NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

Honors Chemistry

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Authors of Course Guide

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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.

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.

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

<table>
<tr><th colspan="3">Unit 1: Atomic Structure and Properties</th></tr>
<tr><td colspan="3">Phenomenon: Chemical reaction of such as Magic Rainbow Wand Chemical Reaction</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td rowspan="5">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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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</td><td>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?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

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>A

A, M

M, T</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…
- 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 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.	

<table>
<tr><td colspan="3">Unit 2: Applied Mathematics</td></tr>
<tr><td colspan="3">Phenomenon: Amazing Ice Melting Blocks</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td rowspan="4">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.]</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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.</td><td>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</td></tr>
</table>

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

<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 - 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)</td></tr>
<tr><td>

A

A, M

M, T

A, M</td><td>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…

- 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 density and calorimetry labs. (E1, E2, E3, E4, E5)
- Modeling the heat transfer of metals</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	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.	

<table>
<tr><td colspan="3">Unit 3: Atomic Structure and the Mole</td></tr>
<tr><td colspan="3">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)</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td rowspan="4">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.]</td><td colspan="2">Transfer</td></tr>
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<tr><td>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.</td><td>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?</td></tr>
</table>

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)	
       A A, M M, T	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…* - **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	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, M M M	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.	

<table>
<tr><td colspan="3">Unit 4: Electron Configurations</td></tr>
<tr><td colspan="3">Phenomenon: Emission spectra of elements - Students will observe the light created by different elements</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td rowspan="4">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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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</td><td>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?</td></tr>
</table>

<table>
<tr>
<td rowspan="3">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.]</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>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</td>
<td>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</td>
</tr>
</table>

	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>

A

A, M

M, T</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…

- 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 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.	

<table>
<tr><th colspan="3">Unit 5: The Periodic Table</th></tr>
<tr><td colspan="3">Phenomenon: Sodium and Potassium in water - Exploring the properties of alkali metals</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td rowspan="4">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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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</td><td>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?</td></tr>
</table>

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.]	**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…* • 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)	 *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

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>

A

A, M

M, T</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…

- 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 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
    A A, M M, T M M, T M	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…* - **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 ionic and covalent and molecular geometry labs. (E1, E2, E3, E4, E5) - **Molecular shapes with Gizmo, pHet** or any other approved virtual lab program (E2, E3, E4) - **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) - **Determining** the formulas based on their elements present (E3, E4)	• 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

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Unit 7: Chemical Reactions

Phenomenon: Can we turn a copper penny into gold?

Stage 1: Desired Results

<table>
<tr><td rowspan="3">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</td><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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</td><td>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?</td></tr>
</table>

<table>
<tr><td rowspan="3">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.]</td>
<td>• 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.</td>
<td></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</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 using a solubility chart.
• Writing a net ionic equation for precipitation reactions in aqueous solutions.</td></tr>
</table>

	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.

<table>
<tr><td></td><td>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.</td><td>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.</td></tr>
<tr><td></td><td></td><td>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</td></tr>
</table>

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)	
         A A, M M, T M, T M, T	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…* - **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 chemical compounds, single, and double replacement labs. (E1, E2, E3, E4, E5) - **Modeling** balancing chemical equation using **GIZMO, pHet or any other approved virtual lab program** (E2, E3, E4) - **Predicting and balancing** the type of	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

	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.	

<table>
<tr><th colspan="3">Unit 8: Stoichiometry</th></tr>
<tr><td colspan="3">Phenomenon: Let's Have S'more Chemistry: Marshmallows, Chocolate, Grams, and Moles</td></tr>
<tr><th colspan="3">Stage 1: Desired Results</th></tr>
<tr><td rowspan="4">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.]</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">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</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>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</td><td>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?</td></tr>
</table>

<table>
<tr>
<td rowspan="3">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</td>
<td>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>
<td></td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…

• Stoichiometry compares the amount of substances in a chemical reaction (CCC: Energy and Matter)
• STP represents standard temperature (0°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.</td>
<td>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.</td>
</tr>
</table>

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

<table>
<tr><td rowspan="4">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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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</td><td>ESSENTIAL QUESTIONS
Students will keep considering…
-
How is energy involved in chemical processes.
Where is the energy stored?</td></tr>
</table>

<table>
<tr>
<td rowspan="3">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</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>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</td>
<td>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</td>
</tr>
</table>

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

<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
• Formal pre-assessments to match the post assessment (optional)</td></tr>
<tr><td>

A

A, M

M, T

M, T</td><td>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…

- 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 Hess's law, cold pack labs. (E1, E2, E3, E4, E5)
- Modeling Thermodynamics using GIZMO, pHet or any other approved</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	virtual lab program (E2, E3, E4) - **Use stoichiometry** to determine the amount of energy released or absorbed. (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.	

<table>
<tr><td colspan="3">Unit 10: Equilibrium</td></tr>
<tr><td colspan="3">Phenomenon: How can ice and liquid water exist at the same time</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td rowspan="5">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.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>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 present.

• 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</td><td>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</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

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 A, M M, T M, T 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 Alka-Seltzer rocket lab. (E1, E2, E3, E4, E5) - **Modeling** Equilibrium and Concentration using **GIZMO, pHet** or any other approved 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.	

NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

Advanced Algebra and Trigonometry

March 2023

Do Not Distribute Not BOE Approved

Authors of Course Guide

Mrs. Yvonne Lazzaro

Do Not Distribute Not BOE Approved

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.

Advanced Algebra and Trigonometry

Grade 11-12

Advanced Algebra and Trigonometry is a full year course designed for students who have completed a full year of Algebra 2. Topics in this course include a study of polynomial, trigonometric, exponential and logarithmic functions, graphing techniques, complex numbers, and topics in analytic geometry. A graphing calculator (TI-83+/TI-84+) is required for this course and is used throughout the year.

Vision of a Graduate

Advanced Algebra and Trigonometry is a course that promotes problem solving, critical thinking, and a positive growth mindset. Throughout this course, students create a plan to solve a problem that follows a set procedure. Students will use effective reasoning to seek alternative and creative methods to find a solution. Students are expected to communicate verbally and through written expression how they arrived at their solution and what the solution means in the context of an application. Students will improve their skills through self-reflection and perseverance.

Pacing Guide

Unit 1: Algebra Prerequisite Review	7-8 weeks
Unit 2: Graphs and Functions	4-6 weeks
Unit 3: Polynomial and Rational Functions	7-8 weeks
Unit 4: Exponential and Logarithmic Functions	3-4 weeks
Unit 5: Trigonometric Functions	7-8 weeks
Unit 6: Additional Topics in Trigonometry	1-2 weeks

ESTABLISHED GOALS

CCSS.Math.Content.HSN.RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

CCSS.Math.Content.HSA.REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

CCSS.Math.Content.HSA.SSE.B.3. a Factor a quadratic expression to reveal the zeros of the function it defines.

CCSS.Math.Content.HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

CCSS.Math.Content.HSA.REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Transfer

Students will be able to independently use their learning to…

Make sense of a problem by initiating a plan and persevere in solving
Model with mathematics by using the appropriate method
Reason abstractly
Justify reasoning or understanding by explaining techniques to solving
Attend to precision

Meaning

UNDERSTANDINGS

Students will understand that…

- Exponents and radicals are related to the operation of addition and multiplication; a radical is the inverse of an exponent.
- Simplified radicals result in a smaller value under the radical while maintaining an exact value.
- Rationalizing the denominator eliminates radical expressions from the denominator.
- Radical expressions can be combined under the basic operations of addition, subtraction, multiplication, and division following a specific process.
- Polynomials can be added, subtracted, and multiplied to make a more simplified expression.
- Polynomials can be broken up into products of more simplified terms by

ESSENTIAL QUESTIONS

Students will keep considering…

- How are the properties of exponents related to the basic arithmetic operations?
- How do radicals relate to exponents?
- Why is it important to simplify radicals?
- Why is it necessary to rationalize the denominator?
- How do radical expressions relate to rational exponents?
- How are polynomial expressions combined using operations of addition, subtraction, and multiplication?
- How do you find the degree of a polynomial function?
- What does the degree of a polynomial tell you about its related polynomial function?
- For a polynomial function, how are factors, zeros, and x-intercepts related?
- What is an extraneous solution for a rational

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<td>factoring.
• The degree of a polynomial is the greatest exponent among its monomial terms.
• Rational functions are a ratio of polynomial functions. If a rational function is in simplified form and the polynomial in the denominator is not constant, the graph of the rational function features asymptotic behavior. It looks quite different from the graph of either of its polynomial components.
• Multiplication and division of rational expressions uses much of what you know about multiplying and dividing fractions.
• Operations of rational expressions use much of what you know about operating with fractions. To add or subtract rational expressions, you first find a common denominator - preferably the least common multiple of the denominators.
• Equations containing rational expressions must be solved by first multiplying each side by the least common denominator of the rational expressions. Doing this, however, can introduce extraneous solutions.
• Linear equations and inequalities can be solved following a specific process to give a solution.
• Literal equations are formulas with many variables and can be solved according to the same process as equations with one variable.
• Quadratic and other polynomial equations can be solved using factoring.</td>
<td>function?
• Are a rational expression and its simplified form equivalent?
• What is the importance of following a specified order of operations?
• How are algebraic operations and notation used to simplify and solve equations and inequalities?
• How do literal equations apply to real-world situations?
• For a polynomial equation, how are factors and roots related?</td>
</tr>
</table>

	Acquisition	
	Students will know…	*Students will be skilled at…*
	• Properties of exponents • Definition of nth root, radicand, index, and a principal root of a radical • Steps and processes to simplify a radical expression. • Properties for multiplying and dividing radical expressions. • Steps and processes to "Rationalize the Denominator" • Properties for adding and subtracting radical expressions. • Steps and processes to multiply and divide binomial radical expressions. • Methods and processes to simplify expressions with rational exponents. • Degree of a monomial and polynomial • Definition of an algebraic term Addition, subtraction, and multiplication processes of polynomials • Steps and processes to factoring polynomials • Restrictions on the domain of a rational expression. • Steps and processes to simplifying,multiplying, and dividing rational expressions. • Methods and processes for adding and subtracting rational expressions. • Steps and processes to simplifying complex rational expressions. • Process to solving rational equations. • Comparing values (>, <, =). • The absolute value of a number. • The process for evaluating and	• Simplifying expressions using the rules of exponents • Simplifying nth roots. • Determining all real roots of a real number and the degree of a radical expression. • Simplifying radical expressions. • Multiplying and dividing radical expressions. • Rationalizing the denominator of a radical expression. • Adding and subtracting radical expressions. • Multiplying and dividing binomial radical expressions. • Identifying the degree of a monomial and polynomial • Classifying a polynomial by the number of terms • Performing the operations of Addition, subtraction, and multiplication of polynomials • Factoring polynomial expressions • Identifying values that are restricted from the domain of a rational expression. • Writing a rational expression in simplest form. • Multiplying and dividing rational expressions by factoring. • Adding and subtracting rational expressions. • Simplifying complex rational expressions. • Solving rational equations. • Comparing values both on a number line and using inequality symbols. • Finding the absolute value of a number • Simplifying and evaluate algebraic expressions

	simplifying algebraic expressions and the specific order of operations. • How to solve a linear and literal equation. • Steps to solving inequalities and absolute value equations and inequalities and how to graph solutions on a number line. • Methods and processes to solving a polynomial equation	• Solving linear, literal, and absolute value equations and identifying those that have no solution. • Solving inequalities, compound inequalities, and absolute value inequalities according to specified processes. • Solving polynomial equations by factoring

STAGE 2

Code	Evaluative Criteria	Assessment Evidence
T, M, A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* Goal: To identify correct and incorrect steps for solving linear/rational/quadratic equations Role: Teacher Audience: Student who solved the problem Situation: Students are given a problem set with specific steps shown as a solution. Students then identify if each step is correct or incorrect and explain why. Product: Corrected problem to include feedback and explanation. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Allow students to choose from problems at a variety of difficulty levels.

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…*
M	Thorough understanding of identifying values that are restricted from the domain, simplifying a rational expression, types of polynomials.	• Alternative assessment projects such as "find the mistakes", explain the process, posters, and real world applications • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Quizzes • UNIT Test • "Do Now" questions/opening • Activities • Questioning • Self-assessment • Smartboard activities, (Kahoot, Quizlet, etc.)
T, M, A	Thorough understanding of steps and processes to simplify, multiply, divide, add, subtract, and solve equations.	
T, M, A	Accurate application of content/process to arrive at the correct mathematical solution.	
T, M, A	Selection of evidence that is relevant to content and standardized test processes.	

stage 3

Code	***Pre-Assessment***
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets • Questioning activities, such as basic problems with exponents and radicals. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.

	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
M, A	• Teacher checks for prior knowledge using common formative assessment (pre-test) on properties of exponents and solving polynomial equations.	• Monitoring class work through board work, group work, questioning, warm-ups, and walk-arounds. • Homework check to assess common errors to inform future instruction. • Check prerequisite knowledge throughout the unit using warm-up problems and questioning activities. • Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives • Check for understanding: board and whiteboard activities, or reflections and exit tickets. • Strategic Questioning: Ask students higher-order questions such as "how" and "why," so the teacher can discern the level and extent of the students' understanding.
T, M, A	• Students will work independently on a pre-test for the properties of exponential expressions.	
M, A	• Teacher models real roots by writing $y^2 = 64$ on the board to show the number of real nth roots.	
M, A	• Teacher reviews the perfect square factors, perfect cube factors, perfect fourth root factors, etc. to explain the steps for simplifying radical expressions. Teacher reiterates the importance of factoring out the greatest of these types of factors first.	
M, A	• Students work independently to simplify radicals.	
M, A	• Teacher models the properties and steps for multiplying and dividing radical expressions.	
M, A	• Teacher introduces the concept of "Rationalizing the Denominator" as an alternate method to dividing radical expressions when the denominator contains a radical. Teacher defines "like radicals" to model adding and subtracting radical expressions. Emphasis is placed on the need for students to first simplify the radical expression they want to add or subtract.	
M, A	• Students practice the steps to multiplying and dividing radical expressions.	
M, A	• Teacher makes a connection using the FOIL method for multiplying binomials to multiplying binomial radical expressions.	
M	• Teacher models the addition, subtraction, and multiplication of polynomials.	
M, T	• Students will verbally explain the process of adding, subtracting, and multiplying polynomials. Students will explain what FOIL means in the multiplication of polynomials.	
M	• Teacher explains factoring of a polynomial expression	

	beginning with GCF and grouping on day one, then the difference of squares and the sum and difference of cubes, and lastly trinomials.	
T	• Teacher allows students several opportunities for independent practice and teacher-created groups throughout this topic. Supplemental worksheets and board problems should be used to assess mastery of this concept.	
T,A	• Students will use smartboard to practice factoring polynomial expressions. Students will work in pairs on a mixed review assessment on factoring to explain which method of factoring should be used.	
M	• Teacher uses flow charts to help students determine which method of factoring should be used to factor a polynomial.	
M	• Teacher highlights for students that no matter what a polynomial looks like, the process of factoring always starts with factoring out a GCF if possible.	
M	• Teacher activates prior knowledge via pre-assessment worksheets on the adding/subtracting of rational numbers, simplifying exponential expressions, factoring polynomials, and solving polynomial equations.	
M,A	• Students will work independently and as a class factoring polynomial expressions and solving polynomial equations.	
M	• Teacher introduces the concept of simplifying rational expressions as being dependent on factoring polynomials.	
M, A	• Students will use the white boards to practice simplifying rational expressions.	
M	• Teacher models multiplying and dividing rational expressions.	
M, A	• Students will explain in writing whether or not terms can be canceled in a rational expression and why.	
M, A	• Students will recite the meaning of “Keep-Change-Flip” for dividing rational expressions	
M	• Teacher makes connections to the similarities in the process used in adding/subtracting rational expressions versus basic fractions.	

M	• Teacher invites a volunteer to write the steps for adding a fraction similar to ½ + ⅝ on the board.	
M, A	• Students will verbally explain the process of finding the least common denominator (LCD) in order to add and subtract rational expressions.	
M, A	• Students will practice simplifying complex rational expressions as a class and independently.	
M,A	• Students will solve rational equations by cross-multiplication or by setting the LCDs equal to each other.	
M,A	• Teacher suggests changing a complex fraction to a division problem in the form of (N) ÷ (D) where N and D are the expressions in the numerator and denominator of the complex fraction.	
T, M,A	• Supplemental worksheets and board problems should be used to assess mastery of the process.	
M, A	• Teacher models examples evaluating expressions and solving equations.	
M, A	• Students will work independently practicing evaluating and simplifying algebraic expressions.	
T, M	• Teacher uses TI Emulator software to demonstrate the process of using the graphing calculator to evaluate expressions and to check solutions to equations.	
T, M, A	• Students will practice using the graphing calculator to solve equations and to evaluate expressions.	
M, A	• Teacher models steps to solving algebraic, literal, and fractional equations by hand. Teacher also relates literal equations to formulas and other real-world uses.	
M, A	• Students will work in small groups to solve equations that include basic, fractional, and literal types.	
T, M	• Students will describe the factoring methods for solving polynomial equations and practice this method in teacher assigned groups.	
	<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. • Textbook: Blitzer, Robert. Precalculus Second Edition, Upper Saddle River, NJ: Pearson, 2004. • Supplemental activities from the textbook resources • Teacher-made supplemental activities on applications, performance tasks, and chapter review • Graphing calculator TI Emulator software. • On-line resources such as YouTube, Khan Academy, Desmos, EdPuzzle, Kahoot, etc.	

ESTABLISHED GOALS Include any national/state/or school goals (Power standards).	***Transfer***	
CCSS.Math.Content.HSA.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. CCSS.Math.Content.HSF.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range)	*Students will be able to independently use their learning to…* Make sense of a problem by initiating a plan and persevere in solving Model with mathematics by using the appropriate method Reason abstractly Justify reasoning or understanding by explaining techniques to solving Attend to precision	
	Meaning	
	UNDERSTANDINGS *Students will understand that…*	ESSENTIAL QUESTIONS *Students will keep considering…*

<table>
<tr>
<td rowspan="4">assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f (x) denotes the output of f corresponding to the input x . The graph of f is the graph of the equation y = f (x).

CCSS.Math.Content.HSF.IF.A.2
Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

CCSS.Math.Content.HSF.IF.B.4
For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity . *

CCSS.Math.Content.HSF.IF.B.5
Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For</td>
<td>• A line contains its own unique slope and y-intercept.
• The slope of a line represents the rate of change of that line.
• Information about a line can be used to write an equation for that line.
• Relations have specific characteristics that result in them being considered functions.
• Functions can be represented in several forms including as relations, as a mapping, as a graph, and by using function notation.
• Composition of functions combines two different functions into one new function.
• An inverse of a function “undoes” what the original function did to a value.
• Parent functions have specific characteristics when graphed, and putting values in specific places will transform (move) the graph in specific ways.</td>
<td>• What are the different forms of linear equations, and why is it useful to have them?
• What applications can be represented by linear equations?
• What are the similarities and differences between the graphs of linear functions and absolute value functions?
• Why is it important to represent the same relation or function using multiple formats?
• How are the characteristics of a linear equation different from a nonlinear equation?
• What are some real-world uses of inverse and composite functions?
• What does the parent function of various graphs look like, and how do values change the graph?</td>
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<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…</td>
<td>Students will be skilled at…</td>
</tr>
<tr>
<td>• What the slope of a line represents and how to find it
• The distinction between relations and functions.
• How to find the domain and range of a function
• The processes to identify and evaluate functions
• The key features of graphs. To include: intercepts; intervals where the function is positive, or negative, increasing, or</td>
<td>• Recognizing slope as a rate of change
• Identifying slopes of horizontal, vertical, parallel, and perpendicular lines
• Writing and graph equations in point-slope and slope-intercept form
• Determining the domain and range from a relation and represent the relation using a mapping diagram
• Deciding if a relation is a function when
• given a set of ordered pairs, a mapping, and a graph</td>
</tr>
</table>

example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.	decreasing; relative maximums and minimums; symmetries, and end behavior. • What composition of functions is and how to apply it • The steps to graphing functions from the parent function.	• Evaluating a specific value given the equation or graph of a function (i.e., find f(3) given the graph of f(x)) • Identifying key features of graphs. • Composing two functions • Finding the inverse of a function and graphing it • Determining key features of a graph (vertex, vertical and horizontal shifts, stretch or compression) based on transformations of its parent function.

STAGE 2

Code	Evaluative Criteria	Assessment Evidence
	Further information:	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…*
T, M, A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	<u>Goal</u>: To find the line of best fit given real-world data <u>Role</u>: Financial consultant <u>Audience</u>: Business managers for various companies <u>Situation</u>: Given three different companies (photography, home improvement, and theater), the consultant is asked to provide a cost analysis from given data. <u>Product</u>: Calculated predictions with appropriate explanations <u>Standard for Success</u>: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. <u>To Differentiate</u>: Allow students to choose from problems at a variety of difficulty levels.

M T, M, A T, M, A T, M, A	Thorough understanding of identifying values that are restricted from the domain, simplifying a rational expression, types of polynomials. Thorough understanding of steps and processes to simplify, multiply, divide, add, subtract, and solve equations. Accurate application of content/process to arrive at the correct mathematical solution. Selection of evidence that is relevant to content and standardized test processes.	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* • Alternative assessment projects such as "find the mistakes", explain the process, posters, and real world applications • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Quizzes • UNIT Test • "Do Now" questions/opening • Activities • Questioning • Self-assessment • Smartboard activities, (Kahoot, Quizlet, etc.)

Code	***Pre-Assessment***	
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets • Questioning activities, such as basic problems with exponents and radicals. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.	
M, A A M, A	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…* • Teacher activates prior learning by giving practice through homework, warm-ups, and entrance tickets to review linear equations and slope • Students review and practice writing and graphing linear equations. • Teacher activates prior learning of graphing by giving warm-up exercises on graphing points in the coordinate	Progress Monitoring • Monitoring class work through board work, group work, questioning, warm-ups, and walk-arounds. • Homework check to assess common errors to inform future instruction. • Check prerequisite knowledge throughout the unit using warm-up problems and questioning activities.

 A T, M, A T, M, A T, A M, A T, M, A T, M, A T, M, A	plane and evaluating expressions. • Teacher defines relation, domain,range, and function and models examples on how to identify these from given information (data sets, mapping, graph). • Students will work independently to identify domain and range and determine if a relation is a function. • Students will also evaluate functions for given values. • Teacher discusses the real-world application of composition of functions and models the process of composing two functions into one new function. • Students will complete a practice worksheet on composition of functions and will then compare and discuss their results with a partner. • Students will use graphing technology to discover how graphs are related to their parent function and what causes them to shift vertically, horizontally, and to stretch or compress. • Teacher provides an activity for students to discover what an inverse of a function is. Teacher then models steps to find inverses of given functions. • Students will work collaboratively to discover the relationship between a function and its inverse and will complete a practice worksheet on finding inverses of functions. <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. • Textbook: Blitzer, Robert. Precalculus Second Edition, Upper Saddle River, NJ: Pearson, 2004. • Supplemental activities from the textbook resources	• Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives • Check for understanding: board and whiteboard activities, or reflections and exit tickets. • Strategic Questioning: Ask students higher-order questions such as "how" and "why," so the teacher can discern the level and extent of the students' understanding.

	• Teacher-made supplemental activities on applications, performance tasks, and chapter review • Graphing calculator TI Emulator software. • On-line resources such as YouTube, Khan Academy, Desmos, EdPuzzle, Kahoot, etc.	

<table>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="4">ESTABLISHED GOALS

CCSS.MATH.CONTENT.HSA.APR.B.2 Know and apply the Remainder Theorem: For a polynomial p(x) and a number a , the remainder on division by x - a is p(a), so p (a) = 0 if and only if (x - a) is a factor of p(x).

CCSS.MATH.CONTENT.HSA.APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

CCSS.MATH.CONTENT.HSA.APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition,</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Make sense of a problem by initiating a plan and persevere in solving
Model with mathematics by using the appropriate method
Reason abstractly
Justify reasoning or understanding by explaining techniques to solving
Attend to precision</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

• Polynomials can be added, subtracted, and multiplied to make a more simplified expression.
• Polynomials can be broken up into products of more simplified terms by factoring.
• Quadratic and other polynomial equations can be solved using factoring, completing the square, and Quadratic</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

• How are polynomial expressions combined using operations of addition, subtraction, and multiplication?
• Why does factoring “work” as a method of solving quadratic and polynomial equations?
• What are some real-world applications that involve polynomial modeling?
• Why do some functions have restricted values?</td></tr>
</table>

<table>
<tr>
<td rowspan="3">subtraction, and multiplication; add, subtract, and multiply polynomials.

CCSS.MATH.CONTENT.HSA.REI.B.4.B Solve quadratic equations by inspection (e.g., for x 2= 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b

CCSS.MATH.CONTENT.HSA.REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line)</td>
<td>Formula.
• Graphs of Polynomial functions can be used to find domain, range, and intercepts and to tell the nature of the function(increasing, decreasing, constant , maxima, minima)
• Rational functions are a ratio of polynomial functions. If a rational function is in simplified form and the polynomial in the denominator is not constant, the graph of the rational function features asymptotic behavior. It looks quite different from the graph of either of its polynomial components.</td>
<td>• How do you find the degree of a polynomial function?
• What does the degree of a polynomial tell you about its related polynomial function?
• For a polynomial function, how are factors, zeros, and x-intercepts related?
• For a polynomial equation, how are factors and roots related?
• Writing a rational expression in simplest form.
• What kinds of asymptotes are possible for a rational function?</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…

• Degree of a monomial and polynomial
• Definition of an algebraic term
• Addition, subtraction, and multiplication processes of polynomials
• Steps and processes to factoring polynomials
• Methods and processes to solving a polynomial equation
• A polynomial function is classified by degree.
• The degree of a polynomial determines the possible number of turning points in its graph and the end behavior of the graph.
• A turning point is a relative maximum or relative minimum of a polynomial function.
• What constitutes even vs. odd multiplicity when the function is in its algebraic form.</td>
<td>Students will be skilled at…

• Identifying the degree of a monomial and polynomial
• Classifying a polynomial by the number of terms
• Performing the operations of Addition, subtraction, and multiplication of polynomials
• Factoring polynomial expressions
• Solving polynomial equations by factoring or graphing methods
• Graphing polynomials and Identifying intercepts, points of relative maxima and minima, intervals where the function is increasing, decreasing, or constant, as well as find specific values from the graph of a function
• Recognizing from a graph the key features of a polynomial such as the factors, zeros, relative minimums, relative maximums.</td>
</tr>
</table>

	• Steps and processes to simplifying, multiplying, and dividing rational expressions. • Restrictions on the domain of a rational expression.	• Identifying values that are restricted from the domain of a rational expression. • Writing a rational expression in simplest form.

STAGE 2

Code	Evaluative Criteria	Assessment Evidence
T, M, A	Further information: Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* Goal: To apply the skills of polynomial functions in the design of roller coaster rides. Role: Roller Coaster Engineer Audience : Amusement Park Manager Situation : Given three different polynomial functions that model roller coasters, the student is asked to graph each function, find the heights at different independent variables (time), and evaluate the function at a given independent variable. Product: Demonstration of a clear and in depth understanding of polynomial functions, such as sketching and analyzing graphs of polynomial functions, determining zeros of a polynomial function, and determining polynomial function behavior. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Provide different problems with different levels of difficulty from which students can choose.

M T, M, A T, M, A T, M, A	Thorough understanding of identifying values that are restricted from the domain, simplifying a rational expression, types of polynomials. Thorough understanding of steps and processes to simplify, multiply, divide, add, subtract, and solve equations. Accurate application of content/process to arrive at the correct mathematical solution. Selection of evidence that is relevant to content and standardized test processes.	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* • Alternative assessment projects such as "find the mistakes", explain the process, posters, and real world applications • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Quizzes • UNIT Test • "Do Now" questions/opening • Activities • Questioning • Self-assessment • Smartboard activities, (Kahoot, Quizlet, etc.)

Code	***Pre-Assessment***	
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets • Questioning activities, such as basic problems with exponents and radicals. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.	
M T M	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…* • Teacher checks for prerequisite and prior knowledge via warm-ups on solving and graphing linear functions • Students will work independently and as a class solving equations and graphing linear equations both manually and on graphing calculators. • Teacher introduces the properties of exponents by using visual representations to what exponents mean (e.g., $x^2 \cdot x^3 = x5$ since $x^2 = x \cdot x$ and $x^3 = x \cdot x \cdot x$ giving us a result of 5 x's).	Progress Monitoring • Monitoring class work through board work, group work, questioning, warm-ups, and walk-arounds. • Homework check to assess common errors to inform future instruction. • Check prerequisite knowledge throughout the unit using warm-up problems and questioning activities. • Differentiate through purposeful or flexible grouping, use of diagrams and explanations to

T, M M M, T M T T,A M T,M M M,A	• Students will work independently simplifying exponential expressions and then share results in a teacher created pairing. • Teacher models the addition, subtraction, and multiplication of polynomials. • Students will verbally explain the process of adding, subtracting, and multiplying polynomials. Students will explain what FOIL means in the multiplication of polynomials. • Teacher explains factoring of a polynomial expression beginning with GCF and grouping on day one, then the difference of squares and the sum and difference of cubes, and lastly trinomials. • Teacher allows students several opportunities for independent practice and teacher-created groups throughout this topic. Supplemental worksheets and board problems should be used to assess mastery of this concept. • Students will use smartboard to practice factoring polynomial expressions. Students will work in pairs on a mixed review assessment on factoring to explain which method of factoring should be used. • Teacher uses flow charts to help students determine which method of factoring should be used to factor a polynomial. • Students will describe the factoring methods for solving polynomial equations and practice this method in teacher assigned groups. • Teacher highlights for students that no matter what a polynomial looks like, the process of factoring always starts with factoring out a GCF if possible. Teacher illustrates a method for solving polynomial equations by factoring by hand and by graphing calculators. • Students will solve polynomial equations having a degree greater than two by entering the linear portion in Y1 in their graphing calculators and the rest of the equation in Y2 of their graphing calculators. Students will then use the	demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives • Check for understanding: board and whiteboard activities, or reflections and exit tickets. • Strategic Questioning: Ask students higher-order questions such as "how" and "why," so the teacher can discern the level and extent of the students' understanding.

	intersect feature to find the x-values at that point of intersection.	
M	• Teacher activates prior knowledge via pre-assessment worksheets on the adding/subtracting of rational numbers, simplifying exponential expressions, factoring polynomials, and solving polynomial equations.	
M	• Teacher models how to identify the asymptotes and holes to graph a rational function.	
M, A	• Students will work independently and as a class graphing rational functions.	
T, M, A	• Supplemental worksheets and board problems should be used to assess mastery of the process in graphing a rational function. 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. • Textbook: Blitzer, Robert. Precalculus Second Edition, Upper Saddle River, NJ: Pearson, 2004. • Supplemental activities from the textbook resources • Teacher-made supplemental activities on applications, performance tasks, and chapter review • Graphing calculator TI Emulator software. • On-line resources such as YouTube, Khan Academy, Desmos, EdPuzzle, Kahoot, etc.	

<table>
<tr><td rowspan="6">ESTABLISHED GOALS

CCSS.Math.Content.HSA.SSE.B.3.c Use the properties of exponents to transform expressions for exponential functions.

CCSS.Math.Content.HSF.IF.C.7.e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

CCSS.Math.Content.HSF.IF.C.8.b Use the properties of exponents to interpret expressions for exponential functions.

CCSS.Math.Content.HSF.BF.B.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Make sense of a problem by initiating a plan and persevere in solving
Model with mathematics by using the appropriate method
Reason abstractly
Justify reasoning or understanding by explaining techniques to solving
Attend to precision</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

• Exponential equations can be solved by getting a common base or by using logarithms.
• Logarithms are used to represent exponents, which could not be solved.
• Properties of logarithms relate to the properties of exponents.
• Interest on banking accounts is modeled with exponential functions as well as archaeology, oceanography, and manufacturing applications to name a few.</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

• What is the value of an exponential equation in the real-world?
• How are exponents and logarithms related?
• How does the relationship between exponential and logarithmic functions help us?
• What are some real-world applications of logarithmic and exponential functions?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

• The process of solving exponential equations by getting a common base and</td><td>Students will be skilled at…

• Changing expressions to have the same base in order to solve exponential</td></tr>
</table>

	by using logarithms. • A logarithm is a way to represent exponents. • The properties of logarithms.	equations. • Changing expressions from exponential form to logarithmic form and vice-versa. • Evaluating logarithmic expressions. • Applying the properties of logarithms to solve exponential equations.

STAGE 2

Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Further information: Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of...* Goal: Students will apply concepts of exponential equations in order to calculate continuous versus yearly compounded interest. Role: Students will take on the role of a financial analyst Audience : Business Manager Situation : Students are given different scenarios that they will compare the two different types of interest rates. Product: Analysis of the different scenarios. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Provide different problems with different levels of difficulty from which students can choose.

M T, M, A T, M, A T, M, A	Thorough understanding of identifying values that are restricted from the domain, simplifying a rational expression, types of polynomials. Thorough understanding of steps and processes to simplify, multiply, divide, add, subtract, and solve equations. Accurate application of content/process to arrive at the correct mathematical solution. Selection of evidence that is relevant to content and standardized test processes.	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* • Alternative assessment projects such as "find the mistakes", explain the process, posters, and real world applications • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Quizzes • UNIT Test • "Do Now" questions/opening • Activities • Questioning • Self-assessment • Smartboard activities, (Kahoot, Quizlet, etc.)

Code	***Pre-Assessment***	
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets on simplifying rational exponents,evaluating expressions and using linear models. • Questioning activities, such as basic problems with simplifying expressions with exponents. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.	
M T,A M	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…* • Teacher uses independent/guided practice via supplemental worksheets to review simplifying expressions with exponents. • Students work independently and in teacher created groups to complete practice problems that review exponents. Students will use think-pair-share to compare and discuss their answers • Teacher walks around and monitors student progress,	Progress Monitoring • Monitoring class work through board work, group work, questioning, warm-ups, and walk-arounds. • Homework check to assess common errors to inform future instruction. • Check prerequisite knowledge throughout the unit using warm-up problems and questioning activities. • Differentiate through purposeful or flexible

	assists individual students, and models examples when needed for the class.	grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives • Check for understanding: board and whiteboard activities, or reflections and exit tickets. • Strategic Questioning: Ask students higher-order questions such as “how” and “why,” so the teacher can discern the level and extent of the students’ understanding.
T,A	• Students will individually complete problems on solving exponential equations. Students will volunteer their solutions and will explain the process they used.	
M	• Teacher gives warm-up questions on exponents as a way to introduce exponential equations.	
M	• Teacher models different examples of exponential equations that have the same base and the steps to solving them.	
M,T	• Teacher has the class graph the equation y = 2x and its inverse as a way of introducing the graph of an exponential equation and a logarithm.	
M	• Teacher models how to solve and evaluate logarithmic equations and expressions by changing to exponential form and by applying the properties of logarithms.	
T, A	• Students will practice evaluating and solving logarithmic expressions and equations by various activities such as independent activities such as independent practice, board work, think-pair-share, and/or use of white boards.	
	<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. • Textbook: Blitzer, Robert. Precalculus Second Edition, Upper Saddle River, NJ: Pearson, 2004. • Supplemental activities from the textbook resources • Teacher-made supplemental activities on applications, performance tasks, and chapter review • Graphing calculator TI Emulator software. • On-line resources such as YouTube, Khan Academy, Desmos, EdPuzzle, Kahoot, etc.	

<table>
<tr><td rowspan="4">ESTABLISHED GOALS

CCSS.MATH.CONTENT.HSF.TF.A.1 Understand the radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

CCSS.MATH.CONTENT.HSF.TF.A.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

CCSS.MATH.CONTENT.HSF.TF.A.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for x, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number

CCSS.MATH.CONTENT.HSG.SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Make sense of a problem by initiating a plan and persevere in solving
Model with mathematics by using the appropriate method
Reason abstractly
Justify reasoning or understanding by explaining techniques to solving
Attend to precision</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

• Right triangles, which are similar, will have the same relationships between specific pairs of sides (i.e., opposite: hypotenuse).
• Right triangle trigonometry has many uses and applications in the real-world.
• Right triangle trigonometry has many uses and applications.
• The Unit Circle can represent angles of any measure, in degrees or radians, and is cyclic.
• Trigonometric functions of specific angles relate to specific points and values on the unit circle.
• Graphs of the trigonometric functions are cyclic with certain traits.
• Sine and Cosine graphs produce "waves."</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

• Why do the trigonometric ratios hold for all right triangles with the same angle measures?
• How can the use of right triangles, trigonometric functions, and the Pythagorean Theorem be used to solve real-world problems?
• How can the use of right triangles, trigonometric functions, and the Pythagorean Theorem be used to solve real world problems?
• What is the unit circle and why is it important in trigonometry?
• Why do the graphs of trigonometric functions look the way they do?
• How do the graphs of sine and cosine apply to real life applications?
• What are the uses of inverse trigonometric functions?</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

• Pythagorean Theorem
• Definitions of the six trigonometric functions
• Radian measures
• Angles, points, and trigonometric values on the unit circle
• Reference angles
• Methods to graphing sine, cosine, tangent, cosecant, and secant, and their general behaviors
• Inverse trigonometric functions and the restrictions on their ranges
• Compositions of trigonometric functions</td><td>Students will be skilled at…

• Using the Pythagorean Theorem and right triangle trigonometry to solve right triangles
• Defining the six trigonometric functions
• Constructing a unit circle and identify angles in both degree and radian measures
• Converting degrees to radians (and vice versa)
• Identifying specific points on the unit circle
• Defining the trigonometric functions as related to the x and y coordinates and radius on the unit circle
• Using reference angles and definitions of the trigonometric functions to find the specific values on the unit circle.
• Filing in the trigonometric table for values of special and quadrantal angles
• Graphing sine, cosine, tangent, cosecant, and secant functions and identify special characteristics such as amplitude, period, phase shift, and vertical shift
• Identifying the domain and range of inverse trigonometric functions
• Finding the exact values of inverse trigonometric functions and composite trigonometric functions
• Using graphing calculators to check graphs of trigonometric values and to find approximate solutions to problems
• Solving real-world applications involving right triangle trigonometry.</td></tr>
</table>

Code	Evaluative Criteria	Assessment Evidence
	Further information:	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…*
T, M, A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	Task 1: Goal: To use right triangle trigonometry to solve real-world application problems Role: Students will take on the role of a surveyor Audience : Land development company Situation : Given various situations, you are to calculate unknown distances to report to the land development company for construction purposes. Product: Calculated distances with work shown. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Provide different problems with different levels of difficulty from which students can choose. Task 2: Goal: To calculate your personal biorhythm chart for the current month Role: Students will take on the role of a social scientist Audience: School staff Situation: You are to convince school staff whether or not your personal academic performance will be stronger or weaker based on your biorhythm Product: Your completed biorhythm Standards for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim.

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…*
M	Thorough understanding of identifying values that are restricted from the domain, simplifying a rational expression, types of polynomials.	• Alternative assessment projects such as "find the mistakes", explain the process, posters, and real world applications • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Quizzes • UNIT Test • "Do Now" questions/opening • Activities • Questioning • Self-assessment • Smartboard activities, (Kahoot, Quizlet, etc.)
T, M, A	Thorough understanding of steps and processes to simplify, multiply, divide, add, subtract, and solve equations.	
T, M, A	Accurate application of content/process to arrive at the correct mathematical solution.	
T, M, A	Selection of evidence that is relevant to content and standardized test processes.	

Code	***Pre-Assessment***
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets • Questioning activities, such as basic problems with right triangle trigonometry and simplifying radicals. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.

	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
M	• Teacher reviews the Pythagorean Theorem and right triangle trigonometry.	• Monitoring class work through board work, group work, questioning, warm-ups, and walk-arounds.
M, A	• Students will practice solving right triangles using trigonometry by working in teacher created groups.	• Homework check to assess common errors to inform future instruction.
T, M, A	• Teacher gives review and practice problems as class work to find missing sides and angles. Lesson leads into the introduction of the three reciprocal trigonometric functions, and applications of trigonometry will be discussed.	• Check prerequisite knowledge throughout the unit using warm-up problems and questioning activities. • Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives
T, M, A	• Students will also identify the values of the reciprocal functions and will use their calculators to find specific values.	
M, A	• Teacher introduces the concept of the Unit Circle by first discussing radian measure as a representation of the length of the arc on the circle.	• Check for understanding: board and whiteboard activities, or reflections and exit tickets.
M, A	• Teacher leads the class through the discovery of the relationship between degrees and radians and how to convert degrees to radians and radians to degrees.	• Strategic Questioning: Ask students higher-order questions such as "how" and "why," so the teacher can discern the level and extent of the students' understanding..
M, A	• Students will work independently on changing measures from degrees to radians and radians to degrees.	
M, A	• Teacher continues to demonstrate the relations on the Unit Circle to points on the circle and angle measures.	
T, M, A	• After a review of special right triangles, the teacher models how to find specific points given particular reference angles.	
T, M, A	• Students will complete the Unit Circle chart with specific degree measure, radian measure, and the coordinate of the associated points. Students may collaborate with a partner on their solutions.	
T, M	• Teacher prepares materials (garland, laminated color coded cards with degree measures, radian measures, and coordinates of points) for the Unit Circle activity where students physically construct a model of the Unit Circle.	
T, M	• Students will work cooperatively as a group to construct the Unit Circle in the rotunda using garland and laminated	

T, M, A	values on the circle.	
M, A	• Students will then use the Unit Circle and reference angles to fill in the trigonometric table. Students will then play the "Move It" game where they must move to a specific value on the circle.	
T, M, A	• Teacher reviews the relationships of trigonometric functions in right triangles and then shows the connection with the x, y, and r values of the Unit Circle. Lesson leads into applications of the trigonometric functions to any point in the coordinate plane, which the teacher models and explains.	
M, A	• Students will apply the definitions of the trigonometric functions to the Unit Circle. Students will then find the values of the trigonometric functions at any value.	
M, A	• With the help of the graphing calculator, the teacher leads the class through graphing the sine and cosine curves. Discussion on the general shape of the curves, their periodic behavior, and their amplitude, period, phase shift, and vertical shift occurs.	
T, M, A	• Teacher leads the class through examples on how to graph sine and cosine functions.	
M, A	• Students will work at the board to practice graphing sine and cosine functions, identifying the amplitude, period, phase shift, and vertical shift.	
M, A	• Teacher has the class make a t-table to graph the tangent curve. The general shape of the curve and its period will be discussed.	
M, A	• Teacher models how to graph the secant and cosecant functions by using the sine and cosine graphs as "helpers."	
M, A	• Students will graph y=tanx as well as various cosecant and secant curves by working in teacher created groups.	
T, M, A	• Teacher models how to use the graphing calculator and trigonometric table to find approximate and exact values of inverse trigonometric functions. Teacher also explains how to find composite trigonometric values.	
	• Students will work in pairs to find inverse and composite	

M, A	trigonometric functions using their calculators and the trigonometric table. • Teacher determines cooperative groups for various activities during this unit. <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. • Textbook: Blitzer, Robert. Precalculus Second Edition, Upper Saddle River, NJ: Pearson, 2004. • Supplemental activities from the textbook resources • Teacher-made supplemental activities on applications, performance tasks, and chapter review • Graphing calculator TI Emulator software. • On-line resources such as YouTube, Khan Academy, Desmos, EdPuzzle, Kahoot, etc.	

<table>
<tr><td rowspan="6">ESTABLISHED GOALS

CC 9-12 G-SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

CC 9-12 N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Make sense of a problem by initiating a plan and persevere in solving
Model with mathematics by using the appropriate method
Reason abstractly
Justify reasoning or understanding by explaining techniques to solving
Attend to precision</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

• The Law of Sines and Law of Cosines apply to non-right triangles and can be used to find missing lengths or angles.</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

• How can the use of trigonometric functions be extended to solve word problems and triangles with no right angles?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

• Law of Sines
• Law of Cosines
• Applications of the Law of Sines and Law of Cosines</td><td>Students will be skilled at…

• Solving a triangle for missing sides or angles using the Law of Sines and the Law of Cosines
• Applying the ambiguous of the Law of Sines to determine if there are none, one, or two possible triangles</td></tr>
</table>

Code	Evaluative Criteria	Assessment Evidence
T, M, A	Further information: Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* Goal: To find unknown values in specific real-world situations Role: Students will take on the role of a surveyor Audience : Land development company Situation : Given various situations, use the Laws of Sines and Cosines to calculate values that are otherwise non-measurable (e.g., calculate the distance between two landmarks that have a lake between them). Product: Calculated distances with work shown. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Provide different problems with different levels of difficulty from which students can choose.
M T, M, A T, M, A	Thorough understanding of identifying values that are restricted from the domain, simplifying a rational expression, types of polynomials. Thorough understanding of steps and processes to simplify, multiply, divide, add, subtract, and solve equations. Accurate application of content/process to arrive at the correct mathematical solution.	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* • Alternative assessment projects such as "find the mistakes", explain the process, posters, and real world applications • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Quizzes • UNIT Test • "Do Now" questions/opening • Activities • Questioning • Self-assessment • Smartboard activities, (Kahoot, Quizlet, etc.)

T, M, A	Selection of evidence that is relevant to content and standardized test processes.	

Code	*Pre-Assessment*
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets • Questioning activities, such as basic problems with trigonometry. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.

Code	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
M, A	• Teacher introduces the Law of Sines by having students solve a right triangle. Discussion takes place about solving a non-right triangle, and the teacher gives the formula for the Law of Sines and models some examples.	• Monitoring class work through board work, group work, questioning, warm-ups, and walk-arounds. • Homework check to assess common errors to inform future instruction. • Check prerequisite knowledge throughout the unit using warm-up problems and questioning activities. • Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives • Check for understanding: board and whiteboard activities, or reflections and exit tickets. • Strategic Questioning: Ask students higher-order questions such as "how" and "why," so the teacher can discern the level and extent of the students' understanding.
M, A	• Teacher leads the class through discovery of the relationship between angles and sides in using the Law of Sines in different cases (AAS, ASA, SSA).	
M, A	• Students will work as a whole group to practice some examples on the Law of Sines (non ambiguous case).	
M, A	• Teacher reviews the ambiguous case for the Law of Sines and demonstrates why there are possibly no triangles, one triangle, or two triangles.	
M, A	• Teacher models examples of using the Law of Sines equation with no triangle and with two triangles.	
T, M, A	• Students will practice examples of the ambiguous case of the Law of Sines by working in small teacher created groups.	
M, A	• Teacher leads the class through discovery of the relationship between angles and sides in using the Law of Cosines and discusses when to use it (SSS, SAS cases).	

M, A T, M, A T, M, A	• Teacher models an example where a side should be found first, and then one where an angle should be found first. • Students will solve triangles using the Law of Cosines and will compare their answers with a partner. • Students will work independently to complete the performance task related to applications with the Law of Sines and Law of Cosines. 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. • Textbook: Blitzer, Robert. Precalculus Second Edition, Upper Saddle River, NJ: Pearson, 2004. • Supplemental activities from the textbook resources • Teacher-made supplemental activities on applications, performance tasks, and chapter review • Graphing calculator TI Emulator software. • On-line resources such as YouTube, Khan Academy, Desmos, EdPuzzle, Kahoot, etc.	