Chemistry

2020 New Jersey Student Learning Standards- Science

Performance Expectations

HS-PS1-1	**Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.**
HS-PS1-2	**Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.**
HS-PS1-3	**Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.**
HS-PS1-4	**Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.**
HS-PS1-5	**Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.**
HS-PS1-6	**Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.**
HS-PS1-7	**Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.**
HS-PS1-8	**Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.**
HS-PS2-4	**Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.** [
HS-PS2-6	**Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.**
HS-PS3-1	

	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-3	**Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.**
HS-PS3-4	**Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).**
HS-PS3-5	**Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.**
HS-LS1-7	**Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.**
HS-ESS1-1	**Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.**
HS-ESS1-2	**Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.**
HS-ESS1-3	**Communicate scientific ideas about the way stars, over their life cycle, produce elements.**
HS-ESS1-6	**Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.**
HS-ESS2-2	**Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.**
HS-ESS2-4	**Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.**
HS-ESS2-6	**Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.**
HS-ESS3-2	**Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.**
HS-ESS3-3	**Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.**

HS-ESS3-4	**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.**
HS-ESS3-5	**Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.**
HS-ESS3-6	**Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.**
HS-ETS1-1	**Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**
HS-ETS1-2	**Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**
HS-ETS1-3	**Evaluate a solution to a complex real-world problembased on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**
HS-ETS1-4	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.**

Science and Engineering Practices

- Practice 1: Asking Questions and Defining Problems
- Practice 2: Developing and Using Models
- Practice 3: Planning and Carrying Out Information
- Practice 4: Analyzing and Interpreting Data
- Practice 5: Using Mathematics and Computational Thinking
- Practice 6: Constructing Explanations and Designing Solutions
- Practice 7: Engaging in Argument from Evidence
- Practice 8: Obtaining, Evaluating, and Communicating Information

Cross Cutting Concepts

- Patterns
- Cause and Effect

- Scale, Proportion and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Functions
- Stability and Change

Disciplinary Core Ideas

- PS1.A Structure and Properties of Matter
- PS1.B Chemical Interactions
- PS1.C Nuclear Processes
- PS2.B Types of Interactions
- PS3.A Definitions of Energy
- PS3.B Conservation of Energy
- PS3.C Relationship between Energy and Forces
- PS3.D Energy in Chemical Processes
- PS4.B Electromagnetic Radiation
- LS1.C Organization for Matter and Energy Flow in Organisms
- ESS1.A The Universe and Its Stars
- ESS1.B Earth and The Solar System
- ESS1.C The History of Planet Earth
- ESS2.A Earth Materials and Systems
- ESS2.D Weather and Climate
- ESS3.A Natural Resources
- ESS3.C Human Impacts on Earth Systems
- ESS3.D Global Climate Change
- ETS1.A Defining and Delimiting Engineering Problems
- ETS1.B Developing Possible Solutions
- ETS1.C Optimizing the Design Solution

Unit #1: Matter and Measurement

Overview:

Chemistry investigates matter and energy and ways in which these two quantities interact. Over a course of study in Chemistry, students should be able to recognize how both matter and energy are both quantified (measured) and qualified (observed) in a variety of contexts.

STAGE 1
Desired Results

Essential Questions…

- Why is safety important to Chemistry?
- What tools and equipment do chemists use?
- What is matter?
- How do you determine the masses and volumes of different substances?
- How can you use mass and volume to determine the identity of a substance?

Enduring Understanding…

Chemistry is the study of matter which involves laboratory experiments. By establishing and following safety precautions, one can avoid danger to oneself, fellow classmates and the instructor. Two characteristics of matter are mass and volume, each with different units that are commonly used interchangeably by students. By performing calculations and experiments students will know that density is an intrinsic property, which characterized by mass and volume, and determines the use of materials. Consequently, unknown objects can be identified based on known density values.

Students will be able to...

- Recognize common chemistry tools and equipment that you will be using.
- Find all the safety equipment in the laboratory and understand its use.
- Understand the rules of safety in the chemistry laboratory.
- Define matter.
- Classify an item as matter or not matter.
- Measure mass using a balance.
- Measure the volume of regularly and irregularly shaped objects.
- Define density as the amount of mass in a certain space, or mass per unit volume.
- Solve problems for density, mass, or volume using the equation D = m/V.
- Explain how and why density can be used to identify a substance.
- Differentiate among element, compound, homogenous mixture, or heterogeneous mixture.

Students will know...

Assessment Topic #1 – Lab Safety and Equipment

Key Terms/Vocabulary:

- Balance, beaker, Bunsen burner, Erlenmeyer flask, funnel, graduated cylinder, hot plate, pipette, scale, stirring rod, test tube, weigh boat

Main Ideas/Concepts:

- Certain rules are followed in the lab to keep everyone safe during an experiment
- Each piece of equipment used in the lab has a specific use and purpose

Possible Misunderstandings:

- Lab safety rules only need to be followed when using dangerous chemicals
- It does not matter which piece of equipment is used during a lab

Assessment Topic #2 – Measurements

Key Terms/Vocabulary:

- Dimensional analysis, error, measurement, metric system, scientific notation, signficant figures

Main Ideas/Concepts:
- The metric system is based on the power of ten and can be easily converted from one unit to the next
- Certain measurements are necessary for specific items
- Scientific notation can be used to represent very large or small numbers
- The use of significant figures allows for more precise measurements

Possible Misunderstandings:
- The metric system is difficult to use
- Scientists are the only people who use the metric system

Assessment Topic #3 – Density

Key Terms/Vocabulary:
- Density, extensive property, intensive property, mass, matter, meniscus, volume, water displacement

Main Ideas/Concepts:
- Matter is composed of both mass and volume
- The volume of an irregularly shaped object can be found using water displacement
- Density is an intensive property which is dependent on the material and does not change under standard conditions

Possible Misunderstandings:
- Changing the mass or volume of an object changes its density
- It's not possible to find the volume of an irregularly shaped object

Assessment Topic #4 – Elements, Compounds, and Mixtures

Key Terms/Vocabulary:
- Atom, compound, element, hetereogeneous, homogeneous, mixture, particle, solution

Main Ideas/Concepts:
- The atom is the smallest unit that makes up elements and compounds
- Particle diagrams can be used to represent elements, compounds, and mixtures

Possible Misunderstandings:
- Elements and compounds are the same
- There is only one type of mixture

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Lab Safety and Equipment
- Lab Equipment Stations – Students will identify the name and function of various pieces of equipment that will be used throughout the year by going to different stations to read about and observe each piece.
- Lab Safety Poster – Students will create a poster (digital or handwritten) that displays key safety rules that need to be followed while working in the laboratory.
- Safety Quiz – Students must pass the lab safety quiz with at least 80% to demonstrate their understanding of lab safety before they are allowed to do any lab in the class. This can be taken as often as needed until passed.

Assessment Topic #2 – Measurements
- Gold Penny Demo/Lab – Students will be shown how a regular penny can magically be turned into "gold" through the use of chemistry. This can be completed as a student lab or demonstration.
- Metric Measurement Lab – Students will discuss important measurements for various objects and how to convert between units using the metric system.

Assessment Topic #3 – Density
- Mass/Volume Lab – Students will determine the mass and volume of various objects using simple lab techniques.
- Density Calculations – Students will practice calculating density using mass and volume data.

- Sinking/Floating Simulation – Students will identify whether an object will float or sink in water based on its density value and relation to the density of water.

Assessment Topic #4 – Elements, Compounds, and Mixtures

- Chromatography Lab – Students will create beautiful chromatography designs while discussing how the mixtures of pens (i.e. inks) can be separated with a solvent.
- Separation of a Mixture Lab – Starting with a mixture of various items, students will work together to separate that mixture using various lab techniques and equipment. This lab can be student-driven by allowing them to create their own procedure in a group setting.

Summative Activities, Tasks, or Projects:

- Identity of Unknown Metal Lab – Calculate the densities of unknown metals to determine which object and analyze these values in a graphical format.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 1 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Lab Safety and Equipment
Lesson Theme 1.1 – Lab Safety
Lesson Theme 1.2 – Lab Equipment

Assessment Topic #2: Measurements
Lesson Theme 2.1 – Metric System and Conversions
Lesson Theme 2.2 – Signficant Figures

Assessment Topic #3: Density
Lesson Theme 3.1 – Matter
Lesson Theme 3.2 – Mass, Volume, and Density

Assessment Topic #4: Elements, Compounds, and Mixtures
Lesson Theme 4.1 – Elements, Compounds, and Mixtures
Lesson Theme 4.2 – Particle Diagrams

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research

- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster’s ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials

- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Density (https://phet.colorado.edu/sims/html/density/latest/density_en.html)
- Khan Academy
- Newsela
- YouTube Videos

Unit #2: Atomic Structure

Overview:

All matter is composed of tiny particles called atoms. Based on their observations, chemists agree that atoms themselves are composed of even tinier structures, a nucleus and electrons orbiting around it. What are atoms and what does their structure tell you about matter?

STAGE 1
Desired Results

Essential Questions…

- How are the smallest bits of matter described?
- How are the atoms of one element different from those of another element?
- How can atoms of the same element be different?
- What types of isotopes do the various elements have?

Enduring Understanding…

Elements are collection of similar atoms. The number of protons in the nucleus determines the identity of an atom, for instance, all atoms of gold have 79 protons. However, atoms of an element may have different numbers of neutrons. The number of neutrons is related to the stability of the atom.

Students will be able to...

- Describe and draw an atomic model and explain the evidence that supports the existence of atomic structures.
- Describe the dynamic nature of scientific models.
- Distinguish between atomic number, mass of an atom, and average atomic mass.
- Describe the structure of an atom and draw a simple atomic model of an atom.
- Extract information from the periodic table related to atomic structure and atomic mass.
- Define isotope, write and interpret the symbol for a specific isotope.
- Determine the average atomic mass of an element based on the natural abundance of isotopes of that element.
- Predict the number of protons, neutrons, and electrons in the most abundant isotope of an atom, based on average atomic mass.
- Develop and Bohr models for atoms, illustrating electron energy levels and the placement of electrons within those levels
- Predict the electron configuration of atoms using the periodic table as a model
- Use electron dot structures to represent an atoms' valence electrons

Students will know...

Assessment Topic #1 – Modeling Atoms

Key Terms/Vocabulary:

- Atomic number, electron, mass number, nucleus, neutron, periodic table, proton, subatomic particle

Main Ideas/Concepts:

- Protons and neutrons are located in the nucleus of an atom
- The atomic number of an element indicates the number of protons
- In a neutral atom, the number of protons is equal to the number of electrons

Possible Misunderstandings:

- Neutrons have a negative charge
- Subatomic particles are the same size
- Electrons are used to identity an atom

Assessment Topic #2 – Isotopes and Average Atomic Mass

Key Terms/Vocabulary:

- Isotopes, average atomic mass, percent abundance

Main Ideas/Concepts:

- Isotopes have the same number of protons but different number of neutrons
- The mass number of isotopes are different
- The average atomic mass of an element can be found by taking account the percent abundance

Possible Misunderstandings:

- All atoms are the identical and have the same number of subatomic particles

Assessment Topic #3 – Bohr Model

Key Terms/Vocabulary:

- Bohr model, energy level, flame test, quantum, valence electron

Main Ideas/Concepts:

- Bohr models show the general location of electrons within an atom on shells or energy levels
- Flame tests can be used as an identification tool
- Valence electrons are electrons located on the outermost shell

Possible Misunderstandings:

- The 2, 8, 8 rule applies to every element

Assessment Topic #4 – Electron Configurations

Key Terms/Vocabulary:

- Aufbau Principle, atomic orbital, electron configurations, electron dot structure, Hund's Rule, Pauli Exclusion Principle, spin

Main Ideas/Concepts:

- Electrons are found in different orbitals (s, p, d, f) which can each have a certain number
- No two electrons have the same "address" within an atom
- Electron dot structures show valence electrons only with each dot representing one electron

Possible Misunderstandings:

- All electrons in an atom are equal

Topics that address the Diversity and Inclusion

- Recognizing the contributions of scientists in the history of the atom

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Modeling Atoms

- Build an Atom Simulation – Students will identify the subatomic particles in an atom and determine their locations and charge within the atom.
- Subatomic Particle Calculations – Students will calculate the number of protons, neutrons, and electrons in various atoms.

Assessment Topic #2 – Isotopes and Average Atomic Mass

- Calculating Average Atomic Mass – Students will calculate the average atomic mass of different elements using isotope data.
- Beanium Lab – Students will calculate the average atomic mass of the fictitious element Beanium by measuring the amounts and masses of different bean isotopes.

Assessment Topic #3 – Bohr Model

- Drawing Bohr Models – Students will draw the Bohr models of the first twenty elements on the periodic table after identifying the pattern of electrons in shells
- Flame Test Lab – Students will perform a flame test experiment to determine the type of color produced when different solutions are placed in a flame.

Assessment Topic #4 – Electron Configurations

- Atomic Hotel – Students will identify the locations of electrons in different shells and subshells within an atom in order to create an electron configuration for a particular element.

Summative Activities, Tasks, or Projects:

- End of Unit Assessment – Take an assessment that covers the key points for Unit 2 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Modeling Atoms
Lesson Theme 1.1 – Visualizing the Atom
Lesson Theme 1.2 – Types of Atoms
Lesson Theme 1.3 – Mass Number

Assessment Topic #2: Isotopes and Average Atomic Mass
Lesson Theme 2.1 – Isotopes
Lesson Theme 2.2 – Atomic Mass

Assessment Topic #3: Bohr Model
Lesson Theme 3.1 – The Bohr Model
Lesson Theme 3.2 – Bohr Model Representations of Atoms

Assessment Topic #4: Electron Configurations
Lesson Theme 4.1 – Modern Atomic Theory
Lesson Theme 4.2 – Electron Configurations
Lesson Theme 4.3 – Valence Electrons

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill

- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Build an Atom (https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html)
- Khan Academy
- Virtual Flame Test (http://www.mrpalermo.com/virtual-lab-flame-test--spectroscopy.html)
- Newsela

- YouTube Videos

Unit #3: The Periodic Table

Overview:

Matter is composed of components called elements. There are a limited number of elements in existence. Everything in our world, natural and synthetic, is made of individual elements or some combination of them. Chemical formulas indicate what elements or elements a substance is made of. Atomic structure and the arrangement of the periodic table are the foundation for understanding matter and its interactions. Many substances react chemically with other substances to form substances new substances with different properties. This change in properties results from the ways in which atoms from original substances are combined and rearranged in the new substances.

STAGE 1
Desired Results

Essential Questions…

- What do chemical names and symbols tell you about matter?
- What happens to matter when it is changed?
- What happens to elements in a chemical change?
- How is the periodic table organized?
- What information does the periodic table reveal about the elements?
- Why do elements in the same group in the periodic table have similar properties?

Enduring Understanding…

Students will be able to predict the properties and placement of an unknown element into the periodic table. In addition, they will be able to explain mathematically that matter is conserved during experiments, and that Chemistry is a universal language consisting of chemical names and symbols derived from the periodic table. Copper and gold are in the same group on the periodic table and have similar properties. However, they are distinct elements with many differences, such as their appearances and density. While elements can react to form new compounds, it is impossible to change one element into another.

Students will be able to…

- Define the terms element, compound, and aqueous.
- Recognize whether a substance is an element, or a compound based on its chemical formula or symbol.
- Decipher some basic chemical formulas and symbols.
- Describe how the organization of the periodic table is based on reactivity and atomic mass.
- Predict the characteristics of a missing element on the periodic table based on its position in the table.
- Use the periodic table to identify elements that are metals, nonmetals, metalloids, alkali metals, alkaline earth metals, transition elements, halogens, noble gasses, lanthanides, and actinides.
- Describe the general properties of elements, that are periodic in nature.
- Predict the general properties of an element based on its location on the periodic table and identify elements that will exhibit similar chemical behavior.

Students will know…

Assessment Topic #1 – Overview of the Periodic Table

Key Terms/Vocabulary:

- Alkali metals, alkaline earth metals, aqueous, atomic number, chemical formula, chemical symbol, compound, Dmitri Mendeleev, element, group, halogens, main group elements, metalloids, metals, noble gases, nonmetals, periodic table, period, phase, transition metal

Main Ideas/Concepts:

- The periodic table is organized by atomic number in groups (columns) and periods (rows)
- Groups of elements have similar chemical properties due to their valence electrons

Possible Misunderstandings:

- There is no organization in the periodic table

Assessment Topic #2 – Periodic Trends

Key Terms/Vocabulary:

- Anion, atomic radius, cation, electronegativity, electron affinity, ion, ionic radius, ionization energy, trend

Main Ideas/Concepts:

- There are general trends (increasing or decreasing) down a group or across a period for most main group elements

Possible Misunderstandings:

- Properties do not always have to be continuous to be a trend

Topics that address the Diversity and Inclusion

- Identifying the impact of other individuals on the development of the periodic table

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Overview of the Periodic Table

- Element Project – Students will research an element from the periodic table to present to the rest of the class. Information researched could include history, uses, physical and chemical properties, images, etc.
- Coloring the Periodic Table – Students will identify & color the most important groups on the periodic table such as the alkali metals, transition metals, and noble gases.

Assessment Topic #2 – Periodic Trends

- Periodic Table Card Sorting – Students will try to find patterns in the periodic table from a variety of data such as size, properties, chemical reactions, etc. in groups and periods.
- Graphing Periodic Trends – Using data, students will graph (digitally or handwritten) to identify trends for atomic radius, ionization energy, and electronegativity.

Summative Activities, Tasks, or Projects:

- Periodic Table Project – Students will create their own periodic table that demonstrates periodic trends down a group and across a period.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 3 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Overview of the Periodic Table
Lesson Theme 1.1 – Development of the Periodic Table
Lesson Theme 1.2 – The Modern Periodic Table

Assessment Topic #2: Periodic Trends
Lesson Theme 2.1 – Atomic Radius
Lesson Theme 2.2 – Ionization Energy
Lesson Theme 2.3 – Electron Affinity
Lesson Theme 2.4 – Common Charges in Representative Elements
Lesson Theme 2.5 – Connecting the Trends

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts

- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- Khan Academy
- Newsela
- YouTube Videos

Unit #4: Chemical Bonding

Overview:

Sugar dissolves in water, but glass does not. These properties give clues about how the atoms in these substances are bonded to each other. When atoms form bonds between them, new substances with new properties are formed. There are four basic types of bonds found in the world around us. Each type of bond is a result of a different distribution of electrons within the substance. In addition,

each type of bond is associated with certain properties. The chemical formula of a substance can be used to determine the type of bond in that substance.

STAGE 1
Desired Results

Essential Questions…

- How are atoms connected to one another?
- How do ionic compounds form?
- How does metallic bonding affect the properties of metals?
- How is the bonding in molecular compounds different from the bonding in ionic compounds?
- How do electrons affect the shape of a molecule?
- What factors affect molecular properties?

Enduring Understanding…

A bond is an attraction between the nucleus of one atom and the electrons of another atom. When atoms bond together, new substances with new properties are made. Conversely, elements can be extracted from compounds by breaking the bond. There are 4 types of bonding, depending the location of electrons within the atoms in the substance: ionic, molecular covalent, metallic and network covalent. Certain properties are associated with each type of bonding.

Students will be able to...

- Classify substances into four categories based on solubility and conductivity
- Define a chemical bond and describe the four basic types of chemical bonds
- Use chemical formulas to sort substances into bonding categories
- Predict the properties of a substance based on its chemical formula and bonding type
- Describe the properties of metallic, ionic, and covalent solids.
- Classify a substance as metallic, ionic, or covalent based on data (solubility, melting point, boiling point, conductivity).

Students will know...

Assessment Topic #1 – Ionic Bonds

Key Terms/Vocabulary:

- Conductivity, electron dot structures, cyrstal lattice, Ionic bond, ionic compound, octet rule, solubility

Main Ideas/Concepts:

- An ionic bond is the electrostatic attraction between oppositely charged ions
- Metals tend to lose electrons to achieve a stable octet whereas nonmetals gain electrons

Possible Misunderstandings:

- Ionic bonds occur when electrons are shared

Assessment Topic #2 – Metallic Bonds

Key Terms/Vocabulary:

- Boiling point, malleability, metallic bond, melting point

Main Ideas/Concepts:

- Metals bond with each other by sharing valence electrons between many positively charged nuclei, forming a sea of electrons

Possible Misunderstandings:

- Metallic bonds only occur between two metal atoms

Assessment Topic #3 – Covalent Bonds

Key Terms/Vocabulary:

- Covalent bonds, double covalent bond, electronegativity, molecule, nonpolar covalent bond, polar covalent bond, single covalent bond, triple covalent bond, VSEPR theory

Main Ideas/Concepts:

- Covalent bonds are formed when two atoms share electrons
- When forming compounds, atoms tend to achieve the electron configuration of the noble gases

Possible Misunderstandings:

- Electrons are always shared equally between two atoms

Assessment Topic #4 – Names and Formulas of Compounds

Key Terms/Vocabulary:

- Binary compound, chemical formula, criss-cross rule, monoatomic ion, polyatomic ion, subscript

Main Ideas/Concepts:

- There are separate rules for writing the name and formula of ionic compounds and molecular compounds
- The name of a compound allows prediction of the type of bonds within it

Possible Misunderstandings:

- Prefixes are used in ionic compounds
- The lowest whole numbers in compounds

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Ionic Bonds

- Characteristics of Ionic Bonds Lab – Students will investigate compounds to identify which has the strongest interparticle forces based on observations of physical properties.

Assessment Topic #2 – Metallic Bonds

- Patterns in Melting Points of Metals – Students will analyze and/or graph melting point data for various metals to find patterns and make predictions for other elements.

Assessment Topic #3 – Covalent Bonds

- Bond Polarity Lab – Students will analyze electronegativity data for several elements to identify the polarity of different covalent bonds.
- Lewis Structure Lab – Students will draw Lewis Structures for various molecules using model kits.
- PhET Molecule Shapes Lab – Students will use the PhET Molecule Shapes simulation to investigate the shape and structure of various molecules.

Assessment Topic #4 – Names and Formulas of Compounds

- Ionic Compound Speed Dating – Students will practice writing the name and formula of ionic compounds by partnering with several classmates and determine the correct match of two opposite ions.

Summative Activities, Tasks, or Projects:

- Qualitative Analysis Lab – Students will use their knowledge of the relationship between chemical bonding type and the properties of substances to determine the identify of mystery solids.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 4 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Ionic Bonds

Lesson Theme 1.1 – Ions and the Octet Rule

Lesson Theme 1.2 – Ionic Bonds

Lesson Theme 1.3 – Ionic Compounds
Lesson Theme 1.4 – Properties of Ionic Compounds

Assessment Topic #2: Metallic Bonds
Lesson Theme 2.1 – Sea of Electrons Model
Lesson Theme 2.2 – Properties of Metals

Assessment Topic #3: Covalent Bonds
Lesson Theme 3.1 – Molecular Compounds
Lesson Theme 3.2 – The Octet Rule in Molecules
Lesson Theme 3.3 – Types of Covalent Bonds
Lesson Theme 3.4 – Electronegativity and Bonding
Lesson Theme 3.5 – Geometry and Polar Molecules

Assessment Topic #4: Names and Formulas of Compounds
Lesson Theme 4.1 – Naming Ions
Lesson Theme 4.2 – Names & Formulas of Ionic Compounds
Lesson Theme 4.3 – Compounds with Polyatomic Ions
Lesson Theme 4.4 – Names & Formulas of Molecular Compounds

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required

- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster’s ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Molecule Shapes (https://phet.colorado.edu/sims/html/molecule-shapes/latest/molecule-shapes_en.html)
- Khan Academy
- Newsela
- YouTube Videos

Unit #5: Physical Properties of Materials

Overview:

Physical properties of materials are important factors in how materials can be used. A variety of factors affect the physical properties of materials, including melting point, boiling point, and surface tension. By comparing the structure of substances at the bulk scale, the strength of electrical forces between particles of the substances can be inferred.

STAGE 1
Desired Results

Essential Questions…

- What factors affect molecular properties?
- What kind of attractions occur between molecules?
- How are ionic and molecular compounds different?
- How does the type of bond affect its properties?

Enduring Understanding…

Materials are designed for a specific function that depends upon the state of matter, intermolecular attractions, phase changes, and type of compound. Models of each property or change allows specific functions to be analyzed.

Students will be able to…

- Describe the type of attractions between molecules
- Explain how intermolecular attractions between molecules influence the bulk properties of a material
- Investigate and describe three states of matter (solid, liquid, gas)
- Develop models to explain behaviors of gases with changes in temperature, pressure, and volume
- Develop a model of intermolecular forces and use it to explain states of matter
- Describe how variations in kinetic energy among particles result in constant evaporation and condensation, even without heating or cooling
- Summarize the mechanisms by which gas bubbles in a heated liquid exert enough pressure to break free of the surface, resulting in boiling
- Relate the melting point of different solids to the strength of intermolecular forces or bonds between their particles, and apply that understanding to predict the bond energy of a compound with a known melting point
- Differentiate between the representative units of molecular and ionic compounds
- Identify patterns in the location of elements making up ionic and molecular compounds on the periodic table

- Relate the properties of molecular and ionic compounds at the bulk scale to the intermolecular forces and bonds between their particles

Students will know...

Assessment Topic #1 – Intermolecular Attractions

Key Terms/Vocabulary:

- Dipole interactions, dispersion forces, hydrogen bonds, van der Waals forces, volatility

Main Ideas/Concepts:

- Intermolecular forces occur between covalently bonded molecules and determine many observable physical properties, including volatility, melting point, and boiling point
- The relative values of physical properties can be predicted based on the structure of a compound

Possible Misunderstandings:

- The only important characteristic of a compound is the type of bond within it

Assessment Topic #2 – States of Matter

Key Terms/Vocabulary:

- Covalent network solid, fluid, gas pressure, kinetic theory, metallic solids, molecular solids, ionic solids, standard temperature and pressure (STP

Main Ideas/Concepts:

- The three states of matter – solid, liquid, and gas – can be differentiated on a physical and molecular level
- Intermolecular forces influence the state of a particular compound at room temperature

Possible Misunderstandings:

- The particles in a specific state of matter are arranged the same way

Assessment Topic #3 – Modeling Phase Changes

Key Terms/Vocabulary:

- Boiling point, condensation, deposition, evaporation, melting point, phase change, phase diagrams, sublimation, vaporization, vapor pressure

Main Ideas/Concepts:

- Phase changes can be examined in terms of kinetic energy and intermolecular forces

Possible Misunderstandings:

- The temperature changes during a phase change

Assessment Topic #4 – Comparing Ionic and Molecular Compounds

Key Terms/Vocabulary:

- Alloy, delocalized electrons, ductility, electrical conductivity, luster, malleability, thermal conductivity

Main Ideas/Concepts:

- Ionic compounds contain electrostatic forces and molecular compounds contain intermolecular forces of attractions
- The strength of forces affects the characteristic properties of matter
- Combinations of metals and/or nonmetals determine whether the substances are ionic or molecular compounds

Possible Misunderstandings:

- Ionic and molecular compounds have the same type of properties

Topics that address the Climate Change

- Identifying the properties of materials that could be used as an engineering resource

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Intermolecular Attractions

- Intermolecular Forces Lab – Investigate the boiling point and surface tension of several substances and determine how intermolecular forces impact these physical properties.

Assessment Topic #2 – States of Matter

- PhET States of Matter Virtual Lab – Students investigate the three types of matter to understand the relationship between the molecular level and physical properties of a substance.

Assessment Topic #3 – Modeling Phase Changes

- Phase Change Lab – Students measure and analyze the temperature changes of a specific material (water, stearic acid, etc.) to analyze the phase changes that occur.

Assessment Topic #4 – Comparing Ionic and Molecular Compounds

- Tough Tools Virtual Lab – Students conduct an investigation that allows them to determine the characteristics of ionic, covalent, and network solids.

Summative Activities, Tasks, or Projects:

- Road Deicers Lab – Students will design and conduct an experiment to evaluate the effectiveness of various compounds commonly used as deicers in the winter months.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 5 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Intermolecular Attractions
Lesson Theme 1.1 – Van der Waals Forces
Lesson Theme 1.2 – Hydrogen Bonds
Lesson Theme 1.3 – Properties of Molecular Substances

Assessment Topic #2: States of Matter
Lesson Theme 2.1 – Kinetic Theory and a Model for Gases
Lesson Theme 2.2 – Liquids and Intermolecular Forces
Lesson Theme 2.3 – Solids and Attractice Force

Assessment Topic #3: Modeling Phase Changes
Lesson Theme 3.1 – Phase Changes
Lesson Theme 3.2 – Heating a Liquid or Solid

Assessment Topic #4: Comparing Ionic and Molecular Compounds
Lesson Theme 4.1 – Representative Units
Lesson Theme 4.2 – Determining Compound Type
Lesson Theme 4.3 – Properties of Ionic and Molecular Compounds
Lesson Theme 4.4 – Covalent Network Solids

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding

- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster’s ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials

- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET States of Matter (https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html)
- Khan Academy
- Newsela
- YouTube Videos

Unit #6: Chemical Quantities

Overview:

The mole is the fundamental unit used by chemists for quantifying matter. The mole concept underlies much of chemistry and is crucial to understanding how quantities of different substances combine to form compounds. Students must understand that a mole contains exactly 6.02×10^{23} entities. This quantity is known as Avogadro’s number. The usefulness of the mole is evident when examining empirical formulas, as the subscripts provide the mole ratio of the elements making up a compound.

STAGE 1
Desired Results

Essential Questions…

- Why is the mole an important measurement in chemistry?
- How can the molecular formula of a compound be determined experimentally?
- How can mass help you count large numbers of small objects?
- What is the relationship between mass and moles?
- How can you convert between mass and moles?

Enduring Understanding…

The mole is used to bridge the atomic and macroscopic domains. Using the periodic table and atomic structure, molar mass can be calculated and conversions between moles and mass can be made. The volume and mole relationship and concept of molarity provides yet another example of how the mole touches on nearly every aspect of chemistry.

Students will be able to...

- Investigate the three methods used to measure mater – count, mass, and volume
- Develop models of the mole that encompass atoms, molecules, and formula units
- Explain the relationship between the mole and Avogadro's number
- Use Avogadro's number to convert from moles to particles and particles to moles
- Use the periodic table to find the molar mass of elements and compounds
- Convert mole quantities to masses, and mass quantities to moles
- Explain the relationship between moles and volumes of gases at STP
- Explain how to find the percent composition of a compound
- Develop models to illustrate the law of definite proportion and law of constant composition
- Find the empirical and molecular formulas for a compound
- Use subscripts within a chemical formula to represent a mole ratio
- Find the molarity of a solution
- Investigate how the ratio of solute to solvent affects the concentration of a solution

Students will know...

Assessment Topic #1 – The Mole Concept

Key Terms/Vocabulary:

- Avogadro's number, mass, molar mass, mole,

Main Ideas/Concepts:

- The mole is one of the most fundamental concepts in all of chemistry.
- There are different ways to measure matter, which involve counting, finding mass, and finding volume.
- There is a relationship between Avodgadro's number, 6.02×10^{23}, and the mole

Possible Misunderstandings:

- The scale of the mole is larger than anything seen before
- There is only one way to count particles

Assessment Topic #2 – Molar Relationships

Key Terms/Vocabulary:

- Avogadro's hypothesis, molar volume, density

Main Ideas/Concepts:

- Molar mass can be used to make conversions between moles and mass.
- There is a relationship between moles and volumes of gases

Possible Misunderstandings:

- The mole is not the center of converting between units

Assessment Topic #3 – Percent Composition and Empirical Formulas

Key Terms/Vocabulary:

- Empirical formula, law of definite proportions, molecular formula, percent composition

Main Ideas/Concepts:

- Empirical and molecular formulas are based on mole ratios

Possible Misunderstandings:

- Each compound has the same percent composition

Assessment Topic #4 – Concentrations of Solutions

Key Terms/Vocabulary:

- Concentration, concentrated solution, dilute solution, molarity

Main Ideas/Concepts:

- Many chemical reactions take place in a solution and it's important to understand how concentration is determined.
- Molarity is used to represent the concentration of a solution.

Possible Misunderstandings:

- The amount of solute changes when you dilute a solution
- Increasing the amount of solvent increases the concentration

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – The Mole Concept

- Molar Mass Calculations – Students will calculate the molar mass of a compound using the periodic table.

Assessment Topic #2 – Molar Relationships

- Mole Conversions – Students will create a mole map to determine the different ways to convert between moles, mass, volume, and particles and perform calculations to show these conversions.

Assessment Topic #3 – Percent Composition and Empirical Formulas

- Emprical Formula of Unknown Compound – Students will use an experimental method to determine the empirical formula of an unknown compound using data from the lab and calculations.

Assessment Topic #4 – Concentrations of Solutions

- PhET Molarity Lab – Students will calculate the concentrations of solutions using differing amounts of solute and solvent.
- Kool-Aid Lab – Students will create solutions of Kool-Aid of varying concentrations to identify the best-tasting solution.

Summative Activities, Tasks, or Projects:

- End of Unit Assessment – Take an assessment that covers the key points for Unit 6 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: The Mole Concept
Lesson Theme 1.1 – Measuring Matter
Lesson Theme 1.2 – Counting with Moles
Lesson Theme 1.3 – Volume and Mass of a Mole
Lesson Theme 1.4 – Molar Mass of Compounds

Assessment Topic #2: Molar Relationships
Lesson Theme 2.1 – The Mole Roadmap
Lesson Theme 2.2 – The Mole-Mass Relationship
Lesson Theme 2.3 – Avogadro's Hypothesis
Lesson Theme 2.4 – The Mole-Volume Relationship

Assessment Topic #3: Percent Composition and Empirical Formulas

Lesson Theme 3.1 – Percent Composition of a Compound
Lesson Theme 3.2 – Empirical Formulas
Lesson Theme 3.3 – Molecular Formulas

Assessment Topic #4: Concentrations of Solutions
Lesson Theme 4.1 – Molarity
Lesson Theme 4.2 – Dilutions

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts

- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Molarity (https://phet.colorado.edu/sims/html/molarity/latest/molarity_en.html)
- Khan Academy
- Newsela
- YouTube Videos

Unit #7: Chemical Reactions

Overview:

Chemical reactions can be modeled in various ways and different symbols are used to represent certain aspects. Several types of reactions correspond to real world chemical reactions in which patterns can be identified. Balanced equations provide more information about the moles and ions in aqueous solution offer evidence for why a precipitate may form.

STAGE 1
Desired Results

Essential Questions…

- How do chemists keep track of changes in matter?
- How are changes in matter classified?
- How does mass change during a chemical or physical change?
- How do you balance atoms in a chemical equation?
- How do atoms rearrange to form new products?
- How can you predict the products of a chemical reaction?

Enduring Understanding…

Energy is obtained from chemical reactions through modeling of these reactions and analyzing and interpreting data on what causes reactions. There are patterns in balancing different types of reactions and predicting the products of those reactions.

Students will be able to...

- Write balanced equations for chemical reactions
- Distinguish between endothermic and exothermic reactions
- Explain what causes chemical reactions
- Develop a basic conceptual and mathematical model for the generation of energy from the reaction of two substances
- Identify the five general types of chemical reactions and describe components that are reactants and products in these reactions
- Predict the outcome of certain reactions based on these components, and make a claim about why the reactants react and why the products are formed
- Investigate and explain formation of precipitates using knowledge of solubility and intermolecular forces
- Use evidence to make a claim about whether a reaction will form a precipitate in a chemical reaction

Students will know...

Assessment Topic #1 – Modeling Chemical Reactions

Key Terms/Vocabulary:

- Chemical equation, coefficient, endothermic, exothermic, chemical equations, law of conservation of energy, law of conservation of mass, products, reactants, skeleton equation,

Main Ideas/Concepts:

- Skeleton equations and symbols are used to decode a chemical equation
- Balanced equations show the relationship between reactants and products

Possible Misunderstandings:

- Subscripts are allowed to be changed in a chemical equation
- Coefficients need to be the same on both sides of an equation

Assessment Topic #2 – Predicting Outcomes of Chemical Reactions

Key Terms/Vocabulary:

- Activity series, combination reactions, combustion reaction, decomposition reactions, double-replacement reactions, hydrocarbon, single-replacement reactions, synthesis reaction

Main Ideas/Concepts:

- There are five types of chemical reactions: combination/synthesis, decomposition, singple replacement, double replacement, and combustion.
- Patterns are used to distinguish between the five types of reactions

Possible Misunderstandings:

- The coefficient determines the type of reaction

Assessment Topic #3 – Reactions in Aqueous Solution

Key Terms/Vocabulary:

- Aqueous solution, net ionic equations, precipitate, spectator ion

Main Ideas/Concepts:

- Solubility rules are used to determine if a precipitate will form in a chemical reaction

Possible Misunderstandings:

- All reactions occur without some kind of change

Topics that address the Climate Change

- Researching chemical reactions that occur that may impact the environment

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Modeling Chemical Reactions

- Balancing Equations Practice – Students practice balancing chemical equations based on their appropriate level and difficulty.

Assessment Topic #2 – Predicting Outcomes of Chemical Reactions

- Predicting Products of Chemical Reactions Stations – Students read about each type of reaction to determine the correct type and then try to predict the product based on specific patterns.
- Types of Reactions Demo – Students write observations from chemical demos and try to identify the type of reaction based on the given reactants.

Assessment Topic #3 – Reactions in Aqueous Solution

- Solubility Lab – Students make predictions about chemical reaction solubility and then experiment to determine when a precipitate forms in a double replacement reaction.

Summative Activities, Tasks, or Projects:

- Identifying Evidence of Chemical Reactions Lab – Students will identify the evidence and reasoning for how and why a chemical reaction occurs in order to fill a balloon with gas and write the balanced equation.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 7 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Modeling Chemical Reactions

Lesson Theme 1.1 – Word Eqations

Lesson Theme 1.2 – Chemical Equations

Lesson Theme 1.3 – Balancing Equations

Assessment Topic #2: Predicting Outcomes of Chemical Reactions

Lesson Theme 2.1 – Types of Reactions
Lesson Theme 2.2 – Combination Reactions
Lesson Theme 2.3 – Decomposition Reactions
Lesson Theme 2.4 – Single Replacement Reactions
Lesson Theme 2.5 – Double Replacement Reactions
Lesson Theme 2.6 – Combustion Reactions
Lesson Theme 2.7 – Predicting the Products of Reactions

Assessment Topic #3: Reactions in Aqeuous Solution
Lesson Theme 3.1 – Ions in Aqueous Solution
Lesson Theme 3.2 – Predicting The Formation of a Precipitate

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.

- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Balancing Chemical Equations (https://phet.colorado.edu/sims/html/balancing-chemical-equations/latest/balancing-chemical-equations_en.html)
- Khan Academy

- Newsela
- YouTube Videos

Unit #8: Stoichiometry

Overview:

For a recipe to be successful, ingredients must be added in the correct proportions. If you know how much of one ingredient you have, you can determine how much you need of others using conversion factors. A balanced chemical equation is a type of recipe, and the act of balancing reactants and products accounts for conservation of mass. A balanced equation tells us how to calculate the amount of reactant needed or to predict the amount of product.

STAGE 1
Desired Results

Essential Questions…

- Why is the mole an important measurement in chemistry?
- How are balanced chemical equations used in stoichiometric calculations?
- How can you calculate amounts of reactants and products in a chemical reaction?

Enduring Understanding…

If the the proportions of a chemical reaction are not exact, one reactant will run out before the other, therby limiting the amount of product formed. In addtion, all reactions in the real world involve error, which usually result in a yield less than 100%.

Students will be able to...

- Analyze data on proportionality of reactants and products to predict their stoichiometric ratios in the corresponding chemical equation
- Develop a model that demonstrates conservation of mass in a chemical equation
- Apply mathematical concepts to interpret a chemical equation
- Use dimensional analysis to determine the mass of reactant required to obtain a given amount of product
- Use the mole ratio in a chemical reaction to relate amounts of participating substances
- Develop and use a model of different units of measurement
- Calculate and communicate data on different units of measurement
- Explain the concept of limiting reactant and how it affects the amount of product produced in a reaction
- Explain theoretical and actual yield and why the former is usually larger than the latter
- Use computational thinking to predict the grams of product given the grams of reactant

Students will know...

Assessment Topic #1 – Quantifying Reactants and Products

Key Terms/Vocabulary:

- Law of conservation of mass, products, reactants, stoichiometry

Main Ideas/Concepts:

- Stoichiometry may seem more like math than chemistry, but it is the underlying “language” of how chemistry works
- Stoichiometry is virtal for being able to carry out chemical reactions with an understanding of how much reactant is needed and how much product will be produced

Possible Misunderstandings:

- Balanced equations require the same number of reactant and product molecules

Assessment Topic #2 – Chemical Calculations

Key Terms/Vocabulary:

- Mass-mass calculations mole-mole calculations, mole ratio, volume-volume calculations

Main Ideas/Concepts:

- A mole ratio is used as a unit conversion in predicting the amount of product in a reaction.

- Different units are used for mass, volume, and moles when measuing substances as reactants and products.

Possible Misunderstandings:

- Reactants and products can only be measured as mass or volume

Assessment Topic #3 – Limiting Reagent and Percent Yield

Key Terms/Vocabulary:

- Actual yield, excess reagent, limiting reagent, percent yield, theoretical yield

Main Ideas/Concepts:

- Stoichiometry can be applied to determine the limiting reactant in a. reaction and calculate the percent yield

Possible Misunderstandings:

- The reactant that has the lower amount in the beginning will always be the limiting reactant

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Quantifying Reactants and Products

- Making a Sandwich – Students will use a recipe to make a sandwich to describe the materials used to make the sandwich and how it's related to chemical equations.

Assessment Topic #2 – Chemical Calculations

- Mole Ratio Practice – Students will convert between moles of one species to another using mole ratios and stoichiometry following a mole map.

Assessment Topic #3 – Limiting Reagent and Percent Yield

- Aluminum + Copper Chloride Lab – Students will calculate and measure the amount of product formed between the reaction of aluminum foil and a copper chloride solution in order to identify the limiting reagent.

Summative Activities, Tasks, or Projects:

- Micro Rocket Lab – Students will generate microscale quantities of hydrogen and oxygen to test their explosive nature to find the most powerful mixture to launch a "rocket" across the room.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 8 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Quantifying Reactants and Products
Lesson Theme 1.1 – Equations as a Recipe
Lesson Theme 1.2 – Interpreting Chemical Equations
Lesson Theme 1.3 – What is Conserved?

Assessment Topic #2: Chemical Calculations
Lesson Theme 2.1 – Mole Ratios
Lesson Theme 2.2 – Mole-Mole Calculations
Lesson Theme 2.3 – Mass-Mass Calculations
Lesson Theme 2.4 – Volume-Volume Calculations

Assessment Topic #3: Limiting Reagent and Percent Yield

Lesson Theme 3.1 – Limiting and Excess Reagents
Lesson Theme 3.2 – Mass of Products and Reactants
Lesson Theme 3.3 – Percent Yield

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials

- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Reactants, Products, and Leftovers (https://phet.colorado.edu/en/simulations/reactants-products-and-leftovers)
- Khan Academy
- Newsela
- YouTube Videos

Unit #9: Thermochemistry, Kinetics, and Equilibrium

Overview:

Heat energy and heat flow are governed by particular laws that also describe how this heat energy interacts with chemical bonds through reactions. Enthalpy (heat flow at constant pressure) and can be used to demonstrate exothermic and endothermic reactions or calculate its changes using a variety of methods. Chemical reactions rely on successful collisions between molecules which is the basis of collision theory. The concept of equilibrium ties collision theory to the effects of changing conditions in a reaction system.

STAGE 1
Desired Results

Essential Questions…

- What reactions are sources of heat?
- In what direction is heat transferred during a chemical process?
- What is the difference between temperature and heat?
- How do different substances respond to heat transfer?
- How can you control the speed of a reaction?
- What is the energy associated with reversing reactions?

Enduring Understanding…

Everyone feels warm when they exercise and has felt their body temperature increase when they exert themselves. The heat in systems and surroundings can be described as functions of energy which comes from the different chemical processed that produce them. Temperature, concentration, and pressure affect the number of collisions and temperature also affects the energy with which particles collide.

Students will be able to...

- Explain how molecules must collide with each other with sufficient energy and in the correct orientation for a chemical reaction to take place
- Represent energy changes in exothermic and endothermic reactions using an enthalpy diagram
- Calculate enthalpy of reaction from bond energies and molar enthalpy of reaction data
- Develop and use a model to show the effect of concentration and temperature on reaction rate
- Analyze data on reaction rates and conditions to graph a mathematical description of the relationship between the two
- Assess patterns in the change of reaction rates with changes in conditions
- Make predictions about changes in reaction with changes in concentration and temperature
- Use Le Chatelier's principle to predict the direction a reaction at equilibrium will shift if disrupted by a change in concentration, temperature, or pressure
- Explain how variables such as temperature and pressure can be adjusted to increase or decrease yield in a reaction

Students will know...

Assessment Topic #1 – Energy in Chemical Bonds

Key Terms/Vocabulary:

- Activation energy, bond enthalpy, collision theory, enthalpy, enthalpy diagrams, heat, surroundings, system, thermochemical equations, thermochemistry

Main Ideas/Concepts:

- Scientists can measure the energy in chemical bonds and describe how that energy changes during chemical reactions.
- Energy is released when bonds are broken and energy is absorbed when bonds are formed.

Possible Misunderstandings:

- When bonds are formed energy is not released

Assessment Topic #2 – Rates of Reaction

Key Terms/Vocabulary:

- Collision theory, Concentration, equilibrium, particle size, reaction rates, temperature

Main Ideas/Concepts:

- Collision theory describes what happens on a molecular level between colliding particles
- Temperature, concentration, and particle size affect rates of reaction

Possible Misunderstandings:

- All collisions between particles are successful
- Only chemical reactions that occur fast are important

Assessment Topic #3 – Reversible Reactions and Equilibrium

Key Terms/Vocabulary:

- Change, chemical equilibrium, equilibrium position, Le Châtelier's Principle, pressure, reversible reaction, stability, temperature

Main Ideas/Concepts:

- An equilibrium can be disrupted by various changes in the system
- Equilibrium is a dynamic state that depends upon the conditions

Possible Misunderstandings:

- All reactions go to completion

Topics that address the Climate Change

- Researching energy sources and transfers between various systems

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Energy in Chemical Bonds

- Ice Melting Blocks – Students will investigate what happens when an ice cube is placed on two similar blocks but melt at different times.
- Enthalpy Calculations – Students will calculate the amount of enthalpy in a chemical reaction by determining the amount of energy required to break old bonds and make new bonds.

Assessment Topic #2 – Rates of Reaction

- Rate of Reaction Lab – Students will describe and investigate the factors (temperature, particle size, concentration) that affect the rate of reaction.

Assessment Topic #3 – Reversible Reactions and Equilibrium

- Le Chatelier's Principle Lab – Students will perform a chemical reaction and introduce a change to the system to identify the effect of the change on the position of equilibrium.

Summative Activities, Tasks, or Projects:

- End of Unit Assessment – Take an assessment that covers the key points for Unit 9 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Energy in Chemical Bonds
Lesson Theme 1.1 – Collisions in Reactions
Lesson Theme 1.2 – System and Surroundings
Lesson Theme 1.3 – Bond Enthalpy

Assessment Topic #2: Rates of Reaction
Lesson Theme 2.1 – Collision Theory
Lesson Theme 2.2 – Effect of Concentration
Lesson Theme 2.3 – Effect of Temperature

Lesson Theme 2.4 – Effect of Particle Size

Assessment Topic #3: Reversible Reactions and Equilibrium
Lesson Theme 3.1 – Reversible Reactions
Lesson Theme 3.2 – Chemical Equilibrium
Lesson Theme 3.3 – Le Chatelier's Principle

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts

- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- Khan Academy
- Newsela
- YouTube Videos

Unit #10: Nuclear Processes

Overview:

Nuclear processes provide energy and matter that are useful to humans. Some of these processes happen naturally, while others are the result of human intervention. Taking advantage of nuclear processes requires a variety of advanced technologies that involve trade-offs related to cost, resource availability, wastes that pollute the environment, and safety.

STAGE 1
Desired Results

Essential Questions…

- What are nuclear reactions?
- What types of isotopes do the various elements have?
- How are new elements formed?

Enduring Understanding…

Nuclear fission, nuclear fusion, and radioactive decay can result in new elements. But nuclear fusion and nuclear fission are difficult processes to control and often involve large amounts of energy. Nuclear reactions do take place in the stars where atoms are created. So far it is not yet possible or practical to create gold atoms through nuclear reactions here on Earth.

Students will be able to...

- Describe the particles and forces present in the atomic nucleus
- Develop models to illustrate the changes in the composition of the atomic nucleus and the energy released during radioactive decay
- Use mathematics to calculate the half-life of a radioactive substance and the approximate age of old materials
- Develop models to explain the conservation of mass and energy during the processes of fission and fusion
- Describe conversions between mass and energy during the Big Bang
- Use mathematics to calculate the energy during a nuclear process
- Explain the role of fusion in the formation of new elements and in the star life cycle
- Explain radiation hazards and how they can be measured
- Describe the risks and benefits of nuclear technologies

Students will know...

Assessment Topic #1 – Radioactivity and Half-Life

Key Terms/Vocabulary:

- Alpha decay, beta decay, chain reaction, half-life, isotope, matter, nuclear force, positrons, radioactivity, radioactive decay, radiometric age dating, standard model, transmutation

Main Ideas/Concepts:

- There are various forms of radioactivity with different properties and functions
- The age of old materials can be calculated using radiometric dating

Possible Misunderstandings:

- Radioactivity has no benefits

Assessment Topic #2 – Fission and Fusion

Key Terms/Vocabulary:

- Energy, fissile, gamma rays, mass, nucleosynthesis, nuclear binding energy, nuclear fission, nuclear fusion, star formation

Main Ideas/Concepts:

- Mass conservation no longer applies to fission and fusion because mass is a form of energy and these processes are accompanied by the permanent destruction of a small amount of mass
- The Big Bang resulted in the formation of heavy elements and conversion between mass and energy

Possible Misunderstandings:

- Fission and fusion are only used in nuclear weapons

Assessment Topic #3 – Nuclear Technologies

Key Terms/Vocabulary:

- Cosmic rays, dosimeter, gene mutation, ionizing radiation, nuclear reactors, nuclear power, nuclear waste, radiation

Main Ideas/Concepts:

- There are specific opportunities and risks associated with nuclear technologies such as fission and fusion reactors and radiation in medicine
- Ionizing radiation and cosmic rays have particular damaging effects

Possible Misunderstandings:

- The risks of nuclear technologies outweigh the benefits

Topics that address the Climate Change

- Determining the possibility of nuclear energy as an alternative to fossil fuels

Topics that address the Diversity and Inclusion

- Recognition of scientists in their work in nuclear chemistry

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Radioactivity and Half-Life

- Pennium Half-Life Lab – Students will investigate and collect data on the half-life of the fictitious element Pennium and draw a graph of the data from the lab.

Assessment Topic #2 – Fission and Fusion

- Nuclear Energy Lab – Students will carry out an investigation using dominoes to model critical and supercritical nuclear fission processes.

Assessment Topic #3 – Nuclear Technologies

- Nuclear Power Essay – Students will research the pros and cons of using nuclear power and organize their thoughts into a paper to pick a side.

Summative Activities, Tasks, or Projects:

- End of Unit Assessment – Take an assessment that covers the key points for Unit 10 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Radioactivity and Half-Life
Lesson Theme 1.1 – Radioactivity
Lesson Theme 1.2 – Strong and Weak Nuclear Forces
Lesson Theme 1.3 – Radioactive Half-Lives

Assessment Topic #2: Fission and Fusion
Lesson Theme 2.1 – Conservation of Mass and Energy
Lesson Theme 2.2 – The Big Bang
Lesson Theme 2.3 – Nuclear Fission
Lesson Theme 2.4 – Nuclear Fusion

Assessment Topic #3: Nuclear Technologies
Lesson Theme 3.1 – Radiation
Lesson Theme 3.2 – Nuclear Power

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- Khan Academy
- Newsela
- YouTube Video

Unit #11: Gases

Overview:

Gases differ from liquids and solids and the properties of these gases can be predicted. A variety of equations are used to describe the relationships between pressure, volume, temperature, and amount of a gas. The concept of an ideal gas is used to explain the behavior of real gases and identify the patterns in their properties.

STAGE 1
Desired Results

Essential Questions…

- Why are gases easier to compress than liquids or solids?
- How do gases respond to changes in pressure, volume, and temperature?
- Why is the ideal gas law useful even though ideal gases do not exist?

Enduring Understanding…

The structure of gases at the molecular level can be used to explain gas behavior at the bulk scale. The relationships among the volume, temperature, pressure, and number of molecules of a gas are used to develop models that explain these relationships. Various laws are used to describe the mathematical representation of patterns in these properties.

Students will be able to...

- Investigate and explain how the compressibility of gases differs from the compressibility of solids and liquids
- Use the kinetic theory to explain the properties of gases
- Describe the effects on gases of changes in volume, temperature, pressure, and the number of particles
- Investigate and explain the relationship between the volume, temperature, and pressure of a gas
- Develop and use models to explain the gas laws
- Relate the patterns of interaction between gas particles at the molecular scale to the patterns of gas behavior at the macroscopic scale
- Investigate and explain the ideal gas law
- Construct an explanation for how a real gas differs from an ideal gas
- Explain how the concept of an ideal gas is helpful
- Relate the patterns of interaction between gas particles at the molecular scale to the patterns of gas behavior at the macroscopic scale

Students will know...

Assessment Topic #1 – Properties of Gases

Key Terms/Vocabulary:

- Compressibility, pressure, temperature, volume

Main Ideas/Concepts:

- A change in one factor affecting a gas (pressure, temperature, or volume) results in a change in another factor
- The kinetic theory can explain changes in the properties of a gas

Possible Misunderstandings:

- Gases behave differently because we cannot see them

Assessment Topic #2 – The Gas Laws

Key Terms/Vocabulary:

- Absolute zero, Avogadro's Law, Boyle's Law, Charles's Law, combined gas law, Gay Lussac's Law

Main Ideas/Concepts:

- The gas laws are simple mathematical relationships between volume, pressure, temperature, and quantity of a gas
- The combined gas law is a single mathematical expression of the individual gas laws

Possible Misunderstandings:

- One factor is held constant in the gas laws which allows the others to be changed

Assessment Topic #3 – Ideal Gases

Key Terms/Vocabulary:

- Extensive, ideal gas, Ideal Gas Law, intensive,

Main Ideas/Concepts:

- Ideal gases do not exist but are helpful in explaining the behavior of real gases

Possible Misunderstandings:

- Since ideal gases do not exist, they are not useful to study

Topics that address the Climate Change

- Identifying gases in the environment and their impact on climate

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Properties of Gases

- Compressiblity Lab – Students will plan and carry out an investigation to compare the compressibilities of the three states of matter.
- Gas Properties PhET Simulation – Students examine the properties of gases and how they are related to each other.

Assessment Topic #2 – The Gas Laws

- Relationships Between Gas Variables Lab – Students carry out an investigation to determine how gas pressure and temperature is related to gas volume.

Assessment Topic #3 – Ideal Gases

- Gas Behavior in Popping Candy – Students explore real and ideal gases by manipulating variables in a batch of popping candy.

Summative Activities, Tasks, or Projects:

- Cartesian Divers – Students plan and carry out an investigation to design Cartesian divers using their knowledge of the properties of gases.
- End of Unit Assessment – Take an assessment that covers the key points for Unit 11 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Properties of Gases
Lesson Theme 1.1 – Compressibility
Lesson Theme 1.2 – Gas Pressure and Amount of Gas
Lesson Theme 1.3 – Gas Pressure and Volume
Lesson Theme 1.4 – Gas Pressure and Temperature

Assessment Topic #2: The Gas Laws
Lesson Theme 2.1 – Boyle's Law
Lesson Theme 2.2 – Charles's Law
Lesson Theme 2.3 – Gay Lussac's Law
Lesson Theme 2.4 – Combined Gas Law

Assessment Topic #3: Ideal Gases
Lesson Theme 3.1 – Ideal Gas Law
Lesson Theme 3.2 – Real Gases

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study

- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts

- Use of Merriam-Webster's ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET Gas Properties (https://phet.colorado.edu/sims/html/gas-properties/latest/gas-properties_en.html)
- Khan Academy
- Newsela
- YouTube Videos

Unit #12: Acids and Bases

Overview:

There are various definitions of acids and bases which are all used to this day in different situations. The pH of a solution indicates the acidity of a solution and can be calculated if given the hydronium ion concentration. Ocean acidification can be studied to analyze the cause and effect of changes to pH level, carbon cycling, and currents on the ocean system.

STAGE 1
Desired Results

Essential Questions…

- What are the different ways chemists define acids and bases?
- What does the pH of a solution mean?
- How do chemists use acid-base reactions?
- What factors affect ocean pH and ocean acidification?

Enduring Understanding…

Acid rain can be so dangerous to environmental systems and can be related back to the definitions of acids and bases based on different models of explanation. The pH of a solution can be calculated and titrations can be performed to calculate an unknown concentration.

Students will be able to...

- Define an acid and a base using the Arrhenius, Bronsted-Lowry, and Lewis models
- Calculate the pH value for a solution given its hydronium ion concentration
- Understand the difference between acids and bases
- Describe acid-base neutralization reactions, both qualitatively and quantitatively
- Understand and interpret the results of titrations, including find the equivalence point of the titration, and use that data to find the concentration of unknown solutions.
- Identify global patterns of ocean pH, salinity, and alkalinity
- Apply principles of chemical equilibrium to explain ocean pH
- Predict the impact of ocean acidification on marine organisms such as corals

Students will know...

Assessment Topic #1 – Acids, Bases, and Salts

Key Terms/Vocabulary:

- Acid, base, neutral solutions, pH concepts, salts

Main Ideas/Concepts:

- Acids and bases can be defined using different models (Arrhenius, Bronsted Lowry, Lewis)
- Water can act as an acid or a base
- The pH of a solution can be calculated from its hydronium ion concentration

Possible Misunderstandings:

- Only one model of acids and bases should be used

Assessment Topic #2 – Reactions of Acids and Bases

Key Terms/Vocabulary:

- Equivalence point, neutralization reaction, pH, titration

Main Ideas/Concepts:

- Titrations are used to accurately determine the concentrations of unknown solutions
- There is a mole ration between acids and bases in a neutralization reaction.

Possible Misunderstandings:

- Acids and bases always combine to give a neutral solution

Assessment Topic #3 – Ocean pH Levels

Key Terms/Vocabulary:

- Carbon dioxide, Le Châtelier's principle, ocean acidification, ocean pH, pH variations surface temperature changes

Main Ideas/Concepts:

- The amount of carbon dioxide affects the pH of a saline solution
- An ocean's acid-base equilibria is affected by carbon dioxide and thus marine organisms use of specific compounds

Possible Misunderstandings:

- Human and environmental considerations that play a role in ocean and atmospheric properties

Topics that address the Climate Change

- Environmental considerations (human impact, acid rain, ocean pH, etc.) on climate

STAGE 2
Evidence of Learning

Formative Activities, Tasks, or Projects:

Assessment Topic #1 – Acids, Bases, and Salts

- PhET Simulation pH Scale – Students investigate the pH of everyday solutions to reinforce the concept of the pH scale.

Assessment Topic #2 – Reactions of Acids and Bases

- Acid-Base Titration Lab – Students perform a titration to calculate the concentration of an unknown solution.

Assessment Topic #3 – Ocean pH Levels

- Ocean pH Interactive – Students explore changes in ocean pH over recent centuries and investigate how changes in ocean CO_2 concentrations have affected the health of coral reefs.

Summative Activities, Tasks, or Projects:

- End of Unit Assessment – Take an assessment that covers the key points for Unit 12 using a variety of question types (multiple-choice, fill-in-the-blank, matching, short answer, open-ended, etc.).

STAGE 3
Learning Plan

Assessment Topics and Lesson Themes:

Assessment Topic #1: Acids, Bases, and Salts
Lesson Theme 1.1 – Properties of Acids, Bases, and Salts
Lesson Theme 1.2 – Defining Acids and Bases
Lesson Theme 1.3 – Calculating pH

Assessment Topic #2: Reactions of Acids and Bases
Lesson Theme 2.1 – Acid-Base Neutralization Reactions
Lesson Theme 2.2 – Acid-Base Titrations

Assessment Topic #3: Ocean pH Levels
Lesson Theme 3.1 – Carbon Dioxide and Ocean pH
Lesson Theme 3.2 – Ocean Salinity and Alkalinity

Unit Specific Accommodations and Modifications

Gifted and Talent Accommodations and Modifications:

- Allow for further independent research on topics of interest related to the unit of study
- Advanced leveled readers and sources
- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products

- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Special Education, and At-Risk Accommodations and Modifications:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

English Language Learners:

- Focus on concept not details
- More visual prompts
- Leveled readers and teacher annotated sources
- Guided notes with highlighted words and concepts
- Use of Merriam-Webster’s ELL dictionary
- Timelines and graphic organizers
- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding

- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Unit Specific Interdisciplinary Connections / Materials

Argument-Driven Inquiry in Chemistry, POGIL Activities for High School Chemistry

Additional Materials

Digital Tools/Resources:

- Saavas Experience Chemistry
- PhET pH Scale (https://phet.colorado.edu/sims/html/ph-scale/latest/ph-scale_en.html)
- Khan Academy
- Newsela
- YouTube Videos

Horizontal Integration/Interdisciplinary Connections:

See Appendix