NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

CP Chemistry

03/2023

BOE Approved June 2023

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New Milford's Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

BOE Approved June 2023

CP Chemistry

Grade Levels

A brief description of the course..

Connection to the Vision of a Graduate (critical thinking, communication,creativity, problem solving, positive relationships, self-knowledge and management, growth mindset, social awareness)...

Vision of a Graduate

Throughout the CP Chemistry course students will connect with the characteristics identified in New Milford's Vision of a Graduate. Students will enhance their problem solving skills by applying critical thinking skills while developing positive relationships with their peers.

Critical Thinking: Students will make logical connections between knowledge they have and information they have gathered and be able to connect them together in order to solve a problem. Students will use their prior knowledge to determine if the results they have reached are logical answers to their questions or lab results.

Problem Solving: Students will work on understanding the questions that are posed to them and identifying the information within the question and use their prior knowledge to help them find a solution. Students then will be able to predict the correct outcomes for specific heats of metals and the amount of matter produced in a chemical reaction. Using the information gathered the students will be able to identify specific compounds, metals, and molecules created from chemical reactions. These skills will enable the student's to successfully determine the unknown compound at the end of the year.

Positive Relationships: Students will develop positive relationships with their peers by performing laboratory experiments, group work, and delivering productive criticism or encouragement while working in small groups.

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Chemistry includes the study of the structure and properties of matter, chemical behavior, and energy relationships. There is strong emphasis on science processes, quantitative and laboratory skills. At the CP level, this course is more rigorous and moves at a faster pace. Additional homework may be required. In addition, Chemistry CP students must identify an unknown substance at the end of the year.

Transfer Goals (SEP)

- Make and use observations to identify and analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
- Evaluate systems, including their components and subsystems, in order to connect how form determines function and how any change to one component affects the entire system.
- Conduct investigations, individually and collaboratively, to answer questions.
- Evaluate scientific claims for validity.

Pacing Guide

Include a list of the units and the approximate number of days/weeks it will take to teach the unit.

	Units	Number of Blocks
Unit 1:	**Atomic Structure and Properties**	8 blocks
Unit 2:	**Applied Mathematics**	8 blocks
Unit 3:	**Atomic Structure and the Mole**	12 blocks
Unit 4:	**Electron Configurations**	6 blocks
Unit 5:	**Periodic Table**	8 blocks
Midterm Exam		
Unit 6:	**Chemical Bonds**	11 blocks
Unit 7:	**Chemical Reactions**	12 blocks
Unit 8:	**Stoichiometry**	11 blocks
Unit 9:	**Kinetic Molecular Theory**	6 blocks
Final Exam		

Key for National and State Standards

HS-LS = Next Generation Science Standards: Life Sciences

HS-ES = Next Generation Science Standards: Earth Sciences

HS-ETS = Next Generation Science Standards: Engineering, Technology, and Applications of Science

RST = Common Core Reading Standards for Literacy in Science 6-12

WHST = Common Core Writing Standards for Science and Technology

5E Model
E1- Engage
E2 - Explore
E3 - Explain
E4 - Extend
E5 - Evaluate

AMT Coding

A - Acquire
M - Meaning
T - Transfer

Unit 1: Atomic Structure and Properties

Phenomenon: Chemical reaction of such as Magic Rainbow Wand Chemical Reaction

Stage 1: Desired Results

ESTABLISHED GOALS

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. [Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.]

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 3 - Plan and Carry Out Investigations
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms

PS1-B: Chemical Reactions

- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions

ESSENTIAL QUESTIONS

Students will keep considering…

- What is matter and how is it classified?
- How can different types of matter be distinguished; mixtures vs pure substances?
- How can these materials be separated into the smallest unit?
- What are the differences between a physical change and a chemical change?
- When and where is the law of conservation of mass observed?

Acquisition

communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.]	*Students will know…* ● The relationship between states of matter and their energy and their particle arrangement (CCC: Energy and Matter) ● The forces and energy changes involved in changes of states of matter (CCC: Energy and Matter) ● Distinguish between physical and chemical properties and use them to identify and describe physical and chemical changes. (CCC: Stability and Change) ● Observations that denote a chemical change. ● Energy is transferred during a physical and chemical change. ● Matter is conserved during a chemical reaction. (CCC: Stability and Change)	*Students will be skilled at…* ● Using models to describe the characteristics of the three common states of matter. ● Classifying matter as a mixture (homogeneous or homogeneous) or pure substance (element or compound) ● Giving examples of non-matter ● Distinguishing between solutions, suspensions, and colloids. ● Select appropriate separation techniques based on the physical properties of the components in the mixture. ● Interpreting and drawing a phase diagram for a single compound system.

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately describing a substance with the correct state of matter ● Accurately classifying a mixture as homogeneous or heterogeneous or a pure substance as an element or compound ● Accurately choosing the correct separation techniques to separate mixtures ● Drawing the correct phase diagrams for a compound system ● Analyze different compounds for their physical and chemical properties	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Separation of a mixture lab -** Students will be assigned various mixtures and will decide on the correct separation procedure. Examples of mixtures include coffee beans and water, borax, and pigments of a plant.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

<table>
<tr><th colspan="3">Stage 3: Learning Plan</th></tr>
<tr><td>Code</td><td colspan="2">Pre-Assessment
● Informal assessment of prior knowledge
● Ask students to talk about the phenomenon - what were the two things at the beginning, what was the end result?
● Formal pre-assessments to match the post assessment (optional)</td></tr>
<tr><td></td><td>Summary of Key Learning Events and Instruction

The teacher will introduce the phenomenon (Chemical reaction such as Magic Rainbow Wand Chemical Reaction) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts.

Student success at transfer, meaning and acquisition depends on…

A - Taking notes from lecture, class discussions, videos and textbook readings on each topic (E2, E3)
A, M - Working collaboratively with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)
M, T - Lab work applied to key concepts from the unit.Questions about the separation of a mixture lab. (E1, E2,</td><td>Progress Monitoring

● Warm-Up / Exit tickets
● Monitor progress for depth and accuracy
● Kahoot or other active online learning activities
● Questions on activities/labs
● Verbal questions for comprehension
● End of unit assessment</td></tr>
</table>

	E3, E4, E5) Resources: All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 2: Applied Mathematics

Phenomenon: Comparison of different measurements - 1 gallon vs 1 liter, 1 foot vs 1 meter, etc.

Stage 1: Desired Results

ESTABLISHED GOALS

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.]

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. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.]

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 3 - Plan and Carry Out Investigations
- SEP 5 - Using Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms

PS2.B: Types of Interactions

- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

ESSENTIAL QUESTIONS

Students will keep considering…

- How can units be converted from one to another?
- What is the difference between accuracy and precision and why are they important?
- How do significant figures determine which numbers are important in a measurement?
- Why should big and small numbers be written in scientific notation?
- How can density be used to determine what kind of material an object is?

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.]	**PS3.A: Definitions of Energy** ● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. **PS3.B: Conservation of Energy and Energy Transfer** ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. ● The availability of energy limits what can occur in any system.	

	Acquisition	
	Students will know… ● The relationships between different units and how to move between them. (CCC: Scale, Proportion, and Quantity) ● That big and small numbers should be converted into scientific notation to make them more manageable. (CCC: Scale, Proportion, and Quantity) ● The difference between accuracy and precision. ● That the density of an object can determine the type of object it is.	*Students will be skilled at…* ● Converting from one unit to another ● Accurately describing the differences between accuracy and precision ● Calculating the number of significant figures ● Calculating the density of an object ● Converting from standard notation to scientific notation ● Analyzing heating and cooling curves

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately converting from one unit to another. ● Accurately converting from standard notation to scientific notation ● Accurately describing a series of measurements as being accurate or precise or both ● Accurately calculating the density of an object	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Density Lab -** Students will be given a selection of objects that have different densities and will be tasked with determining their densities and then correctly identifying the material.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

Stage 3: Learning Plan		
Code	***Pre-Assessment*** ● Informal assessment of prior knowledge ● Ask students to talk about the phenomenon - which block will melt the ice faster? Why do you think this block will melt it faster? ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction The teacher will introduce the phenomenon (Comparison of different measurements - 1 gallon vs 1 liter, 1 foot vs 1 meter, etc.) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts. *Student success at transfer, meaning and acquisition depends on…*	Progress Monitoring ● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot or other active online learning activities ● Questions on activities/labs ● Verbal questions for comprehension ● End of unit assessment
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	
A, M	- **Working collaboratively** with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)	
M, T	- **Lab work** applied to key concepts from the unit. Questions from the density lab. (E1, E2, E3, E4, E5)	
A, M	- **Modeling** the heat transfer of metals	

M M	using using **GIZMO, pHet** or any other approved virtual lab program (E2, E3, E4) - **Calculating** densities of different objects (E2, E3) - **Converting** units and standard notations to new units and scientific notations (E2, E3) <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 3: Atomic Structure and the Mole

Phenomenon: Mole Lab Practical, students will try to determine how much of a substance is needed to make a mole of it (ex: Aluminum, water)

Stage 1: Desired Results

ESTABLISHED GOALS

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.]

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. [Clarification Statement: Emphasis is on explaining the

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyzing and Interpreting Data
- SEP 5 - Using Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms

PS2.B: Types of Interactions

- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as

ESSENTIAL QUESTIONS

Students will keep considering…

- How can units be converted from one to another?
- What is the mole and how can it be used in chemistry?
- What are the different parts of an atom?
- What Is Avagadro's number and hypothesis?
- How do you determine the percent composition of elements in a compound?
- How do you calculate the molar mass of a compound?

meaning of mathematical expressions used in the model.] HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] 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. [Clarification Statement: Emphasis is on simple qualitative modes, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.]	the contact forces between material objects. **PS3.B: Conservation of Energy and Energy Transfer** ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. ● The availability of energy limits what can occur in any system. **PS1.B: Chemical Reactions** ● The fact that atoms are conserved together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. **PS1.C: Nuclear Processes** ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total	

	number of neutrons plus protons does not change in any nuclear process.	
	Acquisition	
	Students will know… ● The relationships between different units and how to move between them. (CCC: Scale, Proportion, and Quantity) ● The different subatomic particles in an atom. ● The difference between an unstable and a stable isotope. (CCC: Energy and Matter) ● How to calculate the average atomic mass of an element ● How to determine the number of protons, neutrons, and electrons in an atom. ● How to calculate how many moles, molecules, grams, or liters are in a substance using the mole as a base. (CCC: Scale, Proportion, and Quantity) ● How to calculate the percent composition of different atoms in a compound. (CCC: Energy and Matter)	*Students will be skilled at…* ● Converting from one unit to another ● Calculating the number of protons, neutrons, and electrons in an atom ● Determining which atoms are isotopes of each other ● Calculating the average atomic mass ● Calculating the correct number of moles, molecules, grams, and liters in a substance using the mole as a base ● Calculating the percent composition of different atoms in a substance

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately converting from one unit to another. ● Accurately determining the correct number of protons, neutrons, and electrons in an atom. ● Correctly determining the atoms that are isotopes of each other ● Correctly calculating the average atomic mass of an element ● Accurately calculating the numbers of moles, molecules, grams and liters in a substance using the mole as the base. ● Accurately calculating the percent composition of different atoms in a substance.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Average Atomic Mass Lab -** Students will use either pennies or candies to calculate the average atomic mass of “Pennium” or “Candium” **Moles of Chalk Lab -** Students will calculate how many moles of chalk it takes to write their name **Percent Composition of a Hydrate Lab** - Students will be given a hydrate and will need to determine how much water by mass is trapped in each compound **Mole Project -** Students will construct a mole after an element, create an information sheet about the element and will present it to the class.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

<table>
<tr><th colspan="3">Stage 3: Learning Plan</th></tr>
<tr><td>Code</td><td colspan="2">Pre-Assessment
● Informal assessment of prior knowledge
● Ask students to talk about the phenomenon - how can you determine how many atoms you are putting into the beaker, or are folding up with the aluminum?
● Formal pre-assessments to match the post assessment (optional)</td></tr>
<tr><td></td><td>Summary of Key Learning Events and Instruction

The teacher will introduce the phenomenon (Mole Lab Practical, students will try to determine how much of a substance is needed to make a mole of it (ex: Aluminum, water) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts.

Student success at transfer, meaning and acquisition depends on…

A - Taking notes from lecture, class discussions, videos and textbook readings on each topic (E2, E3)
A, M - Working collaboratively with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)</td><td>Progress Monitoring

● Warm-Up / Exit tickets
● Monitor progress for depth and accuracy, specifically looking at how they are converting the units for the mole questions
● Kahoot or other active online learning activities
● Questions on activities/labs
● Verbal questions for comprehension
● End of unit assessment</td></tr>
</table>

M, T A, M M M	- **Lab work** applied to key concepts from the unit. Questions from the atomic mass, moles of chalk, and percent composition labs. (E1, E2, E3, E4, E5) - **Modeling** the mole unit with the mole project (E1, E2, E3, E4, E5) - **Calculating** the number of subatomic particles, atomic mass, the number of moles, molecules, grams, and liters in a substance, and the percent composition of substances (E2, E3) - **Converting** units from moles to molecules, grams, or liters (E2, E3) <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 4: Electron Configurations

Phenomenon: Emission spectra of elements - Students will observe the light created by different elements

Stage 1: Desired Results

ESTABLISHED GOALS

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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.]

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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.]

HS-PS1-8: Develop models to illustrate the changes in the

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyzing and Interpreting Data
- SEP 6 - Construct Explanations
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states

ESSENTIAL QUESTIONS

Students will keep considering…

- How do electrons influence the light that substances produce?
- Why does the way electrons are arranged have a role in where the elements are placed on the periodic table?
- How do you create an electron configuration?
- How do you draw an orbital spin diagram?
- How do you create a noble gas configuration?

composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative modes, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.]	**PS2.B: Types of Interactions** ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. **PS1.B: Chemical Reactions** ● The fact that atoms are conserved together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	
	Acquisition	
	Students will know… ● That electrons return to their ground state and this produces light (CCC: Energy and Matter) ● That the periodic table is based on groups of elements that have similar electron configurations (CCC: Patterns) ● How to create an electron configuration ● How to draw an orbital spin diagram ● How to create a noble gas configuration ● How to determine an element based off of the flame the element creates (CCC: Patterns) ● How to determine what the element is	*Students will be skilled at…* ● Writing electron configurations ● Drawing orbital spin diagrams ● Writing noble gas configurations ● Determining elements based on the flame they produce

	by the electron configuration	

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately creating the correct electron configuration ● Accurately drawing the correct orbital spin diagram ● Accurately creating the correct noble gas configuration ● Predicting what element is in an unknown solution based on the flame produced by the chemical ● Solving what the element is based on the electron configuration	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Flame Test Lab -** Students will test different chloride compounds in a flame to see what colors the different compounds will turn. Then they will need to determine which element(s) are in an unknown solution.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

<table>
<tr><th colspan="3">Stage 3: Learning Plan</th></tr>
<tr><td>Code</td><td colspan="2">Pre-Assessment
● Informal assessment of prior knowledge
● Ask students to talk about the phenomenon - what is producing the different colors? What happens when the element changes?
● Formal pre-assessments to match the post assessment (optional)</td></tr>
<tr><td></td><td>Summary of Key Learning Events and Instruction

The teacher will introduce the phenomenon (Emission spectra of elements - Students will observe the light created by different elements) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts.

Student success at transfer, meaning and acquisition depends on…</td><td>Progress Monitoring

● Warm-Up / Exit tickets
● Monitor progress for depth and accuracy, specifically looking at how the students are drawing the orbital spin diagrams and making the configurations
● Kahoot or other active online learning activities
● Questions on activities/labs
● Verbal questions for comprehension
● End of unit assessment</td></tr>
<tr><td>A

A, M

M, T</td><td>- Taking notes from lecture, class discussions, videos and textbook readings on each topic (E2, E3)
- Working collaboratively with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)
- Lab work applied to key concepts</td><td></td></tr>
</table>

M M M, T	from the unit. Questions about the flame test lab. (E1, E2, E3, E4, E5) - **Creating** the correct electron configurations and noble gas configurations (E2, E3) - **Drawing** the correct orbital spin diagrams (E2, E3) - **Predicting** the elements from configurations or from colors in a flame (E1, E2, E3, E4, E5) <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 5: The Periodic Table

Phenomenon: Sodium and Potassium in water - Exploring the properties of alkali metals

Stage 1: Desired Results

ESTABLISHED GOALS

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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.]

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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.]

HS-PS1-3. Plan and conduct an investigation to gather evidence

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyzing and Interpreting Data
- SEP 6 - Construct Explanations
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states

ESSENTIAL QUESTIONS

Students will keep considering…

- What is an ion?
- What is the difference between a cation and an anion?
- What are the families on the periodic table?
- How do the families show similar chemical and physical properties?
- What are some of the trends displayed on the periodic table when the elements are arranged on their increasing atomic number?
- What are the different types of elements?

<table>
<tr><td rowspan="4">to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.]

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.]</td><td>PS1.B: Chemical Reactions

● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● What an ion is compared to a neutral atom
● The different types of elements such as metals and nonmetals
● The difference between a cation and an anion
● The different families found on the periodic table (CCC: Patterns)
● How the periodic law determines properties and trends on the periodic table (CCC: Patterns)
● Some of the chemical and physical properties of metals and nonmetals (CCC: Patterns)
● The general trends for electronegativity, atomic size, ionization energy, and ionic size (CCC: Patterns)</td><td>Students will be skilled at…

● Determining cations and anions
● Identifying which family an element belongs to
● Determining the trend of a group of elements for electronegativity, atomic size, ionization energy, and ionic size
● Identifying elements as metals, nonmetals, or metalloids based on their properties
● Using the periodic law to determine trends in a fictitious periodic table</td></tr>
</table>

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately describing ions as cations or anions ● Correctly identifying elements as metals, nonmetals or metalloids based on their properties ● Accurately describing the trends seen on the periodic table such as electronegativity, atomic size, ionization energy, and ionic size ● Correctly identifying which family on the periodic table an element belongs to ● Creating their own periodic table with trends that the students created and matching that to the real periodic table	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Periodic Trends Lab -** Students will explore elements in group 14 and determine the properties for the missing elements in that group. **Periodic Table Project -** Students will create their own periodic table based on their interests and will show trends that they have created. The trends must follow trends seen on the periodic table (EX: least expensive item to most expensive, biggest item to smallest item, etc.).
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

<table>
<tr><th colspan="3">Stage 3: Learning Plan</th></tr>
<tr><td>Code</td><td colspan="2">Pre-Assessment
● Informal assessment of prior knowledge
● Ask students to talk about the phenomenon - why do these elements behave this way? What happens if we add a different element such as copper or lead?
● Formal pre-assessments to match the post assessment (optional)</td></tr>
<tr><td></td><td>Summary of Key Learning Events and Instruction

The teacher will introduce the phenomenon (Sodium and Potassium in water - Exploring the properties of alkali metals) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts.

Student success at transfer, meaning and acquisition depends on…</td><td>Progress Monitoring

● Warm-Up / Exit tickets
● Monitor progress for depth and accuracy
● Kahoot or other active online learning activities
● Questions on activities/labs
● Verbal questions for comprehension
● End of unit assessment</td></tr>
<tr><td>A

A, M

M, T</td><td>- Taking notes from lecture, class discussions, videos and textbook readings on each topic (E2, E3)
- Working collaboratively with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)
- Lab work applied to key concepts from the unit. Questions from the</td><td></td></tr>
</table>

M M, T	periodic trends lab. (E1, E2, E3, E4, E5) - **Determining** the elements based on their family and properties (E3, E4) - **Predicting** the properties of elements in the same family (E1, E2, E3, E4, E5) <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 6: Chemical Bonds

Phenomenon: Rainworks -How is this possible?

Stage 1: Desired Results

ESTABLISHED GOALS

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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.]

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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.]

HS-PS1-3. Plan and conduct an investigation to gather evidence

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyzing and Interpreting Data
- SEP 6 - Construct Explanations
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.A: Structure and Properties of Matter

- The types of electrical attractions in a bond within a substance influences its micro and macro chemical and physical properties.
- Communicating information about chemical concepts is highly dependent upon understanding the symbolism and conventions used to represent matter and information about the matter
- Bonding occurs in patterns related to the periodic table

ESSENTIAL QUESTIONS
Students will keep considering…

- How do atoms bond?
- What role do valence electrons play in determining the chemical properties and the type of bond formed between atoms?
- How does the type of electrical attraction create macroscale properties?
- How are the symbolic representations, chemical notation, and rules of nomenclature used in the language of chemistry?

to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.]	• Chemical bonding in matter results in the formation of new compounds with different properties.	
	Acquisition	
	Students will know… • That big and small numbers should be converted into scientific notation to make them more manageable. (CCC: Scale, Proportion, and Quantity) • The difference between accuracy and precision. • The charge an ion will likely form based on the position of the element on the periodic table and using the octet rule. • Why the properties of an ion are different from those of the neutral atom. • The process of forming an ionic and covalent bond. • Why the properties of ionic compounds depend on the electron arrangement between atoms. • The names and formulas of cations, anions, and ionic compounds. • That formulas for ionic compounds are written to show their balance of overall charge • Describe the change in energy and stability that takes place as a chemical bond is formed. • How to distinguish between nonpolar and polar covalent bonds based on differences in electronegativity.	*Students will be skilled at…* • Illustrating the process of forming a covalent bond. • Drawing Lewis structures to show the arrangement of valence electrons among atoms in molecules and polyatomic ions. • Drawing resonance structures for simple molecules and polyatomic ions. • Naming simple covalent compounds using prefixes, roots, and suffixes.

	● The differences between single, double, and triple covalent bonds.	

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately predict the type of bonding which will take place between metals and nonmetals, metals and metals, and nonmetals with nonmetals. as ionic, covalent or metallic compounds ● Correctly identifying the properties of both ionic and covalent compounds	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Properties of ionic and covalent compounds Lab -** Students will be given a number of compounds to test and will be tasked with determining common properties of ion or covalent compounds. Students will use these properties to identify various compounds as either ionic or covalent. **Building a Molecular Model project -** Students will build a model of a molecule and research the molecule. Students will then present their findings in a flier about the molecule.

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

Stage 3: Learning Plan		
Code	***Pre-Assessment*** ● Informal assessment of prior knowledge ● Ask students to talk about the phenomenon - how does Rainart appear? Is this something anyone can create? ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction The teacher will introduce the phenomenon (Rainworks -How is this possible?) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts. *Student success at transfer, meaning and*	Progress Monitoring ● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot or other active online learning activities ● Questions on activities/labs ● Verbal questions for comprehension ● End of unit assessment

	acquisition depends on…	
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	
A, M	- **Working collaboratively** with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)	
M, T	- **Lab work** applied to key concepts from the unit. Questions from the ionic and covalent lab. (E1, E2, E3, E4, E5)	
M	- **Molecular shapes with Gizmo, pHet** or any other approved virtual lab program (E2, E3, E4)	
M, T	- **Predicting** the compounds formed when different elements or ions bond and the properties of compounds in the based on the type of bonding present (E3, E4, E5)	
M	- **Determining** the formulas based on their elements present (E3, E4)	
	<u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 7: Chemical Reactions

Phenomenon: What metals should we use to make jewelry?

Stage 1: Desired Results

ESTABLISHED GOALS

HS-PS 1-2: 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.B: Chemical reactions The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.A: Structure and Properties of Matter

- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states

PS1.B: Chemical Reactions

- In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction

ESSENTIAL QUESTIONS
Students will keep considering…

- What are some of the chemical reactions that occur within our environment everyday?
- How are the symbolic representations, chemical notation, and rules of nomenclature used in the language of chemistry?

<table>
<tr><td rowspan="4">relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.]</td><td colspan="2">determines the numbers of all types of molecules present.
● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● In a chemical reaction atoms rearrange to form new substances
● The signs of a chemical reaction by observation
● Interpret the meaning of symbols used in writing chemical equations
● Know the steps in writing balanced chemical equations
● Relate the Law of Conservation of Mass to a balanced chemical equation
● In a combustion reaction a hydrocarbon reacts with oxygen to form carbon dioxide and water (CCC: Patterns)
● In a synthesis reaction two reactants form a single product (CCC: Patterns)
● In a decomposition reaction a single reactant forms two or more products (CCC: Patterns)
● In a single replacement reaction an element replaces an element from a compound, the activity series is used to determine if a single replacement reaction will take place</td><td>Students will be skilled at…

● Classifying reactions as belonging to one of five general types.
● Balancing chemical equations
● Predicting the products of a balanced chemical reaction using the general forms as a guide.
● Predicting the products of and balancing single replacement reactions using the activity series.
● Predicting the products of and balancing double replacement reactions</td></tr>
</table>

	• In a double replacement reaction the ions of two compounds switch places such that two new compounds form. One of the products must be a solid, gas, or molecular compound(such as liquid water)	

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	• Classifying reactions as belonging to one of five general types. • Balancing chemical equations • Predicting the products of a balanced chemical reaction using the general forms as a guide. • Predicting the products of and balancing single replacement reactions using the activity series. • Creating an activity series based on their lab results • Predicting the products of and balancing double replacement reactions using a solubility chart. • Writing a net ionic equation for precipitation reactions in aqueous solutions.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Signs of a chemical reaction lab -** Students will be given a number of reactions that display different signs of a chemical reaction and will be tasked with determining a series of signs to predict if a chemical reaction has taken place. **Single displacement Lab -** Students will be given a number of different solutions and metals and will then create an activity series based on their results https://assets.savvas.com/file-vault/experience-chemistry/Reactivity-of-Metals/index.html **Double displacement Lab -** Students will be

		given a number of different solutions and will have to determine if a reaction took place and if a reaction took place correctly write the reaction that took place. **Reactivity of Metals - What metals should we use for making jewelry? S**tudents will test a number of unknown metals to determine which metal would make the best choice for a ring.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

Stage 3: Learning Plan	
Code	***Pre-Assessment*** ● Informal assessment of prior knowledge ● Ask students to talk about the phenomenon - Did they turn a copper penny into gold? What do you think happened? ● Formal pre-assessments to match the post assessment (optional)

	Summary of Key Learning Events and Instruction	Progress Monitoring
	The teacher will introduce the phenomenon (what metals should we use to make jewelry) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts. *Student success at transfer, meaning and acquisition depends on…*	● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot or other active online learning activities ● Questions on activities/labs ● Verbal questions for comprehension ● End of unit assessment
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	
A, M	- **Working collaboratively** with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)	
M, T	- **Lab work** applied to key concepts from the unit. Questions from the types of chemical reactions, single, and double replacement labs. (E1, E2, E3, E4, E5)	
M, T	- **Modeling** balancing chemical equation using **GIZMO, pHet** or any other approved virtual lab program (E2, E3, E4)	
M, T	- **Predicting and balancing** the type of reaction, products formed when different compounds are mixed (E3, E4, E5)	
	<u>Resources:</u> All Resources and materials must adhere to all New	

	Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 8: Stoichiometry

Phenomenon: Let's Have S'more Chemistry: Marshmallows, Chocolate, Grams, and Moles

Stage 1: Desired Results

ESTABLISHED GOALS

HS-PS1.B: Chemical reactions The fact that atoms are conserved , together with knowledge of the chemical properties of the elements involved , can be used to describe and predict chemical reactions

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 5 - Using Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.A: Structure and Properties of Matter

- The periodic table orders elements

ESSENTIAL QUESTIONS
Students will keep considering…

- What are some of the chemical reactions that occur within our environment everyday?

relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] 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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] 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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and	horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron state **PS1.B: Chemical Reactions** ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	- How are the symbolic representations, chemical notation, and rules of nomenclature used in the language of chemistry?
	Acquisition	
	Students will know… ● Stoichiometry compares the amount of substances in a chemical reaction (CCC: Energy and Matter) ● STP represents standard temperature ($0^{\circ}C$) and pressure (1 atm). ● Stoichiometry problems involving chemical reactions can always be solved using mole ratios from the balanced chemical equation (CCC: Scientific Knowledge Assumes an Order and Consistency in Natural Systems)	*Students will be skilled at…* ● Determining the moles of reactants or products from balanced chemical equations. ● Calculate masses of reactants or products involved in chemical reactions given data in mass, moles, or volume of gasses at STP. ● Interpret data to determine amounts of reactants or products ● Calculate the percent yield of products.

chlorine, of carbon and oxygen, or of carbon and hydrogen.] 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. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.]	● The limiting reactant is the reactant that is consumed completely in a reaction. (CCC: Energy and Matter) ● The theoretical yield is the amount of product that can be formed from a given amount of limiting reactant. ● The actual yield is the amount of product collected from a real reaction.	

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately calculate the amount of product that will be produced from known quotes of reactants ● Accurately calculate the amount of reactant needed to produce the desired amount of product.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Decomposition of Baking Soda -** predicting the correct reaction based on stoichiometric results **Baking Soda and Vinegar Demo -** determining which is the limiting reagent **What Happens if I Run out of Ingredients? -** POGIL Activity

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

Stage 3: Learning Plan		
Code	***Pre-Assessment*** ● Informal assessment of prior knowledge ● Ask students to talk about the phenomenon - How many S'mores could they make? What was left over? ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction The teacher will introduce the phenomenon (S'more chemistry) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts. *Student success at transfer, meaning and*	Progress Monitoring ● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot or other active online learning activities ● Questions on activities/labs ● Verbal questions for comprehension ● End of unit assessment

	acquisition depends on…	
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	
A, M	- **Working collaboratively** with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)	
M, T	- **Lab work** applied to key concepts from the unit. Questions from the decomposition of baking soda lab. (E1, E2, E3, E4, E5)	
M, T	- **Modeling** stoichiometry and limiting reagents using **GIZMO, pHet or any other approved virtual lab program** (E2, E3, E4)	
M, T	- **Use stoichiometry** to determine the amount of product formed or the amount of reactant needed. (E3, E4, E5)	
	<u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

Unit 9: Kinetic Molecular Theory

Phenomenon: Can I crush a soda can without touching it?

Stage 1: Desired Results

ESTABLISHED GOALS

HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system. [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.]

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-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 5 - Using Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.

PS3.A: Definitions of Energy

- Energy is transferred from one object to another and between different forms of energy but the total energy of the system is conserved at both the macroscopic and microscopic scales unless energy is transferred into or out of the system, in which case the total

ESSENTIAL QUESTIONS

Students will keep considering…

- What are the major gas laws?
- How are the different phases related to particle movement?
- How can you create a heating or cooling curve on a graph?
- How is the kinetic molecular theory used to explain the differences between solids, liquids, and gasses?
- How are the gas laws used to relate temperature, pressure, volume, and mole quantities?

accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions and computer simulations.] HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical	energy of the system and its surroundings is conserved ● Chemical processes and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	
	Acquisition	
	Students will know… ● How particles move within different phases of matter ● The information is given from a heating and cooling curve ● How the molecular structure of molecules and compounds leads to macro properties ● The general properties of gasses ● The SI unit for pressure and how to convert between standard units of pressure ● That the kinetic molecular theory states that gas particles are in constant random motion, and are relatively far apart, and have volumes that are negligible when compared with the total volume of a gas ● How to relate the kinetic molecular theory to the properties of an ideal gas ● How to solve problems where the volume, pressure, and temperature of a gas are known or unknown ● How to differentiate ideal gas behavior	*Students will be skilled at…* ● Convert temperature readings between the Kelvin, Celsius, and Fahrenheit scales. ● Calculate the amount of energy released or absorbed during a chemical reaction ● Calculate the energy within a chemical bond ● Determining factors that affect gas pressure ● Converting between various pressure units ● Using the combined gas law to solve problems with various missing temperatures, pressures, or volumes ● Using the ideal gas law to solve problems using pressure, volume, temperature, and moles of a gas

thinking and not on memorization and rote application of problem-solving techniques.]	from real gas behavior	

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately calculating the missing variable in a combined gas law problem ● Accurately calculating the missing variable in an ideal gas law problem ● Correctly converting to the correct pressure unit ● Correctly converting to the correct temperature unit ● Accurately calculating the energy in a chemical bond	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Create a Tissue Paper Hot Air Balloon -** Students will work in groups to create a hot air balloon made out of tissue paper. This will demonstrate volume and temperature of gasses. **The Molar Mass of Butane -** Students will use a lighter to release butane gas and will collect the gas to determine the molar mass of butane. This will demonstrate the ideal gas law.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoots or other active online learning activities ● Lab analysis questions ● Warm-ups and exit tickets ● Homework assignments ● Google Form questions

<table>
<tr><th colspan="3">Stage 3: Learning Plan</th></tr>
<tr><td>Code</td><td colspan="2">Pre-Assessment
● Informal assessment of prior knowledge
● Ask students to talk about the phenomenon - Why did the soda can get crushed? What variables affected the soda can?
● Formal pre-assessments to match the post assessment (optional)</td></tr>
<tr><td></td><td>Summary of Key Learning Events and Instruction

The teacher will introduce the phenomenon (can I crush a soda can without touching it) at the beginning of the unit. The teacher will introduce the new topic for the students and will monitor progress. As the unit continues new topics will be introduced and the teacher will use/develop activities and laboratory investigations for the unit concepts.

Student success at transfer, meaning and acquisition depends on…

A - Taking notes from lecture, class discussions, videos and textbook readings on each topic (E2, E3)
A, M - Working collaboratively with partners or small groups to complete graphic depictions to summarize major concepts (E1, E2, E3, E4)
M, T - Lab work applied to key concepts from the unit. Questions from the molar mass of butane lab. (E1, E2, E3,</td><td>Progress Monitoring

● Warm-Up / Exit tickets
● Monitor progress for depth and accuracy
● Kahoot or other active online learning activities
● Questions on activities/labs
● Verbal questions for comprehension
● End of unit assessment</td></tr>
</table>

M, T	E4, E5) - **Modeling** Kinetic Molecular Theory using **GIZMO, pHet** or any other approved virtual lab program (E2, E3, E4) <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	