NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

Honors 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

Honors 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 Honor's 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 honors level, this course is more rigorous and moves at a faster pace. Additional homework may be required. In addition, Chemistry Honors 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**	4 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:	**Application of Stoichiometry with Thermodynamics**	6 blocks
Unit 10:	**Equilibrium**	4 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. ● Selecting 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 (the magic rainbow wand) 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, E3, E4, E5)

<u>Resources:</u></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>

	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: Amazing Ice Melting Blocks

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?
- What is heat capacity?
- How is heat different from temperature?
- How can you determine the heat capacity

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.	of an unknown metal?

	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. ● That temperature is a measure of the average kinetic energy of molecules in a system and that heat is the transfer of energy from one system to another. (CCC: Systems and System Models.) ● That the heat capacity of an object can determine what 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 ● Calculating the specific heat of an object ● Analyzing heating and cooling curves ● Determining the density and specific heat of an unknown object

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 ● Accurately calculating the specific heat of an object ● Describing the correct differences between heat and temperature ● Correctly identifying an unknown object based on the density or specific heat	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. **Calorimetry of an Unknown Metal Lab -** Students will be given a metal and will have to determine the specific heat of that metal in order to identify what type of metal it is. A calorimetry apparatus will be set up and the students will need to be able to master the specific heat and calorimetry equations.
		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 (amazing ice melting blocks) 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 and calorimetry labs. (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, specific heats and calorimetries 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 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 2 - Developing and Using Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyzing and Interpreting Data
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- 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 mole and how can it be used in chemistry?
- What are the different parts of an atom?
- How does a radioactive isotope relate to a stable isotope?
- What Is Avagadro's number and hypothesis?
- How do you determine the percent composition of elements in a compound?
- How do you determine the empirical formula of a compound?
- How do you calculate the molar mass of a compound?

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.]	**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) ● How to determine the empirical formula of 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 ● Determining the empirical formula for a compound

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. ● Correctly determining the empirical and molecular formulas for 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

Stage 3: Learning Plan		
Code	***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)	
	Summary of Key Learning Events and Instruction The teacher will introduce the phenomenon (the mole lab practical) 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, 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
A A, M M, T	- **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	

	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.	
A, M M M		

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) ● When electrons absorb and release	*Students will be skilled at…* ● Writing electron configurations ● Drawing orbital spin diagrams ● Writing noble gas configurations ● Determining elements based on the flame they produce ● Determining if electrons have absorbed or released energy

	energy (CCC: Energy and Matter) ● How to determine what the element is 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 (the emission spectra of 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…

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 flame test lab. (E1, E2, E3, E4, E5)</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>
</table>

M M M, T	- **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) 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 periodic trends lab. (E1, E2, E3, E4,</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 M, T	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? Exploring the properties of different bond types and how this influences the macroscopic properties

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.]

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

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? For example melting point, solubility, and ability to conduct electricity.
- How are the symbolic representations, chemical notation, and rules of nomenclature used in the language of chemistry?

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. [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	the periodic table ● 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	*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. ● Predicting the shape of a molecule using VSEPR theory. ● Predicting behavior of a molecule based on the shape predicted using VSEPR theory.

interact with specific receptors.]	differences in electronegativity. ● Associate the polarity of molecules with their shapes and relate the polarity and shape of molecules to the properties of the substance ● The differences between single, double, and triple covalent bonds. ● VSEPR theory can be used to predict the geometric structure of most molecules ● Resonance structures are necessary to show how electrons are distributed in chemical bonds in a molecule when several equivalent Lewis structures are possible	

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 ● Accurately the shape of a molecule based on the formula ● Correctly identifying if a bond is polar or not. ● Correctly identifying if a molecule is polar or not.	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 **Molecular Geometry Lab -** Students will build a 3-D model of various compounds to Classify

		molecular shapes according to the VSEPR model. Students will relate the polarity to the molecular shape. **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	Progress Monitoring
	The teacher will introduce the phenomenon (Rainworks) 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 ionic and covalent and molecular geometry labs. (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)	

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Unit 7: Chemical Reactions

Phenomenon: Can we turn a copper penny into gold?

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

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

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?

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.]	● 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.	
	Acquisition	
	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	*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 using a solubility chart. ● Writing a net ionic equation for precipitation reactions in aqueous solutions.

	compound, the activity series is used to determine if a single replacement reaction will take place ● 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) ● Differentiate between endothermic and exothermic reactions ● Spectator ions do not change during reactions and can be removed from the total ionic equation to form a net ionic equation	

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.	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.

	• 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.	**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. **Unknown Compound Lab -** Students will perform different tests on a compound to determine what their compound is made out of. The students can have compounds of up to four different ions.
		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 The teacher will introduce the phenomenon (turning copper into gold) 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 chemical compounds, 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 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.]

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…

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 state

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?

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-PS1-5: 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	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.	
	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) ● 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.	*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 involved in reactions in aqueous solutions given data in volumes and molarities (M) of solutions. ● Determine the limiting reactants in chemical reactions in order to predict the amounts of products that can be formed. ● Calculate the percent yield of products.

reasoning that focuses on the number and energy of collisions between molecules.]		

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. ● Accurately calculate the amount of excess reactant after one reactant has been used up	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Decomposition of Baking Soda -** predicting the correct reaction based on stoichiometric results **What Happens if I Run out of Ingredients? -** POGIL Activity **Baking Soda and Vinegar Demo -** determining which is the limiting reagent **S'More Lab -** determining which is the limiting reagent

		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: Application of Stoichiometry with Thermodynamics

Phenomenon: Can students make a cold pack? A reaction in a bag - students observe exothermic and endothermic properties

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

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…

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

ESSENTIAL QUESTIONS
Students will keep considering…

-
  How is energy involved in chemical processes.
  Where is the energy stored?

models to illustrate that energy at the macroscopic scale can be 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-PS3-3 Energy Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and	of the system, in which case the total 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… ● Energy is conserved. It may change locations or forms, but does not leave our finite universe. (Law of Conservation of Energy, First Law of Thermodynamics) ● Every time energy changes forms, some of it doesn't go into useful energy but is instead given off as heat, light, sound, etc. ● Energy changes occur as either heat transfer or work, or a combination of both ● Enthalpy is the amount of heat content used or released in a system at constant pressure. Enthalpy is usually expressed as the change in enthalpy. ● As useful energy decreases, the amount of disorder and randomness (entropy) increases. (Second Law of Thermodynamics) ● Chemical reactions either release energy to the environment	*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 ● calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products

efficiency.] 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.]	(exothermic) or absorb energy from the environment (endothermic). ● All chemical reactions require activation energy to begin. ● Hess's Law indicates that the thermodynamic changes for any particular process are the same, whether the changes are treated in a single reaction or a series of steps ● Use Hess's Law and standard enthalpies of formation to calculate enthalpy (ΔH). ● Reactions that have a positive enthalpy change are endothermic, and reactions that have a negative enthalpy change are exothermic	

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately calculate the change of energy that will be produced from known amounts of reactants ● Accurately calculate the amount of energy stored within a particular chemical bond.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Hess's Law Lab -** Students will determine the amount of energy released in a series of reactions that will be added together and compare the results to the final reaction **Dissociation of an ionic compound -** determining which ionic compound (road salt) will release the largest amount of energy when it dissociates **Lab: "Cold Packs"** - Open ended lab where students determine the best chemicals for a cold pack and determines the amount of chemicals required.
		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 ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction The teacher will introduce the phenomenon (reaction in a bag) 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 Hess's law, cold pack labs. (E1, E2, E3, E4, E5)	
M, T	- **Modeling** Thermodynamics using **GIZMO, pHet** or any other approved	

M, T	virtual lab program (E2, E3, E4) - **Use stoichiometry** to determine the amount of energy released or absorbed. (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 10: Equilibrium

Phenomenon: How can ice and liquid water exist at the same time

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.

PS1-6 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.]

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.

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 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS
Students will understand that…

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 prese**nt.**
- All chemical and phase equilibrium share three characteristics:
  1) They are dynamic;
  2) They are reversible; and
  3) Equilibrium positions can be approached from either direction

ESSENTIAL QUESTIONS
Students will keep considering…

- How does collision theory explain why temperature, concentration, surface area, and catalysts affect the rate of reaction between substances?
- How does Le Chatelier's Principle apply to equilibrium in chemical reactions?
- How changing the conditions of a reaction affect the amount of product produced

Acquisition

HS-PS1-7: Refine the design of a chemical system by specifying a change in conditions that would alter the amount 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.]	*Students will know…* ● The collision theory explains how the increased interaction between substances by temperature change, concentration, surface area, or use of a catalyst will result in a faster reaction rate. ● Le Chatelier's Principle describes how the change in amounts or concentrations of products, reactants, and catalysts within a chemical reaction can shift the equilibrium of the reaction in a certain direction.	*Students will be skilled at…* ● Recognizing the characteristics of chemical equilibrium ● Writing equilibrium expressions for systems that are at equilibrium ● Calculating equilibrium constants from concentration data. ● Describing how various factors affect chemical equilibrium ● Applying Le Chatelier's principle to equilibrium systems.

Stage 2: Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M & T	● Accurately calculate the equilibrium constant from known concentrations ● Solve for the concentration of reactants or products form the equilibrium constant ● Accurately predict how a reaction at equilibrium will react to disturbances to the system	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Collision Theory Gizmo -** Students use an online simulation to manipulate temperature, concentration, surface area, and catalyst conditions and evaluate how these factors impact the rate of reaction. Factors that affect reaction rate **Alka-Seltzer Rocket Lab -** students design an experiment to investigate how changing water temperature, amount of Alka-Seltzer, and surface area of Alka-Seltzer affects the rate of reaction. **Equilibrium Blue Bottle and Traffic Light Demonstrations -** This demonstration illustrates equilibrium involving redox reactions. for an online discussion on what is occurring with the chemical reactions and why color changes, and their reversal, are occurring.

		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 ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction The teacher will introduce the phenomenon (how do ice and water exist at the same time) 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 Alka-Seltzer rocket lab. (E1, E2, E3, E4, E5)	
M, T	- **Modeling** Equilibrium and Concentration using **GIZMO, pHet** or any other approved virtual lab program (E2, E3, E4)	
M, T	- **Use stoichiometry** to determine the amount of energy released or absorbed. (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.	