Rumson-Fair Haven Regional High School

Course: *Chemistry Honors*
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Section I: Course Description

The *Chemistry Honors* course is a Chemistry study central to all sciences. It is not only a basis for all other sciences but a link to investigations into natural processes in our world. Students will develop skills and utilize tools that increase knowledge and allow students to think critically about personal and societal issues and needs. Students will have an opportunity to construct scientific explanations and design evidence-based solutions. Students can then contribute meaningfully to decision-making processes, such as discussions about climate change, new approaches to health care, and innovative solutions to local and global problems. This course encourages the development of higher-level thinking and problem-solving skills via self-directed activities and assignments. Additionally, there is a laboratory component to this course in which students are required to question, observe, collect data, experiment, and analyze results. Throughout this course a broad range of topics are presented in depth enabling students to gain a strong knowledge of course concepts and prepare for further challenges. These include, but are not limited to: organization of the periodic table, periodicity, ionization energy, basic atomic structure, electron configuration, electromagnetic radiation, nomenclature, chemical bonding, chemical reactions, stoichiometry, kinetic molecular theory, properties of gasses and gas laws, solutions, acid and base properties, equilibrium and the pH scale, reaction rates, thermochemistry, and nuclear chemistry. Because of the rigor and expectations of this course, it is intended for students with strong backgrounds in both mathematics and science. Students should note that formula sheets will not be provided, but a periodic table and scientific calculator may be used to solidify their understanding. As such, it is strongly recommended that students who take this course are currently enrolled in *Algebra II Honors*. Labs will run once every four-day schedule rotation.

Section II: NJSLS: New Jersey Student Learning Standards/Learning Objectives:

1. ***2020 New Jersey Student Learning Standards – Science*:**
    - "Scientific and technological advances have proliferated and now permeate most aspects of life in the 21st century. It is increasingly important that all members of our society develop an understanding of scientific and engineering concepts and processes. Learning how to construct scientific explanations and how to design evidence-based solutions provides students with tools to think critically about personal and societal issues and needs. Students can then contribute meaningfully to decision-making processes, such as discussions about climate change, new approaches to health care, and innovative solutions to local and global problems."
2. ***2023 New Jersey Student Learning Standards – Mathematics:***
    - "A New Jersey education in Mathematics builds quantitatively and analytically literate citizens prepared to meet the demands of college and career, and to engage productively in an information-driven society; …A high-quality mathematics education fosters a population that…leverages data in decision-making and as a lens for discussing, analyzing, and responding to practical questions, persists to make sense of and model problems arising in everyday life, society, and the workplace, thinks critically and strategically to assess quantitative relationships and to solutions to complex problems, employs precise reasoning and constructs viable arguments to deduce conclusions, recognize false statements and assess peers' reasoning, interprets, evaluates and critiques the mathematics embedded in social, scientific and commercial systems, as well as the claims made in the private and public sectors, communicates precisely when conveying, representing, and justifying both qualitative and quantitative perspectives."
3. ***2023 New Jersey Student Learning Standards English Language Arts:***
    - A New Jersey education in English Language Arts builds readers, writers, and communicators prepared to meet the demands of college and career and to engage as productive American citizens with global responsibilities. …Students will develop the necessary skills in reading, writing, speaking, and listening that are the foundations for creative and purposeful expression in language read rich, challenging texts that build their knowledge of the world, grow their confidence and identities as readers, and develop critical thinking skills and vocabulary necessary for long-term success[; e]ngage in regular, meaningful, writing authentic tasks, exploring valued topics, writing for impact and expression, and sharing their work with others (including authentic audiences) leverage complex texts and digital media to develop comprehension, active listening, and discussion skills ground daily writing and discussion in evidence, fostering an ability to read critically, build arguments, cite evidence, and communicate ideas to contribute meaningfully as productive citizens evaluate the reliability, credibility, and perspective of authors and speakers across all forms of media express ideas and knowledge through a variety of modalities and media, and serve as effective communicators who purposefully read, write, and speak across multiple disciplines [and l]earn to persist in reading complex texts, establishing lifelong habits to read voluntarily for pleasure, for further education, for information on public policy, and for advancement in the workplace.
4. ***Standard 8.1 (Computer Science) and 8.2 (Design Thinking)* of the *2020 NJSLS:***
    - "The 'Intent and Spirit of the Computer Science and Design Thinking Standards' is to focus on deep understanding of concepts that enable students to think critically and systematically about leveraging

technology to solve local and global issues. Authentic learning experiences that enable students to apply content knowledge, integrate concepts across disciplines, develop computational thinking skills, acquire and incorporate varied perspectives, and communicate with diverse audiences about the use and effects of computing prepares New Jersey students for college and careers."

5. ***Standard 9.4 (Life Literacies and Key Skills)* of the *2020 NJSLS*:**
   - "This standard outlines key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy that are critical for students to develop to live and work in an interconnected global economy."
     ***Climate Change:** The state of New Jersey has mandated instruction in, "Climate Change across all content areas, leveraging the passion students have shown for this critical issue and providing them opportunities to develop a deep understanding of the science behind the changes and to explore the solutions our world desperately needs."
6. ****Amistad Law: N.J.S.A. 18A 52:16A-88:***
   - The inclusion of lessons and resources/texts dealing with the African slave trade, slavery in America, the vestiges of slavery in this country and the contributions of African-Americans to our society will be implemented in English and Social Studies courses in accordance with state law: "Every board of education shall incorporate the information regarding the contributions of African-Americans to our country in an appropriate place in the curriculum of elementary and secondary school students."
7. ****Holocaust Law: N.J.S.A. 18A 35-28:***
   - The inclusion of lessons and resources/texts that enable pupils to identify and analyze applicable theories concerning human nature and behavior; to understand that genocide is a consequence of prejudice and discrimination; and to understand that issues of moral dilemma and conscience have a profound impact on life will be implemented in English and Social Studies courses in accordance with state law: "Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens."
8. ****LGBT and Disabilities Law: N.J.S.A. 18A:35-4.35*:**
   - A transformative approach to the inclusion of lessons and resources/texts on the contributions and issues concerning the LGBTQ+ population and people with disabilities will be implemented across all core subjects in accordance with state law: "A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards (N.J.S.A.18A:35-4.36). A board of education shall have policies and procedures in place pertaining to the selection of instructional materials to implement the requirements of N.J.S.A. 18A:35-4.35."
9. ****Asian American and Pacific Islanders Legislation: N.J.S.A 4021/A6100:***
   - The inclusion of lessons and resources/texts on the history and contributions of Asian Americans and Pacific Islanders, will enable New Jersey's schools to provide a curriculum that reflects the diversity of our state. In accordance with state law: "A board of education shall include instruction on the history and contributions of Asian Americans and Pacific Islanders in an appropriate place in the curriculum of students in grades kindergarten through as part of the school district's implementation of the New Jersey Student Learning Standards in Social Studies."
10. Acquisition/development/refinement of the higher-order critical thinking skills aligned with the *Revised Bloom's Taxonomy of Cognitive Objectives*

Section III: Curriculum Modifications

The *Chemistry Honors* curriculum is subject to case-by-case modifications to support/advance the needs of all students, including special education students, English language learners, gifted students and those at risk of school failure. These modifications are based on Individualized Learning Programs (IEPs), recommendations made by the district's English Language Learners (ELL) coordinator, feedback from members of the Intervention & Referral Services Team (*I&RS*) for at-risk students, and 504 Plans.

Coursework and assessments will be modified on an individual basis for students when necessary. Modifications may include but are not limited to those outlined on the Modifications/Accommodations for Science Courses chart.

Section IV: Preparation for Standardized Testing

Instruction in *Chemistry Honors* is aligned with the requirements of state and national standardized assessments, including the *NJGPA*, *NJSLA*, the *ACT*, the *PSAT* and the *SAT*.

Section V: Curriculum Pacing Guide

Curriculum Pacing Guide Chemistry Honors	
Course Title: *Chemistry Honors*	**Grade Level:** 10th
Unit I: Fundamentals of Chemistry	Weeks 1 - 9
Unit II: Organization of Matter	Weeks 10 - 18
Unit III: Matter in Action	Weeks 19 - 29
Unit IV: Applications of Chemistry	Weeks 30 - 40

Section VI: Primary Texts and Year Long Instructional Resources

The following texts and instructional resources are employed for all students in *Chemistry Honors*:

- Google Classroom
- Common Sense Education
- Modifications/Accommodations for Science Course
- PhET Simulations
- Turnitin.com (www.turnitin.com)
- Flinn Scientific (https://www.flinnpavo.com)
- Ptable (www.ptable.com)
- Kahoot (www.kahoot.com)
- Pivot (https://www.pivotinteractives.com/)
- Edpuzzle (https://edpuzzle.com/)
- Vernier (https://www.vernier.com/product/logger-pro-3/)
- American Chemical Society interactives (https://teachchemistry.org/)
- Textbook: *Modern Chemistry*, Mickey Sarquis, Jerry Sarquis, Houghton Mifflin Harcourt (2015)

Unit I: Fundamentals of Chemistry
Unit Summary
In this unit, students will witness and apply the organizational aspects of Chemistry. They will examine the periodic table and use the information contained within it to evaluate matter and its properties as well as employ a system of nomenclature. Students will identify the names of inorganic compounds and acids. Students will employ the SI system to understand units, determine measurements, and employ significant figures and rounding rules. Other major themes include the determination of mass, isotopes, the mole, composition stoichiometry, empirical and molecular formulas, and the mathematical tools used to evaluate scientific measurements. Students are expected to memorize the following: types of elements and location on the Periodic table, periodic table group names, periods, significant figures, rounding rules, SI base units, ions, binary & oxyacid names, inorganic compound naming rules, isotope designation, mass number, average atomic mass formulas, empirical and molecular formula processes, composition stoichiometry formulas converting mole to mass, etc, avogadro's number, and employ dimensional analysis.
Standards/Core Ideas/Performance Expectations/Progress Indicators

The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Chemistry Honors:*

- *2020 New Jersey Student Learning Standards: Science*
  - HS-PS1-1, HS-PS1-3, ESS1-6
- *2023 New Jersey Student Learning Standards: Mathematics*
  - MP.2, MP.4, N.Q.A.1-3, A.SSE.A.1 & B.3, A.CED.A.1-4, F.IF.C.7, S.ID.A.1
- *2023 New Jersey Student Learning Standards English Language Arts*
  - RL.CR.9–10.1, RI.MF.9–10.6, W.AW.9–10.1.A,B & E, SL.PE.9–10.1, SL.II.9–10.2, SL.PI.9–10.4
- *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking*
  - 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5
- *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills*
  - 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.IML.3, 9.4.12.IML.4, 9.4.12.TL.2

Unit Essential Questions	Unit Enduring Understandings

• Why was the Periodic Table first created and how has it evolved? • How is the Periodic Table organized and how can it be useful to the scientific community? • How are physical and chemical properties periodic and how do properties align with the Periodic Table? • What system(s) is(are) in place to standardize the naming of compounds? • How are binary and oxyacids named? • How are atom's charges determined when combined in a molecular bond? • What is the significance of units in measurement? • How are scientific measurements used? (SI System) • What are significant figures and how/why are they important? • What is the Law of Conservation of mass and how does it relate to matter? • How are atoms counted? • What is an isotope and how do you designate them? • How do you calculate mass number? • How do you calculate average atomic mass? • What is the mole? • How is the molar mass of elements related to compounds that combine atoms with bonds? • How are empirical and molecular formulas related? • How do you calculate empirical and molecular formulas? • Historically and today, how have chemists from across the world influenced our learning?	• The Periodic Table was created to organize the universe's elements and has been added to as new information has become available. • The Periodic Table was created to organize the universe's elements and has been added to as new information has become available. • Physical and chemical properties align with group numbers. • Electron configurations and group properties align with group numbers. • Ionic compounds are named based on their balanced charges of ions, while molecular compounds are named based on the number of each atom in the compound. • Binary acids use the prefix hydro, whereas oxyacids are based on the polyatomic ion suffix. • Units define the size of measurement and determine how they are applied. • The SI System is used in the scientific community to help align research and work across the world, reducing the need to convert units from person to person. • Significant figures are the number of digits in a measurement which contribute to the degree of accuracy of the value. The scientific community uses sig figs combined with the SI System to have an efficient, universal system of measurement. • The Law of Conservation of mass states that mass is not created or destroyed during chemical reactions and physical changes. • Atoms are counted in groups in order to make counting possible and to demonstrate their incredibly small size. • Isotopes are atoms with a different number of neutrons and therefore a different mass number. The name of the element hyphen mass number designates an isotope. • Mass number equals protons plus neutrons. • Average atomic mass is calculated using relative abundance and the average masses of each isotope of a given element. • The mole is a unit of measurement, the base unit in the SI system for the amount of a substance, a quantity proportional to the number of elementary entities of a substance, equal to 6.022×10^{23} elementary entities. • Significant figures explain the precision of measurements. • Rounding rules with significant figures standardize measurements. • Formula mass uses the mass of elements to find the mass of any substance with a chemical formula. • Empirical formulas are the simplest ratio of atoms in a compound and used for calculating a chemical analysis of lab data. • Molecular formulas are either equal to the empirical formula or it is a simple multiple of it and it reflects the actual compound in nature. • Empirical formula is the simplest ratio of elements in a compound whereas the molecular formula is the actual ratio of elements in a compound. • Students will research and discover chemists and physical scientists who have played a role in shaping the chemistry content covered for the rest of the school year.

Evidence of Learning

Formative & Alternative Assessments:	**Benchmark & Summative Assessments:**	**Resources Needed:**

• **Unit 1A - Periodic Table**
  ○ Periodic Table Investigation
  ○ Getting to Know the Elements
  ○ Build an Atom Lab with pHet
	• Unit Assessments (Benchmark)
	• Unit 1A-1E quizzes
	• Summative #1
	• Periodic Table Slogan Project
	• Lab Safety Project
		• Phet Simulation Software
		• Flinn Pavo
		• Ptable
		• Kahoot
		• Pivot
		• American Chemical Society
		• Modern textbook
		• Vernier Lab Hardware vernier

○ AACT Safety Pictogram Activity ○ Lab Equipment Activity ○ Lab Scavenger Hunt ○ Lab Safety Poster Project ○ Bunsen Burner Safety Lab #1 ○ Bunsen Burner Lab #2 ○ Bunsen Burner Video Link & Diagram ○ Metal, Nonmetal, Metalloid ○ Mystery Elements - Virtual Properties of Metals, Nonmetals Metalloids - Virtual ○ Physical vs Chemical Changes Physical Chemical Changes Data Table ○ Physical and Chemical Changes Lab #2 ○ Reactivity of Two Alkaline Earth Metals Honors lab ● **Unit 1B - Types and Naming of Compounds and Elements** ○ Rolling for Compounds Initiative ○ Ionic and Covalent Bonding ○ Flinn Ionic Formula Writing Kit ○ ELEMENTS, Compounds, Mixtures Lab ○ Crossword Activity ● **Unit 1C - Measurement** ○ Density ○ Density Pivot ○ Density Escape Room ○ Hershey Bar Measurement Lab ○ Measurement Challenge ○ Measurement Challenge Flinn ○ Identifying Substances by their Density ○ Measurements Activity - Equipment (online extension activity) ○ Boyle's & Charles Graphing Handout ○ Boyle & Charles Law Graphing Template ○ Who Dunnit Scientific Notation ● **Unit 1D - Laws, Isotopes, Mole-Gram Conversions** ○ Average Atomic Mass	● Flinn Safety Test	● Edpuzzle ● Scientific Calculator ● Safety Contract ● Laboratory Equipment ● Lab Safety Diagram ● Lab Safety Practice ● Common Sense Media* - “The Truth in News and Social Media”

○ Naming Atoms Lab ○ Pennium ○ Percent of Water in Popcorn ○ Percent of Sugar in Bubble Gum (CP) ○ Halloweenium ○ Phet Link - Isotopes and Atomic Mass, Phet Student Document ○ Law of Conservation of Mass - Alkaseltzer ○ Organization of the Periodic Table Activity ○ Finding Molar Mass Activity ○ The Mole Lab ○ Color by Number ● **Unit 1E - Formulas** ○ Determining the Empirical Formula for Magnesium Oxide - Sunshine in a Jar ○ MgO Chem Topics Lab ○ MgO % Composition Lab ○ Chem Topics: MgO Empirical Formula Lab ○ Hydrates Lab ○ % Comp ○ Station Review ○ Bubble Gum Lab ● *Student research of past and current chemists ● Assorted alternate labs ● Classwork ● Review guides ● Quizzes ● Individual student check-ins with teacher		

Unit II: Organization of Matter
Unit Summary
Unit II encompasses the organization of matter and investigations into the relationship between electrons and energy. From atoms to elements to compounds, students will differentiate between atoms and ions understanding the role of the electron in determining combinations of atoms and bonding. Students will be able to describe electron configuration and determine the trends in elements revealed on the periodic table. Learners will identify the electromagnetic spectrum, speed of light constant, line emission spectra, and understand the relationship between light and electrons. Energy transitions, wavelength, frequency, and energy will be calculated. Learners will investigate the reorganization of matter in ordinary chemical reactions. Learners will employ the law of conservation of mass to identify the types of reactions, balance equations, predict products utilizing the activity series and solubility rules in simple chemical reactions. Major topics include electromagnetic radiation, energy, speed of light, electron configuration, periodic trends, chemical bonding, intermolecular forces, stoichiometry and chemical reactions. Students will not only deepen their conceptual understanding of Chemistry but also enhance their mathematical computational skills through the application of Algebra II in problem-solving and data analysis. Skills developed through complex operations and graphing data will also be utilized to solidify students' understanding. Students are expected to memorize the following: periodic trends, (s,p,d,f blocks) & rules for determining electron configuration of elements based on the periodic table, speed of light formula & constant, energy formula & planck's constant, molecular geometry shapes & bond angles, determining bond and molecule polarity, balancing rules, solubility rules, reaction stoichiometry formulas, dimensional analysis, avogadro's number.
Standards/Core Ideas/Performance Expectations/Progress Indicators

The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Chemistry Honors:*

- *2020 New Jersey Student Learning Standards: Science*
  - HS-PS1-1 , HS-PS1-2 , HS-PS1-3 , HS-PS1-4 , HS-PS1-7 , HS-PS4-1 , HS-PS4-3 , HS-PS4-4, HS-ESS3-2 , HS-ETS1-1 , HS-ETS1-3
- *2023 New Jersey Student Learning Standards: Mathematics*
  - MP.2, MP.4, N.Q.A.1-3, A.SSE.A.1 & B.3, A.CED.A.1-4, F.IF.C.7, S.ID.A.1
- *2023 New Jersey Student Learning Standards English Language Arts*
  - RL.CR.9–10.1, RI.MF.9–10.6, W.AW.9–10.1.A,B & E, SL.PE.9–10.1, SL.II.9–10.2, SL.PI.9–10.4
- *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking*
  - 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.2.12.ED.1, 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ED.6
- *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills*
  - 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.IML.3, 9.4.12.IML.4, 9.4.12.TL.2

Unit Essential Questions	Unit Enduring Understandings
• What is the electromagnetic spectrum and forms of electromagnetic radiation? • How are frequency, wavelength and energy related? • How is frequency calculated from wavelength and energy calculated from frequency? • What is an electron configuration? • How do electron configurations align with the Periodic Table? • How do periodic trends of ionization energy, electronegativity, electron affinity, atomic radius, ionic radius, metallic character align with the periodic table? • Why do chemicals bond? • How do you determine bond & molecular polarity? • How are molecules made? • How are ionic compounds different from molecules? • How does a "Sea" of electrons influence metals? • What is the difference between inter and intramolecular bonds? • Why do compounds form specific shapes and what are the five basic shapes and their bond angles? • How are chemical reactions recognized and represented? • How are chemical reactions classified? • How can students predict the products formed in a chemical reaction? • How does the activity series of elements dictate what occurs in a chemical reaction? • How do solubility rules govern the products of chemical reactions? • What is a mole ratio and why is it important to mankind? • How are mass and amount related in a chemical reaction with limited or more than enough of each chemical?	• The electromagnetic spectrum displays frequency and wavelength of all forms of electromagnetic radiation including x-rays, ultraviolet, visible, infrared and radio waves. • Frequency and wavelength are inversely proportional whereas frequency and energy are directly proportional. • Frequency, wavelength and energy are calculated using the speed of light and energy formulas. $E=h\nu$ and $C=\lambda\nu$ • An electron configuration is essentially a shorthand map to determine the approximate location of an atom's electrons. • Electron configurations align according to the periodic blocks (s, p, d, f), the periods and the group numbers on the periodic table. • Periodic trends describe the properties of atoms and their behavior and can be organized increasing or decreasing within a period or group on the table primarily as a result of the effect of nuclear pull. • Chemicals bond to achieve a lowered state of potential energy. • Bond polarity is determined by calculating electronegativity difference, whereas molecular polarity is determined from bond polarity, symmetry & dipoles. • Molecules are made when atoms "share" pairs of electrons. • Ionic compounds form organized structures, and are formed from the transfer of electrons between ions. • Metallic properties are solely governed by their "Sea" of mobile, delocalized electrons. • Intramolecular bonds form between atoms to make molecules and compounds whereas intermolecular bonds form between molecules to make "chains" of molecules and are overall weaker than intramolecular bonds. • Chemical bonds organize into shapes that reduce the potential energy involved in reaction and are dependent on the number of bonds and valence electrons around a central atom. The five basic shapes are linear-180, bent-105, trigonal planar-120, trigonal pyramidal-107 and tetrahedral-109.5. • Chemical reactions are represented with specific symbols and follow the Law of Conservation of Mass. • Chemical reactions are classified based on the reactants involved, products made, and the environment in which they are carried out. • Products are determined based on the type of chemical reaction that occurs. • Insoluble products produce reactions whereas soluble products do not. • Replacement reactions occur based on the activity of the ions present in the solution. • The mole ratio relates the amount of different compounds used and formed in a chemical reaction and is based on the law of conservation of mass. • Ideal stoichiometry calculates the amount or mass of an unknown

• What is the difference between what should be made and actually is made in a chemical reaction? • How can mathematical concepts from *Algebra II* be applied to analyze and solve problems related to stoichiometry?	when there is an excess of materials present. • Limiting reagent stoichiometry calculates the amount or mass of an unknown when there is a limited amount of materials present. • Actual yield rarely produces enough product to match theoretical standards, so percent yield shows the relationship between the two. • Mathematical concepts from *Algebra II* provide powerful tools for analyzing and solving problems related to chemical equations, allowing for predictions of physical & chemical phenomena.

Evidence of Learning

Formative & Alternative Assessments:

- **Unit 2A - Arrangement of Electrons**
  - Borax Crystal Lab
  - Electron Configuration Pogil
  - Atomic Spectra
  - Electron Structure 1s Orbital
  - Energy & Light POGIL
  - Flame Test Lab
- **Unit 2B - Periodic Trends**
  - Periodic Trends
  - Ionization Energy & Reactivity
  - Periodic Trends - pTable Activity
  - Trends Reactivity of Alkaline Earth Metals
  - It's in the Cards Trends Lab
- **Unit 2C - Bonding**
  - Chemical Bonding Lab
  - Ionic & Covalent Bonding Virtual Lab
  - Molecular Geometry Lab
  - Alternate Molecular Geo Lab (alternate Molecular Geo Table)
  - Intermolecular Forces Lab
  - IMF Pogil
- **Unit 2D - Reactions**
  - Exploring Chemical Reactions and the Law of Conservation of Mass
  - Flinn Hollow Penny Lab
  - Hollow Penny Student Handout
  - Complete Hollow Penny Lab with Post Lab Questions
  - Signs of Chemical Reaction Lab
  - Single Replacement and Metal Activity Lab

Benchmark & Summative Assessments:

- Unit Assessments
- Units 2A-2E quizzes
- Summative #2

Resources Needed:

- Phet Simulation Software
- Flinn Pavo
- Ptable
- Kahoot
- Pivot
- American Chemical Society
- Modern textbook
- Vernier Lab Hardware vernier
- Edpuzzle
- Scientific Calculator TI-30-XIIS
- Flinn Safety Contract Safety contract
- Laboratory equipment

○ Chemical Reactions Virtual Lab ○ Flinn Chemical Reactions Lab ○ Types of Chemical Reactions Lab ● **Unit 2E - Stoichiometry** ○ Exploring Chemical Reactions and the Law of Conservation of Mass ○ Stoichiometry Smores Lab ○ Mole Ratios Pogil ○ Tums Stoichiometry Lab ○ Limiting and Excess POGIL ○ Mole Ratios Lab ○ Phet Reactants, Products, Leftovers ● Assorted Alternate Labs ● Classwork ● Review guides ● Individual student check-ins with teacher		

Unit III: Matter in Action	
Unit Summary	
Unit III explains the relationship between matter and energy. Learners will be able to distinguish between phases of matter at the particle level, identify properties of matter, and understand the changes in matter as it relates to particle behavior and intermolecular forces. Learners will describe the behavior of gases and understand the gas laws as they relate to ideal and real gases. Learners will also understand temperature, heat, enthalpy and entropy and apply how enthalpy and entropy relate to the spontaneity of reactions. Students are expected to memorize the following: Boyle's, Charles's, Gay-Lussac's, Combined, Avogadro's and Ideal gas laws, inverse and direct relationships and how they apply to the gas laws, temperature conversions, pressure conversions, heat equations and application of exothermic vs. endothermic processes, and free energy equations and application of spontaneity/spontaneity of reactions based on temperature.	
Standards/Core Ideas/Performance Expectations/Progress Indicators	
The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Chemistry Honors:* ● *2020 New Jersey Student Learning Standards: Science* ○ HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS1-4, HS-PS1-7, HS-ESS3-2, HS-ETS1-1, HS-ETS1-3 ● *2023 New Jersey Student Learning Standards: Mathematics* ○ MP.2, MP.4, N.Q.A.1-3, A.SSE.A.1 & B.3, A.CED.A.1-4, F.IF.C.7, S.ID.A.1 ● *2023 New Jersey Student Learning Standards English Language Arts* ○ RL.CR.9–10.1, RI.MF.9–10.6, W.AW.9–10.1.A,B & E, SL.PE.9–10.1, SL.II.9–10.2, SL.PI.9–10.4 ● *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking* ○ 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.2.12.ED.1, 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ED.6 ● *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills* ○ 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.IML.3, 9.4.12.IML.4, 9.4.12.TL.2	
Unit Essential Questions	**Unit Enduring Understandings**
● What is kinetic molecular theory? ● What is energy? ● What are the states of matter and its properties?	● States and interactions of matter are completely governed by the KMT (Kinetic Molecular Theory). ● The principle of energy conservation states that energy cannot be created or destroyed but can only be transferred from one form to another or transferred between objects within a closed system. Climate change,

• What are state changes? How do state changes relate to heating and cooling curves? • What are the two types of solids? • What is the relationship between equilibrium and changes of state? • What is meant by equilibrium vapor pressure? • What is pressure? What is standard pressure? • What are the five assumptions of the kinetic molecular theory? • What is a real gas? What is an ideal gas? • What are the properties of real and ideal gases? • What are the gas laws? • What is standard molar volume of a gas? How is it used to solve ideal gas law problems at STP? • What is STP? • What is temperature? • What is heat? • What is specific heat capacity? • What is enthalpy and how does it relate to state changes? (enthalpies to include: enthalpies of reaction, enthalpies of formation, and enthalpy of combustion) • What is entropy? • What is free energy? • What does spontaneous mean about a reaction? What tends to force spontaneity?	renewable and non-renewable energy sources, along with other factors go into energy conservation. • States of matter are dependent on temperature, pressure, and the attraction of particles in the substance. • The states of matter are solid, liquid and gas. Solid particles are packed tightly and vibrate in place, have a definite shape and volume, have relatively low rates of diffusion, and have strong intermolecular forces of attraction. Liquid particles move freely past one another, have a definite volume and take the shape of the container, have low rates of diffusion and have attractive forces between the particles but less than solid particles. Gas particles move freely and rapidly with no definite shape and volume, they have high rates of diffusion and have relatively no attractive forces between them (ideally). • The two types of solids are amorphous and crystalline. • Freezing and Melting are the state changes between solid and liquid. Vaporization and condensation are the state changes between liquid and gas. Sublimation and Deposition are the state changes between solid and gas. • Equilibrium is two opposing changes happening simultaneously and when a state change occurs, temperature is constant. • The vapor pressure or equilibrium vapor pressure is defined as the pressure exerted by a vapor that is in thermodynamic equilibrium with the condensed phase (solid or liquid) at a given temperature in a closed system. The equilibrium vapor pressure is an indication of the evaporation rate of a liquid. • Pressure is caused by the collision of gas particles on surrounding containers. Standard pressure is 1 atmosphere. • The kinetic-molecular theory of gases assumes that ideal gas molecules (1) are constantly moving; (2) have negligible volume; (3) have negligible intermolecular forces; (4) undergo perfectly elastic collisions; and (5) have an average kinetic energy proportional to the ideal gas's absolute temperature. • A real gas occupies space and has molecular interactions as opposed to an ideal gas which is theoretical and not subject to interparticle interactions. • These are the major gas laws: Boyle's Law, Charles' Law, and Gay-Lussac's Law, Combined Gas Law, Avogadro's Law, Ideal Gas Law, and Dalton's Law of Partial Pressures • Standard molar volume is 22.4 L. This makes for a very useful approximation: any gas at STP has a volume of 22.4 L per mole of gas; that is, the molar volume at STP is 22.4 L/mol. This molar volume makes a useful conversion factor • Standard temperature is 0 ℃ and standard pressure is 1 atmosphere. • Temperature is the average kinetic energy of particles. • Heat is the measure of energy that is transferred due to a difference in temperatures. • Specific heat capacity is the amount of heat that must be added or removed from a unit of mass to change its temperature by one degree Celsius. • Enthalpy is the exchange of heat. Enthalpy can be exothermic (-) or endothermic (+). • Entropy is a factor-measuring disorder. • Gibb's Energy is free energy which combines enthalpy and entropy into a single value. • Spontaneous means that a reaction should occur at given conditions. • Exothermicity and disorder force spontaneity and reactions to occur regardless of the temperature.

Evidence of Learning

Formative & Alternative Assessments:	**Benchmark & Summative Assessments:**	**Resources Needed:**
		• Phet Simulation Software

• **Unit 3A - States of Matter**
  ○ States of Matter Simulation
  ○ Reaction in a Bag (CR)
  ○ KMT Webquest Activity
  ○ Molar Heat of Fusion of Ice
  ○ Alternate Heat of Fusion of Ice Lab with Answer Key
• **Unit 3B - Gas Laws**
  ○ Gas Properties Investigation
  ○ Gas Laws with pHet
  ○ Gas Laws POGIL
  ○ PHET Gas Laws Gas Variables
  ○ Intro to Gas Laws Stations Quick Lab
  ○ Chillin & Heatin Stations Lab and Teacher Guide
  ○ Gas Laws Review Lab
• **Unit 3C - Heat and Energy**
  ○ Specific Heat Capacity Lab
  ○ Heat of Solution Virtual Lab
• *Renewable and Non-renewable Energy Discussion Incorporating Climate Change
• Classwork
• Review guides
• Individual student check-ins with teacher
	• Unit Assessments
	• Unit 3A-3C Quizzes
	• KMT Webquest Presentations
		• Flinn Pavo
		• Ptable
		• Kahoot
		• Pivot
		• American Chemical Society
		• Modern textbook
		• Vernier Lab Hardware Vernier
		• Edpuzzle
		• Scientific Calculator TI-30-XIIS
		• Flinn Safety Contract Safety contract
		• Laboratory equipment

Unit IV: Applications in Chemistry
Unit Summary
Unit IV examines matter in solutions, acids and bases and nuclear chemistry. Unit 4A focuses on distinguishing parts of a solution, types of mixtures, properties of a solution, concentration of solutions and preparation of solutions. Learners will recognize factors that determine the rate of dissolution, and rates of reactions. 4B focuses on the differentiation between the properties and behavior of acids and bases in reactions and in nature, the pH scale, common uses of acids & bases, and calculation of pH and pOH. Learners will name acids & bases, differentiate between the relative strengths of acids & bases, and determine the uses of common acids and bases. Unit 4C introduces both fission and fusion nuclear reactions, differentiating nuclear from chemical reactions and describing the importance, uses, usefulness, and products of nuclear reactions. Students will be able to define radioactivity, radiation, determine half-life, and recognize the difference between alpha, beta and gamma particles. Major topics include solutions, acids and bases, nuclear decay, fusion, and fission reactions. Students will memorize the following: molarity & molality formulas, pH & pOH formulas, and half life formulas. They will also apply the molarity formula to the formulas for calculating acid and base concentrations.
Standards/Core Ideas/Performance Expectations/Progress Indicators

The state standards outlined below, and established by the New Jersey Department of Education, will guide instruction throughout this unit in *Chemistry Honors:*
• *2020 New Jersey Student Learning Standards: Science*
  ○ HS-PS1-1, HS-PS1-2 , HS-PS1-3, HS-PS1-4 , HS-PS1-5 , HS-PS1-6 , HS-PS1-7 , HS-PS1-8 , HS-ESS1-1 , HS-ESS1-3 , HS-ESS1-6 , HS-ESS3-2 , HS-ETS1-1 , HS-ETS1-3
• *2023 New Jersey Student Learning Standards: Mathematics*
  ○ MP.2, MP.4, N.Q.A.1-3, A.SSE.A.1 & B.3, A.CED.A.1-4, F.IF.C.7, S.ID.A.1
• *2023 New Jersey Student Learning Standards English Language Arts*
  ○ RL.CR.9–10.1, RI.MF.9–10.6, W.AW.9–10.1.A,B & E, SL.PE.9–10.1, SL.II.9–10.2, SL.PI.9–10.4

- *2020 New Jersey Student Learning Standards: Computer Science and Design Thinking*
  - 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.2.12.ED.1, 8.2.12.ED.2, 8.2.12.ED.5, 8.2.12.ED.6
- *2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies, and Key Skills*
  - 9.4.12.CI.1, 9.4.12.CT.1, 9.4.12.IML.3, 9.4.12.IML.4, 9.4.12.TL.2

Unit Essential Questions	Unit Enduring Understandings
• How do chemical reactions occur? • What determines the rate a reaction occurs? • Why is the rate of a reaction important? • How are mixtures of pure substances classified? • What factors govern the solubility of a substance and its rate of solution? • What is molarity and how is it determined? • How are solids dissolved in hydration? • How do solutes affect the properties of water when they are in solution? • What are the characteristic properties of acids and bases? • What is pH and how is it calculated? • How are titrations used? • What is radioactive decay? • What is half-life? • How are fission and fusion used differently? • How does a nuclear reactor transform the atom to energy to electricity? • What is the role of fusion on our universe's stars? • How can mathematical concepts from *Algebra II* be applied to analyze and solve problems related to stoichiometry?	• Chemical reactions occur when the kinetic energy of collision causes particles that fit chemically to transform. • The kinetic energy, amount of reactants, amount of product, and collisions determine a reaction rate law. • How we use a reaction is normally dictated by the rate the reaction occurs. • Pure substances can be mixed as solutions, colloids, and mixtures • Temperature, pressure, surface area, and agitation affect the solubility and rate of solution. • Molarity is the amount of solute in moles per liter of total solution. • Water molecules actively dissolve ions and "pull" them into solution. • Water's ability to change state is altered by the presence of a solute and is dependent on the amount of solute present. • Acids and bases are classes of chemicals with distinct and opposite properties. When mixed, they will form water. • pH is the log of the concentration of hydronium ions in an acidic or basic solution. It is a quantitative measurement of an acid or base's strength. • Titrations are useful for testing the accuracy of amounts or finding unknown amounts of substances in solution. • Radioactive decay is the nucleus of a substance releasing energy and particles randomly. • Half-life is the amount of time in which half a substance decays. • Fission is the splitting of an atomic nucleus and fusion is the combining of nuclei causing a release of energy. • $E=mc^2$. The energy that is made heats water and turns a turbine. • The life cycles of stars are based on their fusion reactions. • Mathematical concepts from *Algebra II* provide powerful tools for analyzing and solving problems related to chemical equations, allowing for predictions of physical & chemical phenomena.

Evidence of Learning

Formative & Alternative Assessments:	Benchmark & Summative Assessments:	Resources Needed:

• **Unit 4A - Solutions**
  ○ Solutions
  ○ Assorted Solutions Lab
• **Unit 4B - Acid/Base**
  ○ Acids and Bases Lab
  ○ Assorted Acid/Base Labs
• **Unit 4C - Nuclear**
  ○ Half Life Lab
  ○ Penny Half Life Lab
• Assorted Alternate Labs
• Classwork
• Review guides
• Individual student check-ins with teacher
	• Unit Assessments
	• Nuclear Project
	• Unit 4A-4C Quizzes
	• Students will memorize molarity & molality formulas, pH & pOH formulas, and half life formulas.
	• Students will apply the molarity formula to the formulas for calculating acid and base concentrations.
	• Summative #3
		• Phet Simulation Software
		• Flinn Pavo
		• Ptable
		• Kahoot
		• Pivot
		• American Chemical Society
		• Modern textbook
		• Vernier Lab Hardware vernier
		• Edpuzzle
		• Scientific Calculator TI-30-XIIS
		• Flinn Safety Contract Safety contract
		• Laboratory equipment

Section IX: Unit Reflection

The *Chemistry Honors* instructional team must confer upon the completion of each instructional unit in the *Chemistry Honors* curriculum and rate the degrees to which the instructional units meet performance criteria established by the New Jersey Department of Education using the Unit Reflection Form. Completed unit reflection forms must be submitted to the Department

Supervisor for approval upon completion of curriculum implementation with a complementing list of suggested modifications to the *Chemistry Honors* curriculum.

Unit Reflection Form: *Chemistry Honors*			
Lesson Activities:	**Strongly**	**Moderately**	**Weakly**
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills;			
Are challenging and require higher-order thinking and problem-solving skills;			
Allow for student choice;			
Provide scaffolding for acquiring targeted knowledge/skills;			
Integrate modern, global perspectives, especially those regarding diversity, genocide, global issues, and historical ones regarding racial relations;			
Integrate 21st century skills;			
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills;			
Are varied to address different student learning styles and preferences;			
Are differentiated based on student needs;			
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process;			
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives;			
Provide opportunities for student reflection and self-assessment;			
Provide data to inform and adjust instruction to better meet the varying needs of learners.			

Appendix
Writing Instruction and the RFH Community

Writing instruction should happen across the RFH Community. Writing across the curriculum is a philosophy that advances the belief that writing is a method of learning. Since all departments are committed to helping students learn, writing must be used as a methodology to advance student learning.

Each academic discipline has its own unique conventions, formats and structures. It is the responsibility of each department to agree upon domain-specific writing praxes, model them for students, and require them to utilize them on a consistent basis. Students must understand that acceptable writing in one domain may not be acceptable writing in another area. The development of domain-specific writing skills supports the overall development of the student writer because all writing is grounded in the writing situation: audience, context, purpose, subject, and writer. Representatives from the academic disciplines must share their

domain-specific writing praxes with each other, identify intersections, and determine how to address perceived gaps that limit student learning.

Students must experience writing situations that help them learn how to think creatively and critically and communicate effectively in the academic disciplines. Writing instruction, regardless of the academic discipline, must always reinforce student understanding of the writing situation. When students experience writing situations, they must study examples of domain-specific writing in order to understand how writers communicate in discipline-related contexts. This does not mean information embedded in textbooks. Domain-specific writing is writing that is used to inform and influence readers as it draws them into an established circle of discourse. Students must use these non-fiction texts to develop the close reading skills that will shape their own writing. Focused engagement with domain-specific writing should not be limited to basic reading comprehension and topical understanding. It must also include the analysis of the writing situation that is represented in the text: audience, context, purpose, subject, and writer. The close reading of well-written texts—regardless of the domain—will show students the importance of writing mechanics, diction, and syntax. The development of close reading skills will also help the students grow in terms of their ability to construct and advance independent and original claims that are well-supported by evidence. Domain-specific writing is grounded in positioning of claims and the effective use of evidence.

The final written product is important; nevertheless, the learning that results in this production must not be devalued. The writing process is not limited to the basic steps of planning, drafting, revising, and editing/proofreading. It is a complex sequence of critical and creative thinking and writing that leads to the production of a text that provides evidence of learning and understanding. Students must ultimately develop the ability to self-assess the effectiveness of their writing as a representation of the writing situation. Without the use of models that evidence learning and understanding, students will not develop the ability to self-assess their own work—the true outcome of the writing process.

What types of writing situations should RFH students engage in?

RFH students should engage in writing situations across the curriculum that require them to:

- write to improve mechanical proficiency, diction usage, and syntactical sophistication
- write to narrate, describe, and reflect
- write to summarize and report
- write to classify and define
- write to explain how process leads to an outcome
- write to compare, contrast and evaluate
- write to speculate on cause and effect
- write to propose solutions and solve problems
- write to analyze

These writing situations should be positioned in a coordinated, developmental sequence that extends across the academic disciplines.

Upon Completion of Grade 12, RFH students must be ready to transition to the following writing situations:

- write to analyze
- write to persuade (argument)

The core foci of first-year college writing courses are analysis and argument. These courses orient the students to the demands and expectations of writing for the academic culture of college. At colleges/universities with carefully coordinated writing programs, students must demonstrate proficiency in analysis and argument before they transition to upper level courses that require them to engage in the following writing situation:

- write to investigate (research)