Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

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DEPARTMENT: **Science** COURSE: **Chemistry**

Curriculum Development Timeline

School: Ocean Township High School

Course: Chemistry

Department: Science

Board Approval	Supervisor	Notes
March 2009	Patrick Sullivan	Born Date
July 2010	Patrick Sullivan	Revisions
January 2012	Patrick Sullivan	Revisions
September 2015	Patrick Sullivan	Revisions
July 2016	Patrick Sullivan	Revisions
March 2019	Patrick Sullivan	Review
August 2022	Patrick Sullivan	Alignment to Standards

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Township of Ocean Pacing Guide			
Week	**Marking Period 1**	**Week**	**Marking Period 3**
1	Lab Safety & Chemistry in Today's World	11	Molecular Geometry (VSEPR) & Intermolecular Forces
2	Matter & Change	12	Chemical Formulas & Chemical Compounds
3	Using Scientific Measurements in Chemistry	13	Chemical Formulas & Chemical Compounds
4	Using Scientific Measurements in Chemistry	14	The Math of Chemical Formulas The Mole
5	Atomic Structure	15	Chemical Equations & Reactions
Week	**Marking Period 2**	**Week**	**Marking Period 4**
6	Nuclear Chemistry	16	Stoichiometry The Math of Chemical Equations
7	Quantum Chemistry (Electromagnetic Spectrum & Light)	17	Thermochemistry & States of Matter
8	Electron Structure & The Periodic Table	18	Gas Laws
9	Electron Structure & The Periodic Table	19	Solutions, Acids and Bases, Chemical Equilibrium, & Reaction Rates
10	Chemical Bonding	20	Final Exam

Climate Change: Quantum Chemistry (NJSLS-S: HS-ESS3-5)

Core Instructional & Supplemental Materials including various levels of Texts
Texts: Modern Chemistry - 2009-Holt, Reinhart + Winston (Accelerated Level)

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Basic Chemistry - 2011-Timberlake + Timberlake, 3rd Edition

Digital Resources Across All Levels: (D=differentiated)
ChemTours digital program (D)
Chem Matters newsletters
Edpuzzle (D)
Gizmo (D)
YouTube videos
New York Times Articles
PhET Interactive Simulations (D)
Science News (D)
Ted Talks
OTHS Spartan Learning Library (D)

Time Frame	**1 Week**

Topic

Lab Safety & Chemistry in Today's World

Alignment to Standards

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-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.

Learning Objectives and Activities

Learning Objectives:

- Why should students study chemistry and chemicals?
- What is the importance of laboratory safety?
- Students should study chemistry because it plays an integral part in all aspects of life
- Having students learn the scientific method will help them to develop a theory using observations, hypotheses and experiments
- Students will demonstrate the basic safety rules that must be followed when working in the laboratory

Learning Activities:

- Understand the importance of studying the science of chemistry

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- List the basic safety rules that must be followed when working in the laboratory
- Explain the reason for each laboratory safety rule
- Apply and understand the importance of all safety rules when performing lab work

Assessments

Formative:
- Think-Pair-Share
- Strategic Questioning
- Lesson Checks
- Writing a Lesson Summary
- Exit Tickets

Summative:
- Laboratory Work
- Gummy Worm Inquiry Activity
- Safety First POGIL
- Assess - Lab Safety in the Chemistry Classroom
- Describe the tools that will be used in the chemistry lab

Benchmark:
- Chemistry Department Skills Assessment Benchmark

Alternative:
- Lab Safety Poster Project in lieu of Lab Safety Quiz

Interdisciplinary Connections

WHST.9-12.9: Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3)
SL.11-12.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)

Career Readiness, Life Literacies, and Key Skills

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

Technology Integration

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Career Education
CRP-2: Students will work collaboratively to discover the difference between qualitative and quantitative data through inquiry (Gummy Worm Activity). **CRP-4:** Students will represent understanding of safe lab practices by creating a lab safety poster which will be presented to the class.

Time Frame	**1 Week**

Topic
Matter & Change

Alignment to Standards
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-PS1-3:** 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-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Learning Objectives and Activities
Learning Objectives: • How can one explain the structure, properties, and interactions of matter? • How can a periodic table help classify elements into metals, nonmetals and metalloids? • How do substances combine to form the variety of matter that makes up our world? • How can the Law of Conservation of Matter be proven by conducting a chemical reaction? • Apply chemical substances to the earth's layers and the geochemistry involved. **Learning Activities:** • Use the periodic table as a model to provide evidence for relative properties of elements at different scales based on patterns within a group and period • Use models (flow chart) to summarize and understand how matter can be found in nature • Classify change as a physical process or a chemical process • Describe Earth's distribution of minerals

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- Identify Earth's minerals and materials which are natural resources
- Recognize and discuss the natural and man-induced causes that lead to climate change.

Assessments

Formative:

- Think-Pair-Share
- Strategic Questioning
- Lesson Checks
- Compare/contrast pure substance with mixture
- Describe the four states of matter

Summative:

- Laboratory Work
- Foaming Eggs Inquiry
- Observing a Chemical Reaction
- Law of Conservation of Mass Lab
- Separating Mixtures Inquiry
- Physical & Chemical Changes Lab with writing task
- Classification of Matter POGIL

Benchmark: N/A

Alternative:

- Plan and conduct an investigation to gather evidence to compare the relative difference among elements on the periodic table
- Presentation on the chemistry of climate change

Interdisciplinary Connections

MP.2: Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)
HSN-Q.A.2: Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)

Career Readiness, Life Literacies, and Key Skills

Technology Integration

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw

conclusions about the data.
Career Education
CRP-2: Students will work collaboratively during lab work **CRP-4:** Students will represent understanding of safe lab practices while working in the chemistry lab

Time Frame	**2 Weeks**
Topic	
Using Scientific Measurements in Chemistry	
Alignment to Standards	
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-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Learning Objectives and Activities	

Learning Objectives:

- What are significant digits and how are they used in calculations?
- How are measurements converted into scientific notation?
- What are unit equalities and how are they used in solving dimensional analysis calculations?
- What information is needed to calculate both density and percent error?
- How are graphs used to distinguish between inversely and directly proportional relationships?
- Students will demonstrate their understanding of calculating both density and percent error.

Learning Activities:

- Use units as a way to understand problems and to guide the solution of multi-step problems; choose and use units consistently in formulas
- Develop and use models to help with understanding of key concepts
- Analyze and interpret data and graphs based on laboratory investigations
- Constructing explanations and designing solutions for a specific scientific problem
- Select appropriate tools to collect, record, analyze and evaluate data

- Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated
- Apply techniques of algebra and functions to represent and solve scientific engineering problems

Assessments

Formative:

- Think-Pair-Share
- Apply the concept of slope when calculating density
- Students will use their knowledge of a scientific graph to explain and display experimental data
- Strategic Questioning

Summative:

- Laboratory Work
  - Rainbow Volumes
  - Bunsen Burner Inquiry Lab
  - Graphing Scientific Data Activity
  - Density of a Penny Lab
  - Dimensional Analysis of Fudge Lab
- Cumulative Assessment - Measurements

Benchmark: N/A

Alternative:

- Plan and conduct an investigation

Interdisciplinary Connections

MP.2: Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)
HSN-Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

Career Readiness, Life Literacies, and Key Skills

Technology Integration

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw

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conclusions about the data
Career Education
CRP-2: Students will work collaboratively during lab work **CRP-4:** Students will represent understanding of safe lab practices while working in the chemistry lab

Time Frame	**1 Week**
Topic	
Atomic Structure	
Alignment to Standards	
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.	
Learning Objectives and Activities	

Learning Objectives:

- Who were the scientists and what was their contribution to the current model of the atom?
- How can you mathematically solve for the weighted average atomic mass of an isotope?
- Studying the periodic table is very useful for discovering, learning and remembering the different properties of the elements.
- Students will demonstrate the understanding of the current atomic model by studying the past history of the atom.
- Learning the major components of the atom will lead students to the understanding of atomic number, mass number. ions and isotopes.

Learning Activities:

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- Model with mathematics
- Discuss contributions that scientists made to atomic structure
- Define the terms atom, ions and isotopes and discuss how they are different and related
- Name and describe the three subatomic particles of an atom
- Determine the number of protons, neutrons and electrons in an atom or ion

Assessments

Formative:

- Think-Pair-Share
- Interpreting the periodic table by trends, patterns, etc.
- Strategic Questioning
- Describe how early scientists contributed to the arrangements of elements
- Lesson Check

Summative:

- Laboratory Work
  - History of The Atom - Atoms in Al Foil
  - Bead Lab - Atoms, Ions & Isotopes Manipulative
  - Halloweenium/Candium - Calculating Atomic Mass
- Assess: History of Atomic Structure
- Assess: Atomic Structure - Subatomic Particles, Ions & Isotopes

Benchmark: N/A

Alternative:

- Foldable Project in place of formal quiz on History of Atomic Structure Quiz - Rubric

Interdisciplinary Connections

WHST.9-12.2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2), (HS-PS1-5)
MP.4: Model with mathematics. (HS-PS1-4), (HS-PS1-8)

Career Readiness, Life Literacies, and Key Skills

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).

Technology Integration

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Career Education
CRP-4: Students will demonstrate skills acquired in class through collaboration **CRP-12:** Students work productively during group work

Time Frame	**1 Week**
Topic	
Nuclear Chemistry	
Alignment to Standards	
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-ESS1-5:** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. **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.	
Learning Objectives and Activities	
Learning Objectives: • How are the different types of radiation used to write nuclear equations? • How can radioactivity be both beneficial and harmful? • What is the half-life of a radioactive element? • Explain why nuclear reactions occur and know how to balance a nuclear equation. • Discuss applications of radioactive nuclides. **Learning Activities:** • Develop models based on evidence 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. • Model with mathematics • Reason abstractly and quantitatively • Discuss the pros and cons of using nuclear energy/radiation	
Assessments	

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Formative:
- Think-Pair-Share
- Explain the relationship between number of nucleons and stability of nuclei
- Explain what a nuclide is and describe the different ways nuclides can be represented
- Define and relate the terms mass defect and nuclear binding energy
- Lesson Check

Summative:
- Laboratory Work
  - Half-Life of Pennium with graph
  - Radioactive Decay Cards - Simulate the decay series of Uranium-238
- Compare and contrast nuclear fission and fusion
- Assessment - Atomic Structure & Nuclear Chemistry

Benchmark: N/A

Alternative:
- Nuclear Chemistry Project - Students will pick a topic (i.e., Dirty Bombs, Medical Isotopes) and research it online. Students will then choose a media platform that will best suit their project needs.

Interdisciplinary Connections

RST.9-10.7: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. (HS-PS1-1)

Career Readiness, Life Literacies, and Key Skills

Technology Integration

Career Education

CRP-2: Students will work collaboratively during lab work
CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab
CRP-12: Students will demonstrate skills acquired in class through lab work

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Time Frame	**1 Week**

Topic

Quantum Chemistry
(Electromagnetic Spectrum & Light)

Alignment to Standards

HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media
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.

Learning Objectives and Activities

Learning Objectives:

- What is electromagnetic radiation?
- What are the mathematical relationships between speed of light, wavelength and frequency?
- How is Plank's constant used to solve for the energy of light?
- By studying the electromagnetic spectrum, students will be able to compare the wavelength of radiation with its energy.
- By studying the electromagnetic spectrum students will understand that electrons can only absorb or emit a specific amount of energy.
- Make connections to climate change (Earth warming)

Learning Activities:

- Evaluate the claims, evidence and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations, one model is more useful than the other.
- Use mathematical representations to support a claim regarding relationships among the frequency, wavelength and speed of waves traveling through space.
- Model with mathematics $C=\lambda v$ & $E=hv$
- Reason abstractly and quantitatively
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations

Assessments

Formative:

- Think-Pair-Share
- Describe atomic orbitals in terms of their shape, size and energy
- Strategic Questioning
- Lesson Check
- Minute Math Review

Summative:

- Laboratory Work
  - Flame Test Lab - Students will observe the characteristic colors produced by certain metallic ions when vaporized in a flame
- Assessment - The EMS & Light Problems
- Assessment - Rydberg Equation

Benchmark: N/A

Alternative:

- Electromagnetic Structure Book Project - Students create an EMS Book project to provide evidence of student learning of content and cognitive skills Rubric

Interdisciplinary Connections

RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS4-1), (HS-PS4-4)
MA.9-12.A-CED.A4: Students will rearrange formulas to solve for wavelength, frequency or energy.
MA.9-12.N-Q.A.1: Students will use units to understand what is being measured and to correctly solve math problems (Light Equations & Rydberg Equation).

Career Readiness, Life Literacies, and Key Skills

Technology Integration

Career Education

CRP-2: Students will work collaboratively during lab work
CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab

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CRP-12: Students will demonstrate skills acquired in class through lab work or by creating the EMS Book Project

Time Frame	**2 Weeks**

Topic

Electron Structure & The Periodic Table

Alignment to Standards

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Learning Objectives and Activities

Learning Objectives:

- What are sublevels and orbitals in an atom?
- How can students draw orbital diagrams and write electron configurations of an element?
- How can we classify the elements on the periodic table into specific groups & sublevels?
- How can students use the electron configurations of elements to explain the periodic trends?
- Students will demonstrate the understanding that an atom is composed of specific sublevels and orbitals.
- Use the periodic table to identify the groups and the period of an element and decide whether it is a metal, metalloid or a nonmetal.
- Define and identify the important periodic trends of the periodic table.

Learning Activities:

- Demonstrate understanding of how to write electron configurations and orbitals diagrams for an element in both the ground and excited ion state
- Draw Lewis Structures for atoms
- Cite specific textual evidence to support analysis of science and technical text
- State the periodic law
- Explain why elements in a group have similar properties
- Determine the number of electrons in an atom or ion

Assessments

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Formative:
- Think-Pair-Share
- Write electron configurations for atoms
- Strategic Questioning
- Draw the orbital diagram for various elements of the periodic table
- Lesson Check

Summative:
- Laboratory Work
- Color Code the Periodic Table Lab
- Density is a Periodic Trend Lab with Graphing
- Assessment - Electron Configuration & The Periodic Table
- Assessment - The EMS, Light, Electron Structure & The Periodic Table

Benchmark: N/A

Alternative:
- Discuss contributions that scientists made to the periodic table

Interdisciplinary Connections

LA.9-10RST.9-10.3: Students will have to read and interpret specific written text in order to follow lab procedures while conducting:
- Color Code the Periodic Table Lab
- Periodic Trends Lab

LA.9-10.RH.9-10.4: ChemMatters article, “The Many Looks of the Periodic Table”. Students will read the text and answer specific questions.
MA.9-12.N-Q.A.1: Students will use units to understand what is being measured and to correctly solve math problems (Trends Lab requires density calculations).

Career Readiness, Life Literacies, and Key Skills

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).

Technology Integration

Career Education

CRP-2: Students will work collaboratively during lab work

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CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab
CRP-12: Students work productively during group work

Time Frame	**1 Week**

Topic

Chemical Bonding

Alignment to Standards

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Learning Objectives and Activities

Learning Objectives:

- How can one explain the structure, properties and interactions of matter?
- How can students 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?
- What is the octet rule for both atoms and ions?
- What is the difference between ionic bonding and covalent bonding?
- How can students use Lewis and resonance for molecules and ions?

Learning Activities:

- Apply scientific principles and evidence to provide an explanation about the type of bonding found in various compounds
- From the given model, students identify and describe the components of the model that are relevant for:
  - Elements and their arrangement in the periodic table
  - Electrons in the outermost energy level of the atom and the number of protons present
- Using the octet rule, write the symbols for both atoms and the single ions for the representative elements
- Describe the characteristics of both ionic and covalent bonding
- Describe what a polyatomic ion is

Assessments

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Formative:
- Think-Pair-Share
- Use the periodic table to obtain valence electrons for atoms
- Using the octet rule, students will write the symbols of single ions for the representative elements
- Lesson Check

Summative:
- Laboratory Work
- Electronic Cereal - Visual Aid to how valance electrons are arranged in an atom
- Bonding POGIL
- Represent both ionic and covalent bonding for various compounds
- Draw Lewis Structures and their resonance for molecules and polyatomic ions

Benchmark: N/A

Alternative:
- Chemical Bonding Project - Students will use art and creativity to explain the chemical processes of ionic and covalent bonding by creating a comic strip or a song (Rubric)

Interdisciplinary Connections

RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS2-1)
MP.2: Reason abstractly and quantitatively. (HS-PS2-1), (HS-PS2-2), (HS-PS2-4)

Career Readiness, Life Literacies, and Key Skills

Technology Integration

Career Education

CRP-2: Students will work collaboratively during lab work
CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab
CRP-12: Students work productively during group work

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Time Frame	**1 Week**

Topic

Molecular Geometry (VSEPR) Theory & Intermolecular Forces

Alignment to Standards

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-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Learning Objectives and Activities

Learning Objectives:

- How can students use Lewis structures to predict the geometry (shape), bond angle, hybridization, polarity and IMF of a molecule or polyatomic ion?
- How does hydrogen bonding affect our most important compound, water?
- Describe the VSEPR Theory
- Identify the shapes of various molecules and polyatomic ions
- Understand hybridization and how it relates to sigma and pi bonds

Learning Activities:

- Apply scientific principles and evidence to provide an explanation about the type of bonding found in various compounds
- From the given model, students identify and describe the components of the model that are relevant for:
    - Elements and their arrangement in the periodic table
    - Electrons in the outermost energy level of the atom and the number of protons present
- Using the octet rule, write the symbols for both atoms and the single ions for the representative elements
- Use the VSEPR theory to make predictions about a molecule or polyatomic ion

Assessments

Formative:

- Think-Pair-Share
- Describe the VSEPR Theory
- Identify the shapes of various molecules and polyatomic ions

- Lesson Check
- Atom model kit or balloon geometries

Summative:

- Laboratory Work
  - Gum Drop Lab - VSEPR Theory
  - Properties of Water - IMF Lab
  - IMP POGIL
- Explain what determines polarity of bonds and molecules

Benchmark: N/A

Alternative:

- Explain and describe the different types of intermolecular forces and explain how they influence properties of liquids and solids

Interdisciplinary Connections

LA.9-10RST.9-10.3: Students will have to read and interpret specific written text in order to follow lab procedures while conducting:

- Gum Drop Lab
- Molecular Geometry POGIL and IMF POGIL

LA.9-10.RH.9-10.4: “Smells” article about how the shapes of molecules affect odor
MA.9-12.G-MG: Geometry and VSEPR link

Career Readiness, Life Literacies, and Key Skills

Technology Integration

Career Education

CRP-2: Students will work collaboratively during lab work
CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab
CRP-12: Students work productively during group work

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Time Frame	**2 Weeks**

Topic

Chemical Formulas and Chemical Compounds

Alignment to Standards

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.

Learning Objectives and Activities

Learning Objectives:

- How can formulas and English names be written for:
  - molecular compounds
  - ionic binary and ternary compounds
  - hydrate compounds
  - binary acids and oxyacids
- What is an oxidation number, and how do we assign an oxidation number to atoms in a compound or polyatomic ion?
- Write names for molecular compounds using the prefix system
- Explain how to identify a compound as either a binary or ternary acid
- Describe how to name and write formulas for hydrates

Learning Activities:

- Identify and use the correct prefix and or suffix when naming compounds
- Use roman numerals when appropriate to write formulas
- Apply the correct rules for naming and writing formulas for compounds
- Identification of the type of chemical compound, including how to write their chemical formulas and their English names
- Assign oxidation numbers to compounds and polyatomic ions in order to keep track of electrons being lost and gained when compounds are formed

Assessments

Formative:

- Think-Pair-Share
- Name and write formulas for various compounds containing polyatomic ions
- Describe the characteristics of a covalent bond
- Chem Cubes - Dice Nomenclature Game
- Go Fish for Ions Nomenclature Game

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Summative:
- Laboratory Work
  - Cut and Paste Ions Lab
  - Dropper Lab - Chemical Nomenclature
- Describe how to write formulas and name binary acids and oxyacids

Benchmark: N/A

Alternative:
- Chemical Compounds Project: Students will become better acquainted with writing names of chemical compounds and use of chemicals in everyday life in foods and products that they may use in their daily lives (Rubric)

Interdisciplinary Connections

LA.9-10-RST.9-10.3: Students will have to read and interpret specific written text in order to follow lab procedures while conducting:
- Cut and Paste Ions Lab
- Dropper Lab
- Nomenclature POGIL

Career Readiness, Life Literacies, and Key Skills

Technology Integration

Career Education

CRP-2: Students will work collaboratively during lab work
CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab
CRP-12: Students work productively during group work

Time Frame	**1 Week**

Topic

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DEPARTMENT: **Science** COURSE: **Chemistry**

The Math of Chemical Formulas - The Mole

Alignment to Standards

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

Learning Objectives and Activities

Learning Objectives:

- What is a mole and describe its importance in chemistry?
- What is molar mass and why is it important in chemical calculations?
- How can you convert among the number of moles, the mass of a sample, the volume of a gas and the number of particles?
- What is the percent composition of a substance and how is it calculated?
- Students will demonstrate how to calculate the molar mass of a given chemical formula
- Using molar mass and Avogadro's number, students will be able to complete various conversions using dimensional analysis

Learning Activities:

- Students identify and describe the relevant components in the mathematical representation:
  - Quantities in terms of atoms, moles and mass
  - Molar mass of all compounds
- Apply mathematical modeling by using the mole to convert between various units
- Define a mole and describe its importance
- Identify and use Avogadro's number
- Define molar mass and explain how it relates the mass of a substance to the number of particles in the substance
- Convert among the number of particles, moles and the mass of a substance
- Describe molar volume and use it to solve problems
- Find the percent composition of a given formula
- Use percent composition to determine the formula of an unknown sample

Assessments

Formative:

- Think-Pair-Share
- Students will calculate the mass percentage of each element in a compound
- Students will demonstrate both empirical and molecular formulas

- Minute Math

Summative:

- Laboratory Work
- Percent Composition of a Hydrate
  - Atomic Coatings
  - Cream of the Crop - A Percent Composition Activity
  - Candy Molecules Activity
  - Percent Sugar in Bubble Gum Lab
  - Molar Quantities Lab
  - Determining the Gram Atomic Mass of an Element
  - Determining an Empirical Formula
  - Mole Airlines

Benchmark: N/A

Alternative:

- Formulas in Everyday Life Project with rubric

Interdisciplinary Connections

LA.9-10-RST.9-10.3: Students will have to read and interpret specific written text in order to follow lab procedures while conducting Lab work.
MA.9-12.N-Q.A.1: Students will use units to understand what is being measured and to correctly solve math problems using mole equalities and dimensional analysis.

Career Readiness, Life Literacies, and Key Skills

Technology Integration

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Career Education

CRP-2: Students will work collaboratively during lab work
CRP-4: Students will represent understanding of safe lab practices while working in the chemistry lab
CRP-12: Students work productively during group work

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DEPARTMENT: **Science** COURSE: **Chemistry**

Time Frame	**1 Week**

Topic

Chemical Equations & Reactions

Alignment to Standards

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-PS1-5: 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.

Learning Objectives and Activities

Learning Objectives:

- How does a balanced chemical equation demonstrate the law of conservation of matter?
- What are the four general types of chemical reactions?
- What characteristics identify each type of a chemical reaction?
- What are oxidation numbers and how are they assigned to an atom?
- What is being species oxidized and what species is being reduced in a redox reaction?
- Students should be able to describe the characteristics of a chemical reaction.
- Students will be able to distinguish between the reactants and the products in a chemical equation.

Learning Activities:

- Construct and revise an explanation for the outcome of simple chemical reactions based on the outermost electron states of atoms, trends in the periodic table and knowledge of the patterns of chemical properties.
- Given new evidence or context, students construct a revised or expanded explanation about the outcome of a chemical reaction and justify the revision.
- 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.
- 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.
- Use mathematical representation to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

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- Describe the characteristics of a chemical reaction.by distinguishing between reactants and products.
- Identify a reaction as a synthesis, decomposition, single replacement, double replacement or combustion.

Assessments

Formative:

- Think-Pair-Share
- Students will be able to predict products for the 5 basic reaction types
- Students will be able to distinguish the difference between oxidation and reduction
- Launch Labs

Summative:

- Laboratory Work:
  - Activity Series Lab
  - Reactivity of Metals in Single - Replacement Reactions
  - Bags of Reactions
  - Atomic Coatings
  - Evidence of a Chemical Reaction
  - Types of Chemical Reactions
  - LAB - AIDS #84 Identifications of Chemical Reactions Kit
  - Classifying Chemical Reactions
  - 11-3 Explore Feeling Left Out - Inquiry Activity
  - Valentines Lab - Exploring Chemical Reactions
  - Precipitation Lab - Using Solubility Rules

Benchmark: N/A

Alternative: N/A

Interdisciplinary Connections

WHST.9-12.9: Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3)
HSN-Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

Career Readiness, Life Literacies, and Key Skills

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Technology Integration
Career Education
CRP-2: Students will work collaboratively during lab work **CRP-4:** Students will represent understanding of safe lab practices while working in the chemistry lab **CRP-12:** Students work productively during group work

Time Frame	**1 Week**
Topic	
Stoichiometry The Math of Chemical Equations	
Alignment to Standards	
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-PS1-4:** 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.	
Learning Objectives and Activities	
Learning Objectives: • What is stoichiometry? • How are molar relationships represented in a balanced chemical equation? • What determines the amount of products formed in a chemical reaction? • How is the percent yield of a chemical reaction determined? • Students will be able to distinguish between the reactants and the products in a chemical equation. **Learning Activities:** • Explain how balanced equations apply to both chemistry and everyday life • Interpret balanced equations in terms of moles, representative particles, mass and gas	

volume at STP
- Identify the quantities that are always conserved in chemical reactions
- Calculate stoichiometric quantities from balanced chemical equations
- Calculate theoretical yield, actual yield and percent yield given the appropriate information.

Assessments

Formative:
- Think-Pair-Share
- Students will demonstrate how to obtain mole ratios from a correctly written and balanced equation
- Students will be able to identify the limiting reactant, Excess reactant(s) and Theoretical yield in a chemical equation
- Students will solve for the percent yield of a chemical reaction
- Minute Math

Summative:
- Stoichiometry POGIL
- Stoichiometry of S'Mores
- Stoichiometry Lab
- Determining Percent Yield in a Chemical Reaction Fe to Cu

Benchmark: N/A

Alternative:
- Construct mole ratios from balanced chemical equations and apply these ratios in stoichiometric calculations

Interdisciplinary Connections

LA.9-10RST.9-10.3: Students will have to read and interpret specific written text in order to follow lab procedures while conducting Lab work.
MA.9-12.N-Q.A.1: Students will use units to understand what is being measured and to correctly solve math problems using mole equalities and dimensional analysis.
MA.9-12.N-Q.A.3: Choose a level of accuracy appropriate to limitations on measurements when reporting quantities.

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Career Readiness, Life Literacies, and Key Skills
Technology Integration
Career Education
CRP-2: Students will work collaboratively during lab work **CRP-4:** Students will represent understanding of safe lab practices while working in the chemistry lab **CRP-12:** Students work productively during group work

Time Frame	**1 Week**
Topic	
Thermochemistry & States of Matter	
Alignment to Standards	
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-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Learning Objectives and Activities	
Learning Objectives: • How are the 3 temperature scales related? • How is heat calculated given the mass, the change in temperature and specific heats of substance? • How are thermochemical equations written and used to calculate heat stoichiometry problems? • How will students use and interpret heating and cooling curves? • Students will be able to classify processes as exothermic or endothermic. **Learning Activities:** • Describe the assumption of the kinetic molecular theory as it applies to gases	

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- Define the relationship between Kelvin temperature and average kinetic energy
- Explain how energy, heat and work are related
- Classify processes as either exothermic or endothermic
- Distinguish between heat capacity and specific heat
- Describe how calorimeters are used to measure heat flow
- Calculate heat energy using q=mxΔTxc
- Interpret a heating and cooling curve

Assessments

Formative:

- Students will be able to convert between the three different temperature scales
- Use the heat transfer equation to solve for the various variables using algebra
- Students will be able to graph both heating and cooling curves as well as calculate the total energy in the system
- Minute Math

Summative:

- Thermochemistry POGIL
- Energy in Junk Food Lab
- Specific Heat of Metal Lab
- Heating & Cooling Curve Lab
- Quiz - Thermochemistry
- Test - States of Matter & Thermochemistry

Benchmark: N/A

Alternative:

- Construct thermochemical equations

Interdisciplinary Connections

LA.9-10RST.9-10.3: Students will have to read and interpret specific written text in order to follow lab procedures while conducting Lab work.
MA.9-12.A-RE1.D.10: Students will graph heating and cooling curves, then apply the heat transfer equation, heat of fusion and heat of vaporization to calculate the total amount of energy lost or gained.

Career Readiness, Life Literacies, and Key Skills

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Technology Integration

Career Education
CRP-2: Students will work collaboratively during lab work **CRP-4:** Students will represent understanding of safe lab practices while working in the chemistry lab **CRP-12:** Students work productively during group work

Time Frame	**1 Week**

Topic
Gas Laws

Alignment to Standards
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-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Learning Objectives and Activities
Learning Objectives: • What is the kinetic molecular theory of gases? • What are the four gas variables and how are they expressed? • How do the gas laws relate the variables P, V, n and T? • What is the ideal gas equation and how is it applied? • What is a real gas? • Students will use algebra to solve for a specific variable in the gas laws **Learning Activities:** • Describe the nature of gases and recognize that gases have mass, can be compressed, exert pressure, occupy the space available to them and diffuse rapidly • State the six postulates of the KMT and explain how they account for the physical properties of gases • Explain what gas pressure means and describe how it is measured • State the gas laws and use algebra to solve various gas law problems

- Create graphical representations of the gas laws

Assessments

Formative:

- Students will be able to describe the kinetic molecular theory and explain how it accounts for observed gas behavior
- Students will be able to explain what gas pressure means and describe how it is measured
- State the gas laws
- Minute Math

Summative:

- Laboratory Work
  - Gas Laws POGIL
  - Exploring the Gas Laws Lab
  - Amount of Gas in Pop Rocks Lab
- Compare ideal and real gases
- Relate gas density to temperature and molar mass

Benchmark: N/A

Alternative:

- Discuss the significance of the ideal gas equation

Interdisciplinary Connections

MA.9-12.A-RE1.D.10: Students will graph Boyles's and Charles' gas laws.
MP.2: Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)

Career Readiness, Life Literacies, and Key Skills

Technology Integration

Career Education

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chemistry lab
CRP-12: Students work productively during group work

Time Frame	**1 Week**

Topic

Solutions, Acids & Bases, Chemical Equilibrium & Reaction Rates

Alignment to Standards

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-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Learning Objectives and Activities

Learning Objectives:

- What is solubility?
- What are the four colligative properties of solutions?
- What is a reversible reaction?
- How is chemical equilibrium characterized?
- What is Le Chatelier's Principle
- What are some common properties of acids and bases?
- What is the Bronsted-Lowry definition of acids and bases?

Learning Activities:

- Describe the properties of solutions
- Identify the different types of solutions
- Measure the concentration of solutions in terms of molarity and molality
- Differentiate among saturated, unsaturated and supersaturated solutions
- Define solubility and describe the factors that affect solubility
- 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 (include equilibrium - Le Chatelier's Principle)

Assessments

Formative:

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- Students will be able to write an equilibrium expression for a reversible chemical reaction
- Students will be able to predict the shift in equilibrium position of reactions when a stressor is added
- Students will be able to classify substances as acids or bases based on their properties

Summative:

- Laboratory Work/Activities:
  - Solutions Web Quest
  - Solubility of a Salt Lab
  - Types of Solutions Discovery Activity
  - Ice Cream Colligatives Lab
  - Chemical Equilibrium and Le Chatelier's Lab
  - Acid - Base Titration Lab

Benchmark:

- End of course skills Benchmark
- Final Exam

Alternative:

- Final Project/Research PBL - Chemist Research Project
- Semester Project - Create a photo journal, music video, instructional video, children's book, comic strip based on a major area in which we worked on this semester
- Independent Study - Using Flipped classroom (YouTube videos) students will explore acids, bases, salts, The PH scale, Reaction Rates and Chemical equilibrium

Interdisciplinary Connections

ELA:

LA.9-10RST.9-10.3: Students will have to read and interpret specific written text.

- ChemMatters article, "Salting Roads - The Solution for Winter Driving"
- ChemMatters article, "Swimming Pool Chemistry - Acids & Bases"

MA.9-12.A-RE1.D.10: Students will graph and interpret a solubility curve

Career Readiness, Life Literacies, and Key Skills

9.4.12.CI.1: Demonstrate the ability to reflect, analyze and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

Technology Integration

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Career Education
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Time Frame	**1 Week**
Topic	
Final Exam	
Alignment to Standards	
Summation of entire course- see each unit's Alignment to Standards	
Learning Objectives and Activities	

Learning Objectives:
- Summation of entire course- See each unit

Learning Activities:
- Assess students overall content knowledge for proficiency in chemistry
- Students will apply chemical and physical principles to solve problems

Assessments

Formative: Final Exam Study Guide

Summative: Final Exam

Benchmark: End of course skills Benchmark

Alternative: N/A

Interdisciplinary Connections

See all previous connections

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Career Readiness, Life Literacies, and Key Skills
Technology Integration
Career Education

Modifications (ELL, Special Education, At Risk Students, Gifted & Talented, & 504 Plans)

ELL:

- Work toward longer passages as skills in English increase
- Use visuals
- Introduce key vocabulary before lesson
- Teacher models reading aloud daily
- Provide peer tutoring
- Use of Bilingual Dictionary
- Guided notes and/or scaffold outline for written assignments
- Provide students with English Learner leveled readers.

Supports for Students With IEPs:

- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Allow answers to be given orally or dictated
- Use large print books, Braille, or books on CD (digital text)
- Follow all IEP modifications

At-Risk Students:

- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Allow answers to be given orally or dictated

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- Use visuals / Anchor Charts
- Leveled texts according to ability

Gifted and Talented:

- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Provide options, alternatives and choices to differentiate and broaden the curriculum
- Organize and offer flexible small group learning activities
- Provide whole group enrichment explorations
- Teach cognitive and methodological skills
- Use center, stations, or contracts
- Organize integrated problem-solving simulations
- Propose interest-based extension activities
- Expose students to beyond level texts.

Supports for Students With 504 Plans:

- Follow all the 504 plan modifications
- Text to speech/audio recorded selections
- Amplification system as needed
- Leveled texts according to ability
- Fine motor skill stations embedded in rotation as needed
- Modified or constrained spelling word lists
- Provide anchor charts with high frequency words and phonemic patterns