer
PS4.A: Wave Properties
PS4.B: Electromagnetic Radiation (Morristown High School Physics. Morristown High School Chemistry Unit: Atomic Structure)
PS4.C: Information Technologies and Instrumentation. (Morristown High School Physics and Chemistry; multiple units)

The College Board Standards

The New Jersey Core Content Standards in the Sciences has been heavily influenced by the College Board Standards in Science. The College Board has developed college- and career-readiness standards for science in order to help states, school districts and schools provide all students with the rigorous education that will prepare them for success in college, opportunity in the workplace, and effective participation in civic life. The College Board's commitment to this project is founded on the belief that all students can meet high expectations for academic performance when they are taught rigorous standards by qualified teachers. The College Board believes these standards provide sufficient guidance for curriculum supervisors and teachers to design instruction and assessments that prepare students in middle school and high school for AP and college courses, but the College Board Standards for College Success are not designed uniquely as preparation for AP courses. Rather, the College Board uses these standards to align its own curriculum and assessment programs to achieve the overarching goal of college. By developing academic standards that align with the expectations of postsecondary educators, the College Board is addressing many of the issues identified as impediments to college success for all. The Morristown High School Chemistry Curriculum meets the rigor stressed by the College Board State Standards.

Chemistry
Standard C.1

Structure of Matter (MHS Atomic Structure)

Matter is composed of small particles called atoms that are in constant motion and that combine in various predictable ways.

Objectives

C.1.1 Atomic Theories (MHS Atomic Structure)
Students understand the current model of atomic structure, how the model has changed over time, and how experimental evidence about atomic structure has led to changes in the atomic model.

C.1.2 Electrons (MHS Atomic Structure)
Students understand that the interactions of electrons between and within atoms are the primary factors that determine the properties of matter.

C.1.3 Bonding (MHS Chemical Bonding)
Students understand that matter is composed of atoms of elements, most of which are bonded in different but predictable ways.

C.1.4 Representations of Matter (MHS Chemical Bonding and Matter and Intermolecular Forces)
Students understand that atoms, molecules and ionic substances can be represented with a variety of models.

C.1.5 States of Matter (MHS Matter and Intermolecular Forces)
Students understand that matter exists in different states, and that these states are determined by atomic–molecular level structure, attractions between particles, and the relative motions of particles.

C.1.6 Nuclear Chemistry (MHS Atomic Structure)
Students understand that changes occurring in the nucleus of an atom may alter the identity of an atom and often result in large changes in energy.

Standard C.2
Matter and Change

The properties of matter and the changes that matter undergoes result from its atomic–molecular level structure. For any chemical or physical change, matter is conserved.

Objectives
C.2.1 Periodic Table (MHS Atomic Structure and Periodic Relationships)
Students understand that the periodic table is an organizational tool that can be used for the prediction and classification of the trends and properties of elements.

Standards Outline
C.2.2 Structure–Property Relationships (MHS Chemical Bonding)
Students understand the relationship between molecular-level structure and chemical and physical properties.

C.2.3 Conservation of Matter (MHS Chemical Reactions)
Students understand that matter is conserved whenever any change occurs.

C.2.4 Chemical Equilibrium (MHS Chemical Kinetics and Equilibrium)
Students understand that many reactions do not proceed completely from reactants to products; instead, reactions reach a state of dynamic equilibrium where the amounts of reactants and products appear constant.

C.2.5 Chemical Kinetics (MHS Chemical Kinetics and Equilibrium)
Students understand that for a chemical reaction to occur, reacting particles must collide in the appropriate orientation with enough energy to overcome the activation energy barrier.

Standard C.3

Energy and Change
When any change occurs, energy is transferred and/or transformed, but it is never lost.

Objectives
C.3.1 Conservation of Energy (MHS Thermodynamics in Chemistry)
Students understand that energy is conserved during any change — energy may be transformed into another type of energy, but it never disappears.

C.3.2 Energy Transfers and Transformations (MHS Thermodynamics in Chemistry)
Students understand that when any change occurs, energy is transferred or transformed; some energy (in the form of thermal energy) always spreads out, making it more difficult to effect further change.

C.3.3 Chemical Energy (MHS Thermodynamics in Chemistry
Students understand that energy changes associated with chemical reactions are a result of the rearrangement of atoms in a chemical system.

Teaching/Learning Activities

Science Practices

All students will understand that science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. The ***Chemistry Curriculum Map***, has been prepared to provide greater detail as to specific teaching/learning activities for this course.

The teaching/learning activities in ***Chemistry*** are focused on developing the following science proficiencies:

1. Understand Scientific Explanations

Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.

2. Generate Scientific Evidence Through Active Investigations

Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims. Students must need to know that investigations must be designed logically in order to obtain reliable evidence from which a valid model may be built. Mathematical data must be collected using appropriate technology, and data must be analyzed appropriately to construct valid arguments.

3. Scientific Knowledge builds on itself over time.

The refinement of a scientific model must be completed as new data supports, refutes or alters the model created by previous data analysis. Scientists base their understanding of a system on analyzed data, and as new information becomes available that model may change. The cyclical nature of gathering evidence and revising the model is more consistent with what practicing scientists do. The traditionally taught scientific method is linear and step-wise, and does not include revisiting the hypothesis. Although Democritus first hypothesized that there was an indivisible particle called an atom in ancient Greece, our model of the atom has been revisited and refined continually since.

4. The growth of scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.

Science involves practicing productive social interactions with peers such as partner talk, whole group discussions, and small group work. The use of oral and written language is essential to make scientific knowledge public. It is the communication of scientific results that germinates new scientific ideas.

Assessment and Testing Strategies

Chemistry will include a variety of assessment tools for the effective teaching and learning of students. In addition to classroom and district assessments, students will demonstrate proficiency in Physics by doing performance assessments, experiments and/or projects.

Indicators of Sound Classroom Assessment Practice will consist of both formative and summative assessments that may include, but are not limited to:

- Observation
- SMART responders
- Paper-and-pencil tests/quizzes
- Performance Tasks
- Laboratory experiments
- Self-Reflection

Texts and Materials

Student Text:

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Technology/Computer Software

- *Vernier Probes*
- *SMART Sympodium and Responders*
- *WebAssign*
- *Scientific Calculators*

Procedures for Use of Supplemental Instructional Materials

Instructional materials not approved by the Board of Education must be brought to the attention of the building principal or vice-principal before use in any instructional area. Materials that are approved include all textbooks, videos, and other supplemental material acquired through purchase orders, and/or other school funds. Resources from the County Education Media and Technology Center are also acceptable, with age appropriateness reviewed.

All instructional materials not explicitly Board approved as outlined in above, which are intended for use in any instructional setting must be approved by the building principal or vice- principal at least 5 schools days prior to use. The principal or vice-principal may request to review a copy of the materials, video, etc., prior to use in the classroom.

Chemistry Curriculum Map

Topic	Content Objective	Essential Question/Enduring Understanding	Suggested Activities/Materials	EvaluationAssessment
Unit 1 Introduction to Chemistry Topics: • Safety • Lab equipment • Introduction to matter • Measurement • Metric units • Graphing • Density	To review critical safety issues in the laboratory Review safety issues associated with commonly used equipment in the laboratory Identify and describe steps of solving conceptual and numerical problems Identify physical properties of matter as: extensive or intensive Differentiate between physical properties and chemical properties of matter Describe a physical/chemical change Categorize/distinguish a sample of matter as substance or mixture Distinguish between homogeneous and heterogeneous samples of matter	**Essential Questions:** • Demonstrate knowledge of safe laboratory practices and appropriate use of equipment • What is a general approach to solving a problem using correct SI units and graphing data when applicable? • How can properties used to describe matter be classified? • What and how do chemists use/represent elements and compounds? • How does the precision of a calculated answer compare to the precision of the measurements used to obtain it? • What determines the density of a substance? Calculate density mass and volume.	• Flinn Safety video • Science Safety Scavenger hunt • Court case safety project • Do now, handouts, white boards, Webassign • Cow Eye/Egg Safety Demo • Physical Change/Chemical Change Demos • Observation/of Colors Laboratory Experiment • Physical and Chemical Changes Lab • Element compound mixture POGIL activity • ROYGBIV (How Sweet it is) density column demo • Density lab- calculate density of various objects with differing shapes and compositions	• Safety test with Equipment ID/use Quiz • Web assign/Moodle assessment • Completion of lab reports • Density performance assessment

	Explain the difference between an element and a compound Identify the chemical symbols/names of elements Distinguish among accuracy, precision and error of a measurement List SI units and prefixes Calculate the density of a material from experimental data Determine the number of significant figures in a measurement and in a calculated answer. Use scientific notation to be able to work with very large and very small measurements Construct a graph depicting scientific data	• Why must measurements be recorded with the correct significant figures and scientific notation? **Enduring Understandings:** • Proper behavior and precautions when working with chemicals • Measurement and observation tools are used to categorize, represent and interpret the natural world. • For any chemical or physical change, matter is conserved.	***Most of this content objective is covered in middle school. Webassign or other homework will be used to assess student prior knowledge. It is anticipated that students will need minimal class time on this content objective.	
Topic	**Content Objective**	**Essential Question/Enduring Understanding**	**Suggested Activities/Materials**	**EvaluationAssessment**
Unit 2 **Atomic Structure and Periodic Relationships** Topics:	Describe Democritus' ideas about atoms Relate how historical experiments are correlated to	**Essential Questions:** • Why do we believe in atoms?	• "Do Now", handouts, white boards, Webassignments • Create timeline of how the atomic model has changed	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

• Atomic structure • Atomic theory • Atoms • Molecules • Ions • Isotopes • Nuclear Chemistry • Quantum Theory and the Electronic Structure of Atoms • Periodic Relationships Among the Elements	models developed by Dalton, Thompson, Rutherford, Bohr and Schrödinger. Explain Dalton's atomic theory Identify the inadequacies of each of the previous models Identify three types of subatomic particles (Protons, Neutrons, Electrons) Describe the structure of atoms according to the Rutherford atomic model (Positive nucleus surrounded by negative electrons) Explain that elements are identified by the number of protons in the nucleus (atomic number). Explain isotopes have the same number of protons but different number of neutrons. Compute the number of electrons, protons, and neutrons in atoms, ions and isotopes. The number of neutrons can be calculated by subtracting the atomic number from the mass number. Explain how Nuclear Strong	• How does the atomic structure of matter influence its behavior? • How were the fundamental particles (proton, neutron, electron) discovered? What impact did this have on the model of the atom? • How did the changes to the model of the atom reveal the current theory (quantum) structure of the atom? • How does an atom relate to a molecule, ion and isotope? • How does an unstable nucleus release energy? • What are the three main types of nuclear radiation? • What determines the type of decay a radioisotope undergoes? • What are two ways that transmutation occurs? • What happens in a nuclear chain reaction? • Why are spent fuel rods	• "String Thing" Demo – student infers arrangement of string in opaque tube – accept concepts like atomic structure without visualizing • Rutherford Scatterboard Activity- simulates Gold Foil experiment by predicting the shape and size of unknown object • Protons, Electrons, Neutrons calculations handouts • Isotopes of "Pennium" lab - macroscopic simulation of isotopes' abundance • Isotope/ion (Flinn Building Atoms) hands on activity - visualize through modeling the difference between atoms, ions and isotopes	

	Force binds protons together in the nucleus Explain how an unstable nucleus releases energy Describe the three main types of nuclear radiation Describe the type of decay a radio isotope undergoes Solve problems that involve half-life Describe what happens in a nuclear chain reaction Distinguish fission reactions from fusion reactions Identify three devices that are used to detect radiation Describe how radioisotopes are used in medicine.	from a nuclear reaction stored in water? • How do fission reactions and fusion reactions differ? **Enduring Understandings:** • Historic evolution of atomic theory led to the current model of the atom. • Atomic structure determines properties of matter. • The properties of isotopes, including half-lives, decay modes, and nuclear resonances, lead to useful applications of isotopes. • There are cost-benefits to the use of radioisotopes that are commonly used for medical and commercial purposes. • The sun is a nuclear fusion reactor, and the products from a fusion reaction are less harmful than fission reactions, which produce radioactive waste • The nuclear force that holds neutrons and protons in the		

		nucleus of an atom together are much stronger than the electric forces between the protons and electrons in the atom. • For a given quantity of a substance, the energy release in a nuclear reaction is much greater than the energy given off in a chemical reaction. **Common Misconceptions:** Students lack an appreciation of the very small size of particles; attribute macroscopic properties to particles; believe there must be something in the relatively large space between the particles; and have problems in conceptualize forces between particles.		
Quantum Theory and the Electronic Structure of Atoms	Explain how Planck's theory challenged classical physics. Explain Bohr's model of the atom in terms of energy levels, quanta, and electron orbits. Use the terms ground state and excited state to describe electronic transitions. Qualitatively describe Heisenberg's uncertainty	**Essential Questions:** • Why did the Rutherford model of the atom needed to be revised? • What is the Bohr model, and how does it relate to energy and energy levels? • What are the ground and excited states of an electron in an atom?	• "Do Now", handouts, white boards, Webassignments • Location of a 1s Electron activity (Bohr Model) • Identification of Metallic Elements using the Flame Test Method Lab • Visual identification of Emission Spectra using Excitation of Common	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	principle, Discuss the concept of electron density and probability Describe orbitals, their designations, shape, and number of energy levels that exist per type of orbital. Compare and contrast orbits (shells) in Bohr's theory with orbitals in quantum theory. Categorize orbital energy levels in many-electron atoms in order of increasing energy. Predict the electron configuration and/or create orbital diagrams for multi-electron atoms using the Pauli Exclusion Principle, Hund's rule, and the Aufbau principle. Show how Bohr's model of the atom explains emission, absorption and line spectra for the hydrogen atom. Use of Bohr's equation is optional but not necessary.	• What is Heisenberg's Uncertainty principle, and how does this apply to atomic structure and electrons? • What are orbitals, and what do they mean in terms of electrons and energy levels? • What are the differences between orbits and orbitals? • How can orbitals and energy levels be used to understand the configuration of electrons in many-electron atoms? • How can electrons be located around atoms? • What are line/emission spectra, and how does that relate to the Bohr model with respect to energy levels? **Enduring Understandings:** • Represent, using noble-gas notation, electron configurations for representative elements in Periods 1, 2, and 3	Gases and Spectrophotometers Activity • Creation of and Use of an Orbital Diagram activity	

		(BOUNDARY: Focus on s- and p-orbitals only)		
Periodic Relationships Among the Elements	Explain the basis of the periodic table as described by Mendeleev, and the revision by Moseley to organize element into functional categories. Identify groups/families and periods on the periodic table using IUPAC nomenclature. Identify elements that correspond to each of the following specialized categories : representative elements, alkali metals, alkaline earth metals, halogens, noble gases, transition metals, lanthanides, actinides Identify the three classifications of elements: metals, metalloids, and nonmetals Relate position on the periodic table to the electron configuration of an element Apply the concept of shielding/effective nuclear force to justify periodic trends Predict the trends from left to	**Essential Questions:** • Why are elements arranged in a particular way in the Periodic Table? • What are groups on the Periodic Table? What are the periods? How can their locations be identified? • What are the special names for some groups and broad areas of the Periodic Table? • What are the three classifications of elements? • How are electron configurations and position in the Periodic Table related? • What is the Effective Nuclear Force (Z_{eff}), and how does it influence trends that exist in the Periodic Table? • What are the physical and chemical property trends with respect to elements, and their positions in the Periodic Table?	• "Do Now", handouts, white boards, Webassignments • Periodicity Lab Experiment (Part 1 – Physical Properties of Elements, Part 2- Chemical Properties of Elements) • Periodic Table (wall mounted and individual copies) • Label the Periodic Table activity (using individual copies of table)	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	right and top to bottom of the periodic table for each of the following: atomic radius,□□ionic radius,□□first ionization energy,□□□metallic character	**Enduring Understandings:** • The Periodic Table is a tool which can be used to determine or predict the physical and chemical nature of an atom of an element. • The Effective Nuclear Force (Z_{eff}) is responsible for most periodic trends.		
Topic	**Content Objective**	**Essential Question/Enduring Understanding**	**Suggested Activities/Materials**	**EvaluationAssessment**
Unit 3 **Chemical Bonding** Topics: • Ionic Bonding • Covalent Bonding • Molecular Geometry and VSEPR Theory	Identify the number of valence electrons for all representative elements. Apply the Octet Rule to rationalize why alkali metals and alkaline earth metals usually form cations and oxygen and the halogens usually form anions using Lewis dot symbols in the discussion. Use Lewis dot symbols to show the formation of ionic compounds. Name ionic compounds, and write formulas appropriately. Recognize ionic compounds	**Essential Questions:** • What are valence electrons, and how does it apply to the Octet Rule? • How are ionic compounds formed? • How do properties of metals relate to the bonding that holds metal atoms together? **Enduring Understanding:** • Ionic compounds are held together by an electrostatic attractive force between cations and anions	• "Do Now", handouts, white boards, Webassignments • Students use ionic cards to rationalize that formula units are the least common multiple of cations and anions. • Ionic Formula writing kit	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	are comprised of repeating formula units. Explain how Laws of Definite and Multiple proportions are used to explain how chemical compounds are formed.	• Using the Periodic Table to determine valence electrons, based on the combination of a metal and a nonmetal, the formula and name of the compound can be known. (BOUNDARY: Metal and nonmetal from Groups 1, 2, and 17, and elements hydrogen, oxygen, carbon, and nitrogen. Students to be provided with a reference sheet containing polyatomic ions and their charges.) **Common misconception:** • Many students believe that alkali metals easily ('love to') lose one electron in order to achieve noble gas electron configurations. All alkali metals require energy to be ionized.		
Covalent Compounds	Identify covalent compounds, the type of covalent bonds present, and the number of lone pairs of electrons using Lewis structures. Relate types of bonds to bond length and bond strength. Compare and contrast various	**Essential question**s: • What is the difference between ionic and covalent bonds? • How does electronegativity of atoms affect the bonding type?	• “Do Now”, handouts, white boards, Webassignments • Students make inferences about bond types by examining physical and chemical properties of substances.	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	properties expected for ionic compounds versus covalent compounds. Compare and contrast ionic, polar covalent and nonpolar covalent bonds using the concepts of electronegativity. Predict the relative changes in electronegativity with respect to position on the periodic table. Use Lewis dot and the octet rule to write Lewis structures of compounds and complex ions. Examine the three exceptions to the octet rule. Interpret the prefixes and the names of molecular compounds and apply the rules for naming and writing formulas for binary molecular compounds. Describe the composition of natural gas, petroleum, and coal	• Is there a rationale for structures that disobey the octet rule? • How is the formula of a binary molecular written? • Classify hydrocarbons as molecules containing C and H only. **Enduring understanding:** • Bond types and polarity affect the physical and chemical properties of compounds.	• Students classify chemical compounds using conductivity, boiling and melting data. • Explain why bond type affects the boiling and melting point of a compound. • Properties of Covalent Bonds mini-lab	
Molecular Geometry and VSEPR Theory	Identify, using the VSEPR (Valence-Shell electron-pair repulsion) theory, what category and the corresponding molecular	**Essential Questions:** • How does VSEPR theory help predict the shape of molecules or polyatomic	• Students construct ball and stick models of molecules to show bond angles and molecular geometry. Molecular polarity is also	

	geometry a molecule or polyatomic ion belongs given its formula. Use the concepts of electronegativity, dipole moments, and VSEPR geometries to identify polar and non-polar molecules.	ions? • How can VSEPR, dipole moments, and electronegativity differences identify polar versus non-polar molecules? **Enduring Understandings:** • The VSEPR theory can be used to determine the shape of simple molecules. • There is a difference between bond polarity and molecular polarity. It is possible to have polar bonds within a molecule, but the molecule itself is non-polar. (BOUNDARY: Construct VSEPR diagrams only for the following combination of elements: H, C, N, O, P, S, halogens)	predicted.	
Topic	**Content Objective**	**Essential Question/Enduring Understanding**	**Suggested Activities/Materials**	**EvaluationAssessment**
Unit 4 **Mass Relationships in Chemical Reactions** Topics:	Calculate average atomic mass given the mass and natural abundance of each isotope. Determine the molecular/formula mass and	**Essential Questions:** • What is atomic mass, and how is it determined? • What is the	• "Do Now", handouts, white boards, Webassignments • Empirical Formula Laboratory Experiment	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

• Atomic Mass • The Mole • Conversions between mass, moles, particles, and volume of a gas • Percent Composition by mass • Empirical and Molecular Formula • Chemical Equations • Oxidation-Reduction Reactions • Mole-Mole and Mass-Mass Conversions • Limiting Reactant • Percent Yield	molar mass given the element or compound formula. Determine the number of particles present in a given number of moles. Convert between mass, moles, number of particles, and volume of a gas of an element or a compound using dimensional analysis. Compute the percent composition (mass percent) of each element in a compound, given the chemical formula for the compound. Create the empirical or molecular formula of a compound, given the mass of each element present (or mass percent of each element) and the compound's molar mass. Balance chemical equations. Interpret the meaning of chemical equations in terms of molecules, moles, and masses, and distinguish between products and reactants in a chemical equation. Identify the type of reaction	molecular/formula mass of an element or compound? What is its molar mass? • How many particles (atoms, molecules, or formula units) are in a given number of moles of a substance? • How can mass of a sample of a substance be expressed in terms of moles of that substance? Number of particles in that sample? And, if the substance is a gas, what volume does it occupy at standard temperature and pressure? • What is the percent composition by mass of each element in a compound? • What is the empirical formula of a compound, and how can it be calculated? What is the molecular formula of a compound, and how can it be determined? • What does a chemical equation represent, and how does the Law of Conservation of Matter affect chemical equations? When an equation is said to	• Types of Chemical Reactions Laboratory Experiment • Oxidation of Magnesium and the Yield/Amount of Product Made Experiment • Limiting Reactant in Brownies Lab Activity • Balancing Chemical Equations Kit (Flinn) • Redox Lab (Part 1 and 2)	

	based on the reactants and the products. Predict the product of a reaction based on the reactants and the type of reaction. Define oxidation and reduction in terms of the loss or gain of oxygen and the loss or gain of electrons. State the characteristics of a redox reaction and identify the oxidizing and reducing agent. Describe what happens during the decomposition process. Determine the oxidation number of an atom of any element in an atom or compound. Define oxidation and reduction in terms of a change in oxidation number and identify atoms being oxidized or reduced in redox reactions, Describe how oxidation numbers are used to identify redox reactions. Predict whether a single-	be "balanced", what does this mean, and how is this reflected in the equation? • What is the structure of a chemical equation? • What are the basic types of chemical reactions? • How can products of reactions be predicted? • What do the terms "oxidation" and "reduction" mean in terms of loss or gain of oxygen or electrons. • What are the defining characteristics of a redox reaction? • How can the oxidizing agent and reducing agent in a redox reaction be identified? • What are oxidation numbers? What is the general rule for assigning oxidation numbers? • How is a change in oxidation number related to the process of oxidation and reduction?		

	replacement reaction between a metal and a metallic compound will occur. Use stoichiometric methods to predict the mass (number of moles) of the products formed given the mass of each reactant (number of moles of each reactant) (Mass-Mass/Mole-mole conversions). Use stoichiometric methods to deduce the limiting reactant, excess reactant, the amount of expected products produced, and the amount of excess reactant left over upon completion of the reaction given the mass (number of moles) of each reactant in the chemical equation. Use stoichiometric methods to predict the theoretical yield and percent yield given the mass (number of moles) of each reactant and the actual yield of a reaction. Calculate the mass of each reactant required given the percent yield and the mass (number of moles) of products desired.	• What happens to the oxidation number of an atom or compound reacting in a redox reaction? • How is the activity series of metals used to determine if single-displacement reactions between a metal and a metallic compound will occur? • How can the amount of product made in a reaction be predicted by knowledge of the amount of reactant and a balanced chemical equation? • When is the amount of product made in a reaction limited? What causes this reduction? • In a chemical reaction, what is the amount of product actually produced versus the amount of product that should have been made? What is this reaction's percent yield in terms of product? • What information needs to be known in order to produce a given amount of product?		

		Enduring Understandings: • Chemical equations must obey the Law of Conservation of Matter/Mass. • Chemical reactions can be represented in written form and molecular-level representations • Oxidation-reduction reactions are important sources of heat and energy. Corrosion and the burning of fuel are two common examples of redox reactions. • The mole concept can be used to interconvert between reactants and products in chemical reactions at the macroscopic level. (BOUNDARY – Limiting reactant is conceptual only) (BOUNDARY – Not expected to memorize Avogadro's number or use it explicitly in calculations.)		
Topic	**Content Objective**	**Essential Question/Enduring Understanding**	**Suggested Activities/Materials**	**EvaluationAssessment**

Unit 5 **States of Matter** Topics: • Solids, Liquids, and Gases • Behavior of Gases • Water and aqueous systems • Solutions	Describe the assumptions of the kinetic theory as it applies to gases Interpret gas pressure in terms of kinetic theory Define the relationship between Kelvin temperature and average kinetic energy Identify factors that determine physical properties of a liquid Define evaporation in terms of kinetic energy Describe the equilibrium between a liquid and its vapor Identify the conditions at which boiling occurs Account for the trends in the melting points and boiling points of various compounds Explain why gases are easier to compress than solids or liquids are. Describe the three factors that affect gas pressure Describe the relationships among the temperature, pressure, and volume of a gas.	**Essential Questions:** • What are the three assumptions of the kinetic theory as it applies to gases? • How does kinetic theory explain gas pressure? • What is the relationship between the temperature in kelvins and the average kinetic energy particles? • What factors determine the physical properties of a liquid? • What is the relationship between evaporation and kinetic energy? • When can a dynamic equilibrium exist between a liquid and its vapor? • Under what conditions does boiling occur? • Why are gases easier to compress than solids or liquids? • What are the three factors that affect gas pressure?	• "Do Now", handouts, white boards, Webassignments • Observing gas pressure demo – small glass filled with water inverted with index card • Elastic Collision - Newton's cradle demo • Air Pressure demo- students will become aware of the tremendous pressure exerted by 'earth's atmosphere - aluminum can boil water invert into cool water • Kinetic molecular demonstrator - visualize what is happening in a gas as the average kinetic energy increases • Water vs. alcohol - observe differences in relative vapor pressure • Temperature and boiling - students measure the temperature of water every 30 seconds as it is heated and boiled • Crystalline solid modes -	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	Use the combined gas law to solve problems. Compute the value of an unknown using the ideal gas law. Compare and contrast real and ideal gases. Explain the high surface tension and low vapor pressure of water in terms of the structure of the water molecule and hydrogen bonding Describe the structure of ice Distinguish between a solute and solvent Explain why all ionic compounds are electrolytes Demonstrate how the formula for a hydrate is written Distinguish between a suspension and a solution Identify the distinguishing characteristics of a colloid Identify the factors that determine the rate at which a solute dissolves Identify the units usually used	• How are the pressure, volume and temperature of a gas related? • When and how is the combined gas law used to solve problems? • What is needed to calculate the amount of gas in a sample at given conditions of volume, temperature, and pressure? • Under what condition are real gases most likely to differ from ideal gases? • How can you account for the high surface tension and low vapor pressure of water? • How do you describe the structure of ice? • What is the difference between a solute and a solvent? • What happens in the solution process? Why are all ionic compounds electrolytes? • How do you write the formula for a hydrate?	blow bubbles in dishwashing detergent (OHP) to observe regular repeating pattern • Boiling in a syringe demo kit • Solid-liquid-gas demo cards • Buckyball activity • Pressure and temperature demo • Vacuum pumper lab experiment • Vacuum pump with marshmallow demo - observe the effect that changing pressure has on the volume of a gas • Demo of an Antacid - measure the amount of CO_2 given off when antacid tablets dissolve in water • Electrolytes demo - compare electrolytes using a conductivity tester • Demonstrate Tyndall effect • Observation of solution bottles	

	to express the solubility of a solute Identify the factors that determine the mass of solute that will dissolve in a given mass of solute Solve problems involving the molarity of a solution Describe the effect of dilution on the total moles of solute in solution Define percent by volume and percent by mass solutions Identify three colligative properties of solutions Explain why the vapor pressure, freezing point, and boiling point of a solution differ from those properties of the pure solvent	• What is the difference between a solutions and a suspension? • What distinguishes a colloid from other suspensions or solutions? • What factors determine the rate at which a substance is dissolved? • How is solubility usually expressed? • What conditions determine the amount of solute that will dissolve in a given solvent? • How do you calculate the molarity of a solution? • What effect does dilution have on the total moles of a solute in solution? • What are the two ways to express the percent concentration of a solution? • What are three colligative properties of a solution? • What factors determine the amount by which a	• Demo - preparation of standard solutions - serial dilutions • Factors of Solubility Lab	

		solution's vapor pressure, freezing point and boiling point differ from those properties of the solvent? **Enduring Understandings:** • Kinetic-molecular theory accounts for the differences between the solid, liquid, and gas phases. • Properties of solids, liquids, and gases can be identified by the relative arrangement of their particles. States of matter can be depicted in molecular-level pictures/animations. • Gases fill a container of any size, while liquids flow and spread out to fill the container, and solids hold their own shape, caused by particle motion and the attractions between particles. • When any change occurs, energy is transferred and/or transformed to another type of energy, but it is never lost (Law of Conservation of Energy) • The kinetic-molecular theory of gases explain		

		natural phenomena (e.g. cold air escaping from a tire or low atmospheric pressure on rainy days) • Gasses are compressible and mix easily with other gases due to the large distance between particles • Assumptions made for ideal gases break down when gas particles get too close (low temperature and high pressure) • Hydrogen bonding accounts for many of water's unique properties • Ions must be mobile in order to conduct • Some heterogeneous mixtures (colloids) will not settle • Adding a solute disrupts solvent-solvent intermolecular forces		
Topic	**Content Objective**	**Essential Question/Enduring Understanding**	**Suggested Activities/Materials**	**EvaluationAssessment**
Unit 6: Thermochemistry	Explain how energy, heat, and work are related.	**Essential Questions:** • How are energy, heat, and	• "Do Now", handouts, white boards, Webassignments	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	Classify processes as endothermic or exothermic Identify the units used to measure heat transfer Distinguish between heat capacity and specific heat Describe how calorimeters are used to measure heat flow. Construct thermochemical equations for a chemical reaction, and calculate the enthalpy change by using heats of reaction. Perform calculations involving heat, specific heat, mass and temperature change.	work related? • What makes a process endothermic or exothermic? • How are the units of calories, kilocalories, Calories, and Joules related? • What is the difference between heat capacity and specific heat of a substance? • What is a calorimeter, and how is it used to measure heat flow? • How is the enthalpy change in a chemical reaction calculated? • How is heat, mass, specific heat, and temperature change related? Enduring Understandings: • All chemical reactions can provide energy to do work. • Heat is transferred from hot to cold objects.	• Heat of Reactions/Calorimetry Laboratory Experiments (2)	
Topic	**Content Objective**	**Essential Question/Enduring**	**Suggested Activities/Materials**	**EvaluationAssessment**

		Understanding		
Unit 7: Reaction Rate, Equilibrium, and Entropy	Explain the collision theory of reactions and how effective and ineffective collisions affect amount of product made. Define reaction rate. Create a reaction-energy diagram and identify the energy of the reactants, the energy of the products, the activation energy, and the position of the activated complex. Determine if a reaction is exothermic or endothermic based on the reaction-energy diagram. Identify factors that affect the rate of reaction and state the process by which each factor affects the rate For reversible reactions, define the concept of chemical equilibrium in both dynamic and static states. Apply Le Chatelier's Principle to affect equilibrium Explain what the value of K_{eq} indicates about the position of equilibrium.	**Essential Questions:** • What is the collision theory of reactions? • What is reaction rate and how is it expressed? • What is a reaction-energy diagram, what important information does it contain, and how is it interpreted? • What factors influence the rate of a reaction? • How do the amounts of reactants and products change after a reaction has reached chemical equilibrium? • What is Le Chatelier's Principle, and what are the three stresses that can upset the equilibrium of a chemical system? • What does the equilibrium constant express about the amount of reactants and products at equilibrium? • What are the characteristics of spontaneous reactions?	• Demos – show influence of temperature, surface area, catalyst use with respect to rate of reaction	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	Identify two characteristics of spontaneous reactions. Describe the role of entropy in chemical reactions. Identify two factors that determine the spontaneity of a reaction. Define Gibbs free-energy change. (optional) Describe the general relationship between the value of the specific rate constant k , and the speed of a chemical reaction. Interpret the hills and valleys in a reaction progress curve.	• What part does entropy play in determining whether a reaction is spontaneous or not? • What two factors determine the spontaneity of a reaction? • What is Gibbs free-energy change? • How does the size of the specific rate constant k related to the speed of the reaction? • What do the hills and valleys in a reaction progress curve represent? **Enduring Understandings:** • The change in rate of a reaction is affected by factors such as temperature, mixing, concentration, particle size, and surface area, or adding a catalyst/inhibitor • Activation energy is essential to have a chemical reaction occur. • The driving forces of a chemical reaction are		

		energy and entropy. • In any system of atoms or molecules, the statistical odds are that the atoms or molecules will end up with less order than they originally had and that the thermal energy will spread out more evenly. The amount of order in a system may stay the same or increase, but only if the surrounding environment becomes even less ordered. The total amount of order in the universe always tends to decrease. • Describe, using graphic representations, change in potential energy for an exothermic or endothermic reaction that may occur when a bond between atoms, molecules, or ions is broken or formed. (BOUNDARY – Students are not expected to do calculations involving equilibrium constants)		
Topic	**Content Objective**	**Essential Question/Enduring Understanding**	**Suggested Activities/Materials**	**EvaluationAssessment**
Unit 8 **Acids and Bases**	Define the properties of acids and bases Compare and contrast acids	**Essential Questions:** • What are the properties of	• "Do Now", handouts, white boards, Webassignments	Tests, Quizzes, Webassignments, Homework, Laboratory and Activity Reports

	and bases as defined by the theories of Arrhenius, Bronsted-Lowry and Lewis Apply the rules for naming acids and bases Apply rules of writing formulas for acids Describe how [H+] and [OH-] are related in an aqueous solution Classify a solution as neutral, acidic, or basic given the hydrogen-ion or hydroxide-ion concentration Convert hydrogen-ion concentrations into pH values and hydroxide-ion concentration into pOH values Describe the purpose of an acid base indicator Define the products of an acid-base reaction Explain how acid-base titration is used to calculate the concentration of an acid or a base Explain the concept or equivalence in neutralization reactions	acids and bases? • What distinguishes and Acid and base in each of the definitions? • What are the rules for naming acids and bases? • How are the formulas for acids determined? • How are [H+] and [OH] related in an aqueous solution? • How is hydrogen-ion concentration used to classify a solution as neutral, acid, or basic? • What is the most important characteristic of an acid-base indicator? • What are the products of the reaction of an acid with a base? • What is the endpoint of a titration? • When is the solution of a salt acidic or basic? **Enduring Understandings:**	• Rainbow tube - demo use of indicator to show range to pH • Everyday Acids and Bases Lab - record acid/base/pH levels of various household substances and conclude categories based on pH levels - using meters and natural indicators • Titration Laboratory/demo - properties of titration and end point	

	Describe the relationship between equivalence point and the end point of titration	• The pH scale corresponds directly to the concentration of various acids and bases **Common Misconceptions:** • Students' ideas about acids are derived from sensory experiences and crime stories, leading to the notions of "acids can eat you" and "acids can burn you". Yet students are less likely to form preconceptions about bases.		