Washington Township School District

The mission of the Washington Township Public Schools *is to provide a safe, positive, and progressive educational environment that provides opportunity for all students to attain the knowledge and skills specified in the NJ Learning Standards at all grade levels, so as to ensure their full participation in an ever-changing world as responsible, self-directed and civic-minded citizens.*

Course Title:	**Honors Chemistry**
Grade Level(s):	**10th, 11th grade**

Duration:	*Full Year:*	**X**	*Semester:*		*Marking Period:*	
Course Description:	**The Honors level chemistry course will provide students with the opportunity to explore fundamental chemistry concepts focusing on matter, forces, and changes. This course will include both qualitative and quantitative topics and instructors will emphasize scientific reasoning and problem solving during instruction. Students will discover cause and effect relationships that govern physical science and apply mathematical relationships and techniques to solve quantitative problems. Upon completion of the Honors chemistry course, students will be prepared to pursue further studies in physical science classes.**					
Grading Procedures:	**Marking period grades will be determined using these categories and weights:** **- Tests 45%** **- Quizzes 20%** **- Lab 20%** **- Independent Work 15%** **Midterm exams and Final exams will be counted as 10% of each semester grade for the course**					
Primary Resources:	**NJ Model Curriculum: High School Chemistry** **Next Generation Science Standards (NGSS)** **New Jersey Student Learning Standards (NJSLS)** **Chemistry: The Central Science (14th edition) by Brown, LeMay** **"Mastering Chemistry with Pearson" – E text**					

Washington Township Principles for Effective Teaching and Learning

- Implementing a standards-based curriculum
- Facilitating a learner-centered environment
- Using academic target language and providing comprehensible instruction
- Adapting and using age-appropriate authentic materials
- Providing performance-based assessment experiences
- Infusing 21st century skills for College and Career Readiness in a global society

Designed by:	Mr. Andrew Holmes
Under the Direction	Dr. Patricia Hughes

Written: July 2017

Revised: _____

BOE Approval: _____

Unit 1 Title: Atoms and Atomic Theory

Unit Description: This unit will highlight and present information about the composition and structure of matter. Atoms, sub-atomic particles, atomic theory and development, nuclear changes, and introductory mole concepts will be covered.

Unit Duration: 4 weeks

Desired Results

Standard(s): Physical Science "Matter and its Interactions": HS-PS1-1, HS-PS1-8, HS-PS1-6

Indicators: PS1.A "Structure and Properties of Matter", PS1.C "Nuclear Processes", PS2.B "Types of Interactions"

Understandings:
Students will understand that…

Atoms are the building blocks of all matter

Sub-atomic particle combinations in atoms creates the unique properties of elements

Our understanding of atoms has evolved over time

Forces within the nucleus explain atomic stability and nuclear change

Electrons orbiting the nucleus explain chemical properties and contribute to chemical changes

Quantities of small particles is best communicated and calculated through the mole concept

Observation and accurate measurement is vital to discovering knowledge in the laboratory

Essential Questions:

What are the similarities and differences among protons, neutrons, and electrons?

What are isotopes and how does sub-atomic particle data relate to stability and nuclear change?

What scientists have shaped our evolving understanding of the nature and behavior of atoms?

How do protons and neutrons contribute to physical properties and nuclear changes within matter?

How do electrons contribute to chemical changes among matter?

Why is the mole concept used rather than mass or particle quantity in many chemistry problem solving applications?

How are physical properties most accurately measured and communicated in the science laboratory?

Assessment Evidence

Performance Tasks:

Quizzes:

UNIT 1 QUIZ 1 "Atoms, Sub-Atomic Particles and Atomic Theory"

- List fundamental properties of protons, neutrons, and electrons
- Describe differences among sub-atomic particles
- Label and identify atomic number and mass number
- Identify scientists with contributions to atomic theory
- Define ions and isotopes

UNIT 1 QUIZ 2 "Nuclear Chemistry and The Mole concept"

- Define radioactivity
- Compare alpha and beta decay using nuclear equations
- Use data to calculate half-life for isotopes
- Identify ions and isotopes using symbolic representation
- Explain the value and usefulness of the mole concept
- Calculate molar mass and percent composition

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: "Measurement and Density"

LAB: "Isotopes of Veggium"

LAB: "Mole Identification"

Independent Work and Cooperative Learning Activities:

"Isotopes Research Activity" – Research assigned isotope for sub-atomic particle, half-life, decay type and modern uses information

"Molar Mass of a Mineral" – Research assigned mineral and calculate molar mass and percent composition of each element

	"Future of Nuclear Power – Long Read" – Read and complete worksheet and participate in discussion of nuclear energy options "Mole Day Celebration: - Share a creative and unique representation of mole knowledge with classmates

Benchmarks:

UNIT 1 TEST

Learning Plan

Learning Activities:

Chapter 1 – Matter, Energy, and Measurement
Lesson 1 – Classifications of Matter (1-2 class periods)

- Share and discuss types of matter via Summer Assignment work
- Introduce and compare matter classifications using examples and definitions
- Deduce and explain differences between pure substances and mixtures
- Identify and describe differences between elements and compounds
- Research and explain separation methods such as filtration and distillation
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 1 – Matter, Energy, and Measurement
Lesson 2 – Properties and Changes (2-3 class periods)

- Read and discuss nature of physical properties and changes using visuals and examples
- Read and discuss nature of chemical properties and changes using visuals and examples
- Compare and explain changes in matter using laboratory demonstrations and experiments
- Define density and calculate density using mass and volume data
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 1 – Matter, Energy, and Measurement
Lesson 3 – Measurement (2-3 class periods)

- Accurately read measurement scales for temperature and volume
- Recognize significant digits in measurements
- Express calculated answers to scientific math problems with the correct number of significant digits
- Define and explain the differences between accuracy and precision
- Apply correct units to all measurements and calculated answers during problem solving
- Observe and draw conclusions about matter and measurement during lab activities
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 2 – Atoms, Molecules, and Ions
Lesson 1 – Discovery of the Atom (1-2 class periods)

- Research and compare theories and models of atoms throughout history
- Identify scientists and experimentation leading to advanced knowledge of atoms throughout history
- Explain the properties and roles of sub-atomic particles in atoms
- Use models and simulation activities to recognize the evolution of our understanding of atoms
- Explain why liquids have definite volume but not definite shape.

- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 2 – Atoms, Molecules, and Ions
Lesson 2 – Sub-Atomic Particles (1-2 class periods)

- Identify and compare fundamental properties of protons, neutrons, and electrons
- Connect and explain the relationship between protons, atomic number and element identity
- Recognize and determine atomic mass and mass number data for atoms by considering protons and neutrons
- Consider and explain the nuclear forces that hold atoms together
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 2 – Atoms, Molecules, and Ions
Lesson 3 – Isotopes vs. Ions (2-3 class periods)

- Define and compare definitions for isotopes and ions
- Identify and determine specific isotopes and ions using symbolic representations for mass and charge
- Build and analyze isotopes and ions using computer simulation activities
- Research and share properties and behavior of specific ions and isotopes valuable to modern science
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 21 – Nuclear Chemistry
Lesson 1 – Radioactivity and Nuclear Equations (2-3 class periods)

- Define radioactivity and compare/contrast common radioactive processes such as alpha and beta decay
- Research and explain electron capture and positron emission
- Identify parent and daughter isotopes in nuclear equations
- Predict atomic number and mass number data for isotopes participating in nuclear changes
- Use nuclear equations to recognize types of radioactivity and predict isotopic reactants and products
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 21 – Nuclear Chemistry
Lesson 2 – Nuclear Stability and Half-Life (2-3 class periods)

- Identify sub-atomic particle and force factors that contribute to the stability of isotopes
- Research and consider the band of stability through sub-atomic particle data and ratios
- Use graphs, charts, and mathematics to determine or calculate the half-life of isotopes
- Model half-life and nuclear decay through lab activities
- Consider and discuss impact of half-life on matter and the physical world
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 21 – Nuclear Chemistry
Lesson 3 – Fission, Fusion and Nuclear Energy (1-2 class periods)

- Compare and contrast fission and fusion through nuclear equations
- Recognize pros and cons of fission and fusion as nuclear energy production means
- Research and explain current and future advancements and limitations of nuclear energy production
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 3 – Chemical Reactions and Stoichiometry
Lesson 1 – Avogadro's Number and The Mole Concept (1-2 class periods)

- Discuss importance of a fixed quantity in chemistry for counting atoms and other particles
- Present Avogadro's number and emphasize its origin and size
- Explain various ways by which moles can be measured or calculated in the laboratory
- Use examples and visuals to quantify the similarities and differences among mole samples
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 3 – Chemical Reactions and Stoichiometry
Lesson 2 – Molar Mass and Percent Composition (2-3 class periods)

- Use examples to highlight the relationship between moles and mass on the Periodic table
- Calculate molar mass values for various elements and compounds
- Calculate and compare mass percent composition of elements within compounds using molar mass
- Research, calculate and share molar mass and percent composition data for minerals and hydrates
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 1, 2, 3, and 21 (w/ Mastering Chemistry E-Text)

Phet.colorado.edu: pHet Sims Activities **-** "Build an Atom", "Isotopes and Atomic Mass", "Alpha Decay", "Beta Decay", "Rutherford Scattering"

Video Clips: "Just How Small is an Atom?", "Fission vs. Fusion", "Dirty Bombs", "Nuclear Medicine", "How big is a Mole?", "NOVA – The Nuclear Option"

Crash Course Chemistry video series

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): PS1.A "Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons."	
4.0	**Students will be able to:** • Communicate properties of matter attributed to unique quantities of protons, neutrons and electrons • Prove and explain the relationships among particles and forces within an atoms or ion
3.0	**Students will be able to:** • Determine sub-atomic particle data and element identification from isotope symbols • Communicate how different scientists over time shaped our understanding of atoms and sub-atomic particles
2.0	**Students will be able to:** • Identify atoms, ions, and isotopes using proton, neutron and electron data • Recognize that all the matter in the universe contains atoms and therefore understanding atoms and sub-atomic particles is the key to understanding chemistry and physical science ***Students will recognize and recall specific vocabulary, including:*** • Atoms, protons, electrons, neutrons, atomic number, isotopes, mass number, atomic mass,

1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): PS1.C "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."	
4.0	**Students will be able to:** • Communicate advantages and disadvantages of nuclear energy processes such as fission and fusion in the modern-day world • Interpret and solve complex nuclear equations that highlight various natural and/or forced nuclear changes
3.0	**Students will be able to:** • Communicate the similarities and differences among natural radioactive decay processes such as alpha, beta, electron capture, etc.… • Identify that combinations and ratios of protons and neutrons can be used to predict the stability or instability of specific isotopes
2.0	**Students will be able to:** • Predict products to nuclear changes using previously gained knowledge of isotopes and the Law of Conservation of Matter • Recognize that nuclear forces determine the radioactive nature of isotopes and half-life is used to quantitatively compare the life span of isotopes. ***Students will recognize and recall specific vocabulary, including:*** • Isotope, Nuclear change, radioactivity, alpha decay, beta decay, gamma rays, half-life, fission, fusion, transmutation, radiotracer
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	Create additional and alternative assignments and assessments to create challenge and foster discovery of knowledge
Struggling Learners	Facilitate access to review materials and remediation activities through OneNote content library and through online textbook content
English Language Learners	Coordinate with ELL advisors to modify activities where appropriate http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable

	that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections
Indicators: **ELA/Literacy –** RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. (HS-PS1-1) WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2), (HS-PS1-5) WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3), (HS-PS1-6) WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3) SL.11-12.5Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)

MP.4 Model with mathematics. (HS-PS1-4), (HS-PS1-8)

HSN-Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5),

Integration of 21st Century Skills

Indicators:

Career Ready Practices:

CRP2 – Apply appropriate academic and technical skills.
CRP5 – Consider the environmental, social and economic impacts of decisions.
CRP6 – Demonstrate creativity and innovation.
CRP7 – Employ valid and reliable research strategies.
CRP8 – Utilize critical thinking to make sense of problems and persevere in solving them.
CRP10 – Plan education and career paths aligned to personal goals.
CRP11 – Use technology to enhance productivity.
CRP12 – Work productively in teams while using cultural global competence.
9.2 Career Awareness, Exploration, and Preparation
9.2.12.C.1 – Review career goals and determine steps necessary for attainment.
9.2.12.C.3 – Identify transferable career skills and design alternate career plans.
9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources for owning and managing a business.

Unit 2 Title: Electrons and The Periodic Table

Unit Description: This unit will highlight and present information about the importance and role of electrons and energy within atoms. Electron configuration, orbitals, electron transitions, electromagnetic energy, periodic table structure, periodic table property trends, ionic and covalent bonding models as well as formula writing / naming chemical compounds will be covered.

Unit Duration: 4 weeks

Desired Results

Standard(s): Physical Science "Matter and its Interactions": HS-PS1-2, HS-PS1-4, HS-PS1-6,
Physical Science "Waves and their Applications in Technologies for Information Transfer":
HS- PS4-1, HS-PS4-3, HS-PS4-4, HS-PS4-5

Indicators: PS1.A "Structure and Properties of Matter", PS2.B "Types of Interactions", PS3.A "Definitions of Energy", PS4.A "Wave Properties", PS4.B "Electromagnetic Radiation"

Understandings:
Students will understand that…

Valence electrons determine the chemical reactivity of atoms

The Periodic Table of the Elements is organized to display electron configuration

Forces of attraction and repulsion within and among atoms dictate chemical behavior

Excitement of electrons in atoms yields various types of electromagnetic energy

Atoms can form compounds and the formula and nature of these compounds is determined by sub-atomic particles and forces

Compounds have names and formulas that reflect how electrons are utilized to form bonds

Essential Questions:

How does the location of an element on the Periodic Table indicate the location of its core and valence electrons?

What is electronegativity and what is ionization energy and how are these properties related to atomic radius?

How is the layout of the Periodic Table a reflection of electron details such as energy levels and orbitals?

What relationships exist among energy, wavelength, and frequency of electromagnetic waves produced when electrons become excited?

How can the Periodic Table be used to predict whether atoms will transfer electrons and form ionic compounds or share electrons and form molecular compounds?

What rules and system is used to accurately name and write formulas for ionic and molecular compounds?

Assessment Evidence

Performance Tasks:

Quizzes:

UNIT 2 QUIZ 1 "Electrons and The Periodic Table"

- Define and identify valence electrons
- Write and analyze electron configurations
- Complete orbital filling diagrams per Hund's rule
- Calculate wavelength, frequency and energy for waves
- Explain atomic radius differences among atoms and ions
- Define and compare ionization energy and electronegativity

UNIT 2 QUIZ 2 "Bonding Models and Compounds"

- Label bonds as ionic or covalent per electronegativity
- List and describe nature of ionic bonds and properties of ionic solids
- List and describe nature of covalent bonds and properties
- Accurately write formulas for ionic and molecular compounds
- Accurately name ionic and molecular compounds

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: "Alkali Metals and Water"

LAB: "Flame Test Analysis"

LAB: "Empirical Formula of a Hydrate"

+

Independent Work and Cooperative Learning Activities:

"Periodic Table Puzzle Activity" – Use knowledge of atoms and properties to place and identify unknown elements on periodic table

"Electron Configuration Analysis" – Solve, interpret and correct mistakes for a variety of electron configuration examples

- Identify acids and hydrocarbons through names and formulas	"Comparison of Ionic Salts" – Draw conclusions about Coulomb's law using a variety of examples of ionic compounds "Applications of the Electromagnetic Spectrum" – Research and share modern uses of electromagnetic energy such as infrared, radar, UV, etc. "Formula Writing and Naming Compounds" Continual practice of proper formula writing and nomenclature per IUPAC "How does Medical Imaging Work?" – Investigation and research into MRI, X-RAY, CAT Scan, PET Scan

Benchmarks:

UNIT 2 TEST

Learning Plan

Learning Activities:

Chapter 6 – Electronic Structure of Atoms
Lesson 1 – Electron Configuration and the Periodic Table (3-4 class periods)

- Present models indicating specific energy shells that can be occupied by electrons in atoms
- Represent individual electron locations in energy levels and sublevels using electron configuration codes
- Write and interpret electron configuration codes and determine valence electron amounts
- Discover orbitals and electron spin using Hund's Rule and orbital filling diagrams
- Compare and contrast diamagnetic and paramagnetic nature
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 6 – Electronic Structure of Atoms
Lesson 2 – Wave Nature and Quantum Mechanics (2-3 class periods)

- Examine the particle-wave duality of electrons through visual models
- Discover and solve problems focusing on relationships among wavelength, frequency and energy
- Research and discuss unique forms of energy found within the electromagnetic spectrum
- Consider electron transitions, ground states and excited state to link atoms with electromagnetic energy
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 7 – Periodic Properties of the Elements
Lesson 1 – Effective Nuclear Charge and Atomic Radius (2-3 class periods)

- Indicate that relative proton quantities and electron configuration details determine effective nuclear charge
- Use examples and periodic table trends to establish where effective nuclear charge is greatest and weakest
- Link atomic/ionic size (radius) to effective nuclear charge and the shielding effect of the electron cloud
- Identify atoms having largest or smallest atomic radius within groups or periods
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 7 – Periodic Properties of the Elements
Lesson 2 – Ionization Energy and Electron Affinity (2-3 class periods)

- Define ionization energy and use atomic models to highlight this property
- Present data trends in first, second, and third ionization energies among the elements
- Use electron configurations and the Periodic table to predict relative ionization energy
- Define electron affinity and electronegativity and use models to compare these properties to ionization energy

- Observe and conclude cause and effect among alkali metal reactions using lab activity
- Research and explain electronegativity comparisons for element groups including the noble gases
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding of matter

Chapter 7 – Periodic Properties of the Elements
Lesson 3 – Metals, Nonmetals, and Metalloids (1-2 class periods)

- Present where the metal, non-metal, and metalloid elements are located on the Periodic table
- Discuss relationships between electron configuration, effective nuclear charge and physical properties
- Focus on main group metals, halogens, and noble gases to highlight extreme differences among elements
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 8 – Basic Concepts of Chemical Bonding
Lesson 1 – Ionic vs. Covalent Bonding (2-3 class periods)

- Define ionic and covalent bonds per electronegativity difference
- Use examples of both ionic and covalent compounds to emphasize use of valence electrons
- Research and share typical properties of compounds held together by each type of bond
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 2 – Atoms, Molecules and Ions
Lesson 1 – Naming and Formula Writing: Ionic and Molecular Compounds (3-4 class periods)

- Instruct systematic naming and formula writing systems for both ionic and molecular compounds
- Compare and contrast naming and formula writing details using a variety of examples and mixed practice
- Extend naming and formula writing for ionic compounds to include transition metal oxidation states
- Extend naming and formula writing for molecular compounds to include acids and hydrates
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 22 – Chemistry of the Nonmetals
Lesson 1 – Periodic Trends and Chemical Reactions (1-2 class periods)

- Highlight similarities and differences among non-metal elements in Groups 13 – 18 on Periodic table
- Use electron configuration and periodic property trends to indicate unique properties of certain non-metals
- Emphasize the reactive nature of halogens and the unreactive nature of noble gases
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 6, 7, 22, 23, 8 (w/ Mastering Chemistry E-Text)

Phet.colorado.edu: pHet Sims Activities - "Models of the Hydrogen Atom", "Wave on a String", "Microwaves", "Radio waves and Electromagnetic Radiation", "Neon Lights"

Video Clips: "Crash Course Astronomy – Light", "The Genius of Mendeleev", "NOVA: Earth from Space", "The Periodic Table Song",

Crash Course Chemistry video series

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): PS1.A "The Periodic Table orders elements horizontally by number of protons in an atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of the table reflect patterns of outer electron states"	
4.0	**Students will be able to:** • Construct a pattern/trend for several unknown elements based on provided periodic properties • Prove and explain that behavior and properties of bonded atoms in compounds reflect periodic trends
3.0	**Students will be able to:** • Communicate patterns of periodic properties such as atomic radius, electronegativity, and ionization energy • Identify atoms and ions of greater or lesser property values for each studied trend through comparison problems
2.0	**Students will be able to:** • Identify regions of the Periodic Table that include the elements • Recognize patterns of increasing atomic number and atomic mass on the Periodic Table ***Students will recognize and recall specific vocabulary, including:*** Atoms, protons, electrons, neutrons, groups, periods, metals, non-metals, atomic number, atomic mass, atomic radius, electronegativity, ionization energy
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): PS4-A: "The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing"	
4.0	**Students will be able to:** • Discover that the wavelength of light emitted from an atom reflects unique relationships among energy waves and atomic structure details
3.0	**Students will be able to:** • Calculate the frequency of a wave when provided with wavelength data, and vice versa • Connect wavelength and frequency data to the properties of energy wave types found on the electromagnetic spectrum • Interpret the magnitude and impact of Planck's constant and the speed of light constant on energy wave calculations
2.0	**Students will be able to:** • Use algebraic formulas to calculate an unknown quantity • Accurately perform calculations using numbers in scientific notation • Energy manifests itself in various ways in science

	Students will recognize and recall specific vocabulary, including: Energy, Waves, Electromagnetic Spectrum, Wavelength, Frequency, Speed
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	Create additional and alternative assignments and assessments to create challenge and foster discovery of knowledge
Struggling Learners	Facilitate access to review materials and remediation activities through OneNote content library and through online textbook content
English Language Learners	Coordinate with ELL advisors to modify activities where appropriate http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators:

ELA/Literacy –

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

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

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3), (HS-PS1-6)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3)

SL.11-12.5Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)

MP.4 Model with mathematics. (HS-PS1-4), (HS-PS1-8)

HSN-Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5),

HSA.SSE. A.1 Interpret expressions that represent a quantity in terms of its context. (HS-PS2-1), (HS-PS2-4)

HSA.SSE. B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-1), (HS-PS2-4)

HSA.CED. A.1 Create equations and inequalities in one variable and use them to solve problems. (HS-PS2-1), (HS-PS2-2)

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. (HS-PS2-1), (HS-PS2-2)

HSA.CED. A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS2-1), (HS-PS2-2)

Integration of 21st Century Skills

Indicators:

Career Ready Practices:

CRP2 – Apply appropriate academic and technical skills.
CRP5 – Consider the environmental, social and economic impacts of decisions.
CRP6 – Demonstrate creativity and innovation.
CRP7 – Employ valid and reliable research strategies.
CRP8 – Utilize critical thinking to make sense of problems and persevere in solving them.
CRP10 – Plan education and career paths aligned to personal goals.
CRP11 – Use technology to enhance productivity.
CRP12 – Work productively in teams while using cultural global competence.
9.2 Career Awareness, Exploration, and Preparation
9.2.12.C.1 – Review career goals and determine steps necessary for attainment.
9.2.12.C.3 – Identify transferable career skills and design alternate career plans.
9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources for owning and managing a business.

Unit 3 Title: Chemical Bonding Extensions: Molecular Geometry, Polarity, Introduction to Organic Chemistry

Unit Description: This unit will highlight and present information about the nature and behavior of molecules. VSEPR theory, molecular shapes and bond angles, polar vs. non-polar nature, and bond hybridization will be covered. Introductory organic chemistry concepts focusing on isomers and functional groups will be covered as well.

Unit Duration: 4 weeks

Desired Results

Standard(s): **Physical Science "Matter and its Interactions": HS-PS1-3**

Physical Science "Motion and Stability: Forces and Interactions": HS-PS2-6

Physical Science "Energy": HS-PS3-2

Indicators: **PS1.A "Structure and Properties of Matter", PS2.B "Types of Interactions", PS3.A "Definitions of Energy", PS3.C "Relationships between Energy and Forces"**

Understandings:
Students will understand that…

Combinations of bonded pairs and lone pairs of electrons determines the spacing of atoms and the molecular geometry of particles

The extent of symmetry of atoms and electrons in molecules contributes to the degree of polarity and polar behavior of molecules

Covalent bonding and molecular geometry is best explained through the bond hybridization model using sigma and pi bond notation

The physical and chemical properties of molecules is a direct result of molecular geometry and polarity specifics that describe particles

Carbon is a diverse atom that can bond in many ways with other non-metals to create a wide variety of organic compounds

Organic chemistry highlights molecules with carbon backbones and specific functional groups that play important roles in biology and modern material science

Essential Questions:

What combinations of bonded electrons and lone pair electrons create molecules with various shapes and bond angles?

How does the combination of electron groups and atoms in a molecule or ion contribute degrees of polarity and electron imbalance in a molecule or ion?

Why do unsymmetrical particles have greater potential to behave in a polar manner than symmetrical particles?

How do sigma bonds and pi bonds and bond hybridization models better explain the use of electrons to create binding forces in molecules?

Why can carbon atoms bond in a variety of ways with other non-metals to create many types of organic compounds?

What kinds of functional groups contribute to organic molecules having certain physical and chemical properties?

Assessment Evidence

Performance Tasks:

UNIT 3 QUIZ 1 “Molecular Geometry and Polarity”

- Explain the acronym VSEPR
- Identify simple molecular shapes: linear, bent, tetrahedral, etc...
- Draw accurate Lewis structures for molecular compounds
- Explain the octet rule and apply when drawing Lewis structures
- Define resonance
- Identify and explain polarity in molecules

UNIT 3 QUIZ 2 “Hybridization and Organic Chemistry”

- Define bond hybridization
- Write hybridization codes for various molecular geometries
- Explain need for orbitals to hybridize during bonding
- Label sigma and pi bonds in Lewis structures
- Define and identify isomers
- Recognize common functional groups in organic molecules

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: “Qualitative Analysis”

LAB: “pHet: Molecule Shapes and Polarity”

LAB: “Isomers and Functional Groups”

Independent Work and Cooperative Learning Activities:

“Lewis Structure Construction” – Building and analyzing covalent molecules per valence electrons and octet rule

“Expanded Octet Molecules” – Research and share unique electron combinations and spacing in expanded octet molecules

“Isomers and Functional Group Modeling” – Build and analyze hydrocarbons and derivatives with organic modeling kits

“Bond Length / Bond Strength Relationships” – Use of examples and data to draw conclusions about factors affecting bond energy

“Allotropes Investigation” - Discovery of relationship between atomic arrangement and physical properties in molecules

“Plastics Project” – Research and share bonding, geometry, and property details for assigned polymer / plastic

Benchmarks:

UNIT 3 TEST

Learning Plan

Learning Activities:

Chapter 8 – Basic Concepts of Chemical Bonding
Lesson 1 – Ionic Bonding: Coulomb's Law and Lattice Energy (2-3 class periods)

- Present Coulomb's Law and apply its relationships to definition of lattice energy
- Compare lattice energy data for various ionic solids to draw conclusions about forces within crystals
- Use lattice energy data and theory to explain properties typical of ionic solids
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 8 – Basic Concepts of Chemical Bonding
Lesson 2 – Covalent Bonding: Bond Length and Strength (1-2 class periods)

- Differentiate between single, double, and triple bonds in terms of length and strength
- Present and discuss potential energy and bond energy data for covalent bonds
- Examine examples of various covalent bonds for property comparison purposes
- Re-visit electronegativity to explain physical properties typical of matter containing covalent bonds
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 8 – Basic Concepts of Chemical Bonding
Lesson 3 – Lewis Structures and Resonance (3-4 class periods)

- Present steps for accurate use of bonded pairs and lone pairs to draw Lewis structures
- Discuss the octet rule as it pertains to bonding and previously studied concept of valence electrons
- Examine and analyze various examples and classwork Lewis structures for accuracy
- Read and discuss role of delocalized electrons in resonance structures
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 9 – Molecular Geometry and Bond Theories
Lesson 1 – VSEPR Theory and Simple Shapes (2-3 class periods)

- Interpret VSEPR theory through break down of acronym and review of forces
- Examine Lewis structures and use ABE formulas to categorize similar Lewis structures
- Consider and discuss relationships between central atom, electron groups, and molecular structure
- Present and consider incomplete octets and formal charges within select Lewis structures
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 9 – Molecular Geometry and Bond Theories
Lesson 2 – Geometry and Polarity (3-4 class periods)

- Discuss the importance of understanding the 3-D geometries of molecules
- Examine simple molecules and determine molecular shapes and bond angles
- Compare the effect of different combinations of bonded pairs and lone pairs on molecular shapes and angles
- Research and discuss how geometry and electronegativity contribute to molecular polarity
- Compare and contrast the Lewis structures and geometries of both polar and nonpolar molecules
- Practice all Lesson 2 topics using textbook and worksheet problems

- Use of vocabulary and examples to review and extend understanding

Chapter 9 – Molecular Geometry and Bond Theories
Lesson 2 – Bond Hybridization (3-4 class periods)

- Revisit knowledge or orbitals and review s, p, and d orbital facts and figures
- Use orbital model visuals to represent hybridized orbitals to highlight the true cause of molecular geometry
- Use hybridization models to discover sigma and pi nature of double and triple bonds
- Deduce hybridization codes for a variety of molecules and ions
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 24 – The Chemistry of Life: Organic and Biological Chemistry
Lesson 1 – Isomers and Functional Groups (2-3 class periods)

- Instruct the topic of isomers using hydrocarbon alkane examples and practice problems
- Draw Lewis structures for isomers and identify geometry and polarity differences
- Brainstorm and predict why isomers would have similar but slightly different properties and behavior tendencies
- Research and share common organic chemistry functional groups using famous molecule examples
- Read and learn fundamental organic chemistry vocabulary words used to describe and categorize matter
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 12 – Solids and Modern Materials
Lesson 1 – Ionic Solids, Metallic Solids, and Polymers (2-3 class periods)

- Use bond model diagrams and classic examples to highlight bonding in metallic solids
- Compare and contrast use of delocalized electrons for bonding in metals to electron roles in other solids
- Identify properties typical of metals and explain these unique properties in terms of delocalized metallic bonding
- Research and share properties and uses for specific metal elements
- Examine the structure, properties, and advantages of metallic alloys
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 8, 9, 24, 12 (w/ Mastering Chemistry E-Text)

Phet.colorado.edu**:** pHet Sims Activities - “Build a Molecule”, “Molecule Shapes”, “Molecule Polarity”

Video clips: “Crash Course Biology – Water, Liquid Awesomeness”, “Polarity and Molecular Behavior”, “Sigma vs. Pi Bonds”, “Plastics: Manufacturing and Recycling”

Crash Course Chemistry video series

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): PS1.A “The structure and interaction of matter at the bulk scale are determined by electrical forces within and between atoms”	
4.0	**Students will be able to:** • Predict properties of unseen molecular compounds and support predictions with

	bond theory evidence • List and explain factors contributing to observable properties and behavior for ionic, molecular and metallic materials
3.0	**Students will be able to:** • Construct and analyze geometric details for expanded octet molecules as well as polyatomic ions • Identify relationships between bond strength and bond length using previously gained knowledge of periodic table properties such as atomic radius and ionization energy
2.0	**Students will be able to:** • Construct and analyze geometric details for simple molecules that abide by the octet rule • Recognize patterns represented by combinations of bonded pairs and lone pairs per VSEPR theory and how these combinations influence molecular geometry ***Students will recognize and recall specific vocabulary, including:*** Valence electron, octet rule, Lewis structure, lone pair, bonded pair, single bond, double bond, triple bond, resonance, isomer, functional group
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): PS2-B: "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."	
4.0	**Students will be able to:** • Communicate how degrees or significance of polarity in molecules, as determined by atomic composition and geometry, ultimately determines behavioral tendencies of covalent molecule • Predict similarities and differences among molecules with varying polarities due to unique atomic composition and geometries
3.0	**Students will be able to:** • Use periodic table knowledge with Lewis structure construction to recognize and predict polar or non-polar nature in simple molecules • Recognize the polarity reflects degrees or levels of imbalance or asymmetry among electron groups in molecules or ions
2.0	**Students will be able to:** • Use electronegativity difference and basic knowledge of the elements to predict whether bond nature will be ionic, polar covalent, or non-polar covalent • Discover unique properties of metals are attributed to delocalized electrons rather than localized electron pairing that occurs in other solids ***Students will recognize and recall specific vocabulary, including:*** Polar, Non-Polar, Sigma Bond, Pi Bond, Resonance, Metallic Bonding, Bond Hybridization, Isomers, Delocalized Electrons

1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	Create additional and alternative assignments and assessments to create challenge and foster discovery of knowledge
Struggling Learners	Facilitate access to review materials and remediation activities through OneNote content library and through online textbook content
English Language Learners	Coordinate with ELL advisors to modify activities where appropriate http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators:

ELA/Literacy –

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

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

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3), (HS-PS1-6)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3)

SL.11-12.5Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)

MP.4 Model with mathematics. (HS-PS1-4), (HS-PS1-8)

HSN-Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5),

Integration of 21st Century Skills

Indicators:

Career Ready Practices:

CRP2 – Apply appropriate academic and technical skills.
CRP5 – Consider the environmental, social and economic impacts of decisions.
CRP6 – Demonstrate creativity and innovation.
CRP7 – Employ valid and reliable research strategies.
CRP8 – Utilize critical thinking to make sense of problems and persevere in solving them.
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Unit 4 Title: Chemical Changes, Reactions, Stoichiometry

Unit Description: This unit will highlight and present information about chemical changes. Chemical equation writing, building and balancing chemical equations, identifying chemical reaction types, predicting products for reactions, and stoichiometric problem solving will be covered.

Unit Duration: 4 weeks

Desired Results

Standard(s): Physical Science "Matter and its Interactions": HS-PS1-1, HS-PS1-2, HS-PS1-7

Indicators: PS1.B "Chemical Reactions", PS2. B "Types of Interactions", PS3.D "Energy in Chemical Processes"

Understandings: *Students will understand that…*	**Essential Questions:**
Atoms and molecules often react in predictable ways per valence electron quantities and periodic table properties Atoms are never created or destroyed during chemical changes Element and compound products can be predicted per the Law of Conservation of Matter and with reference to common reaction types Chemical reactions can be studied for the new matter they create but also for the energy created or required The mole concept when combined with an understanding of chemical reactions can be used to solve quantitative problems using stoichiometry Stoichiometry can also be used to determine limiting reactants and percent yield for chemical reactions	How do balanced chemical reactions reflect and support the Law of Conservation of Matter? How do synthesis, decomposition, single displacement, double displacement, and combustion reactions compare? How can knowledge of periodic table property trends be used to identify reaction types and predict products? How can the mole concept and knowledge of chemical reactions be combined to make predictions and solve problems through stoichiometry? What is a limiting reactant and how can a limiting reactant be determined using stoichiometric problem solving? How does percent error calculation reflect laboratory efficiency?

Assessment Evidence

Performance Tasks:

Quizzes:

UNIT 4 QUIZ 1 “Predicting Products and Reaction Types”

- Label reaction types for various chemical changes
- Explain symbolism included in chemical equations
- Provide coefficients to balance chemical equations
- Explain the Law of Conservation of Matter
- Predict products and write product formulas for chemical equations

UNIT 4 QUIZ 2 “Stoichiometry”

- Use mole definitions to complete mole conversions
- Explain relationship between moles and coefficients in equations
- Use dimensional analysis to predict quantities using stoichiometry
- Analyze and compare stoichiometric problem solving
- Define limiting reactant and identify limiting reactants in reactions
- Calculate percent yield

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: “Types of Chemical Reactions”

LAB: “Simple Stoichiometry”

LAB: “Determining Mole Ratios from Precipitate Formation”

+

Independent Work and Cooperative Learning Activities:

“Recognizing Reaction Types and Predicting Products” – Applications of formula writing combined with use of common chemical change formats

“Mixed Stoichiometry Problem Solving” – Dimensional analysis problem solving combining mole knowledge and other unit conversion factors

“Combustion Realities” – Analysis of stoichiometric realities of fossil fuel burning combustion reactions

“Stoichiometry and Lab Efficiency” – Student decision making for most efficient production of an assigned chemical product

“Famous Chemical Reactions” - Compare and contrast of details found among famous industrial and biochemical reactions

“Environmental Chemistry” – Investigation into reactions causing ozone layer depletion and acid rain precipitation

Benchmarks:

UNIT 4 TEST

Mid Term Exam

Learning Plan

Learning Activities:

Chapter 3 – Chemical Reactions and Reaction Stoichiometry

Lesson 1 –Chemical Equations and Simple Patterns of Chemical Reactivity (3-4 class periods)

- Identify reactants and products in chemical equations and symbols used to describe matter in equations
- Explain the Law of Conservation of Matter and need for using coefficients to balance equations
- Use examples and analogies to identify synthesis, decomposition, displacement, and combustion reactions
- Combine reactions and formula writing knowledge to predict products for various chemical changes
- Recognize reaction types and build chemical equations through lab activity
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 3 – Chemical Reactions and Reaction Stoichiometry

Lesson 2 – Stoichiometric Problem Solving (4-5 class periods)

- Examine balanced chemical equations and identify mole ratios of reactants and products
- Use dimensional analysis problem solving and mole conversions to predict quantities for reactions
- Practice and analyze results for variety of stoichiometry prediction problems
- Research and discuss the role of a limiting reactant in chemical reaction
- Use examples and problems to identify limiting reactants and calculate percent yield for various reactions
- Create and isolate a chemical product and compare experimental yield to stoichiometric prediction
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 4 – Reactions in Aqueous Solution

Lesson 1 – Precipitation and Neutralization Reactions (2-3 class periods)

- Read and conclude that many reactions in aqueous environments result in soluble and insoluble products
- Consider reasons why some products will dissolve while others will precipitate in water
- Read and conclude that many reactions result in the neutralization of specific ions
- Predict products for neutralization and precipitation reaction and explain how products differ from reactants
- Compare and contrast diamagnetic and paramagnetic nature
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 18 – Chemistry of the Environment

Lesson 1 – Chemical Changes in the Environment (1-2 class periods)

- Research and discuss chemical reactions that are influential in environmental science
- Examine and discuss specific reactions that contribute to the nature of atmospheric chemistry
- Examine and discuss specific chemistry concerns that face society on our planet
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 3,4 18 (w/ Mastering Chemistry E-Text)

Phet.colorado.edu: pHet Sims Activities – “Balancing Chemical Equations”, “Reactions Leftovers and Products”

Video clips: “The Martian”, “Decomposition of Ammonium Dichromate”, “What is Green Chemistry?”, “Gasoline, Diesel, and Jet Fuel”

Crash Course Chemistry video series

PS1.B “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”	
4.0	***Students will be able to*:** • Convert written descriptions of reactants to predict products and build accurate formulas for all types of reactions studied • Compare similarities and differences among various reaction types through observed changes in laboratory activities • Predict usefulness of applying chemical reactions knowledge to quantitative changes during introduction to stoichiometry

3.0	***Students will be able to*:** • Satisfy the Law of Conservation of Matter by balancing reactants and products in chemical equations with coefficients • Classify chemical changes into one of five reaction type categories
2.0	***Students will be able to:*** • Continue to build accurate formulas for ionic, molecular, acid and hydrocarbon compounds ***Students will recognize and recall specific vocabulary, including:*** • Compounds, Chemical Formulas, Cation, Anion, Molecule, Reactant, Product, Synthesis, Decomposition, Displacement, Combustion
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

PS3.D "Although energy cannot be destroyed it can be converted into less useful forms – for example, to thermal energy in the surrounding environment"	
4.0	***Students will be able to*:** • Predict bonding factors that cause some reactions to release energy while other reactions require an input of energy • Communicate how bond type and bond energy differences between reactants and products explains energy change during chemical changes
3.0	***Students will be able to*:** • Observe and compare heat energy changes during reactions as temperature change during experiments and demonstrations • Recognize the spontaneous or natural chemical reactions usually release energy when reactant particles are converted to product particles
2.0	***Students will be able to:*** • Identify different forms of energy that is manifested during chemical change, such as heat and light • Discover that energy can be neither created nor destroyed, but rather energy change during reactions is a transfer from one source to another ***Students will recognize and recall specific vocabulary, including:*** • Heat, Temperature, Law of Conservation of Energy, Exothermic, Endothermic

1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

Unit Modifications for Special Population Students	
Advanced Learners	Create additional and alternative assignments and assessments to create challenge and foster discovery of knowledge
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English Language Learners	Coordinate with ELL advisors to modify activities where appropriate http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org

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Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)

MP.4 Model with mathematics. (HS-PS1-4), (HS-PS1-8)

HSN-Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5),

Integration of 21st Century Skills

Indicators:

Career Ready Practices:

CRP2 – Apply appropriate academic and technical skills.
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CRP7 – Employ valid and reliable research strategies.
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CRP12 – Work productively in teams while using cultural global competence.
9.2 Career Awareness, Exploration, and Preparation
9.2.12.C.1 – Review career goals and determine steps necessary for attainment.
9.2.12.C.3 – Identify transferable career skills and design alternate career plans.
9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources for owning and managing a business.

Unit 5 Title: Physical Properties and Changes, Solutions, Gases

Unit Description: This unit will highlight and present information about physical properties and changes. Intermolecular forces, relationships among intermolecular forces and physical properties, physical vs. chemical change, physical state comparisons, kinetic-molecular theory of gases, and gas law relationships with problem solving will be covered.

Unit Duration: 4 weeks

Desired Results

Standard(s): Physical Science "Matter and its Interactions": HS-PS1-3

Physical Science "Energy": HS-PS3-1, HS-PS3-2

Indicators: PS1.A "Structure and Properties of Matter", PS2.B "Types of Interactions", PS3.A "Definitions of Energy", PS3.C "Relationships between Energy and Forces"

Understandings: *Students will understand that…*	**Essential Questions:**
Intermolecular forces of attraction among neighboring particles in a sample ultimately determines physical properties There are different types of intermolecular forces that vary in strength and in frequency of occurrence	What types of intermolecular forces exist among particles of matter? How does knowledge of the periodic table help to better understand the cause and nature of intermolecular forces? Why is hydrogen bonding the strongest IMF and why are dispersion forces the weakest IMF?

Solid, liquid and gas states reflect the collective strength of intermolecular forces found among particles in a sample Intermolecular forces explain the physical process of dissolving and the role of energy in solubility There are many direct and inverse relationships among environmental variables such as temperature, volume and pressure that can be observed and calculated when studying gases The mole concept and stoichiometry can be extended and applied to solve advanced problems associated with gas law relationships and gas reactions	How does the polarity of water explain is ability to act as a strong solvent of many solid and liquid solutes? What comparisons can be made among solids, liquids and gases in terms of intermolecular forces and physical properties? What is the cause of direct and inverse relationships among temperature, pressure, volume, and moles when studying gas samples? How can lack of intermolecular forces and kinetic molecular theory explain the unique nature and properties of gases as compared to liquids and solids?

Assessment Evidence

Performance Tasks:

Quizzes:

UNIT 5 QUIZ 1 "Intermolecular Forces and Solubility"

- Define dispersion, dipole and hydrogen bonding forces
- Explain differences among types of intermolecular forces
- Explain relationship between intermolecular forces and physical state
- Compare molecules and interpret intermolecular force differences
- Explain solubility in terms of intermolecular attractions
- Compare solutes using solubility curves
- Calculate concentration of solutions using molarity

UNIT 5 QUIZ 2 "Gases and Gas Law Relationships"

- List characteristics of gases found in kinetic-molecular theory
- Explain properties of gases as lack of intermolecular forces
- Identify compounds most likely to exist as gases
- Apply Boyle's, Charles' and Ideal gas laws for gas problem solving
- Calculate density and molar mass using Ideal gas law
- Predict gas quantities using Avogadro's law and stoichiometry

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: "Concentration and Kool-Aid

LAB: "Solubility Curves"

LAB: "Molar Volume of a Gas"

+

Independent Work and Cooperative Learning Activities:

"Exploding Paint Can Demo" – Combining brainstorming and knowledge to explain cause and effect after classroom demonstration

"Phase Diagrams" – Graph analysis and interpretation considering temperature, pressure, and physical state

"Colligative Properties" – Research and problem solving highlighting impact of concentration on physical properties of solutions

"Racing Gases" – Graham's Law of Effusion discovery via lab demonstration observations and rate of motion problem solving

"Solutions and Gases in the Body" - Research and share details of specific solutions and gases and role/importance to biology

"Intermolecular Force Comparisons" – Practice work to strengthen ability of students to recognize, compare and explain effects of IMF's

Benchmarks:

UNIT 5 TEST

Learning Plan

Learning Activities:

Chapter 11 – Liquids and Intermolecular Forces

Lesson 1 – Intermolecular Forces: Types and Impact on Physical Properties (4-5 class periods)

- Emphasize that forces of attraction among neighboring particles determine physical properties

- Define dispersion forces, dipole forces, and hydrogen bonding forces in terms of strength and occurrence
- Use examples and visual diagrams to highlight nature and impact of different types of IMF's
- Revisit Lewis structures and molecular compounds to link physical properties with degree of IMF's
- Explain many of water's impressive and unique properties in terms of hydrogen bonding ability
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 11 – Liquids and Intermolecular Forces
Lesson 2 – Solubility and Solutions (4-5 class periods)

- Explain why dissolving is a physical change and not a chemical change
- Use diagrams and models to highlight forces and interaction between solute and solvent particles
- Compare solubility values of various solutes using solubility curves and related problem solving
- Research various concentration systems, including molarity, and calculate concentration data for solutions
- Prepare solutions of various concentrations from scratch and via dilution using mole math
- Research and discuss properties of liquids such as boiling point, density, viscosity and surface tension
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 10 – Gases
Lesson 1 – Characteristics of Gases and Kinetic Molecular Theory (2-3 class periods)

- Brainstorm and list qualities that distinguish gases from other forms of matter
- Read and discuss properties and behavior tendencies of gases set forth in kinetic-molecular theory
- Explain that all gases behave per very minimal influence of intermolecular forces
- Discover and compare relationships between temperature, volume, pressure and moles found in gas laws
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 10 – Gases
Lesson 2 – Gas Law Problem Solving and Analysis (4-5 class periods)

- Calculate volume, pressure and temperature data for gases using Boyle's, Charles', and Combined gas law
- Consider role of moles with other gas measurements for calculations using the Ideal gas law
- Examine gas mixtures through Dalton's Law of Partial Pressure
- Collect a gas during lab activity and mathematically confirm Avogadro's law
- Extend gas law instruction to include comprehensive Ideal gas law equation and consideration for "ideal" gases
- Research and discuss relationship between molecular mass and diffusion velocity using Graham's law
- Discuss environmental conditions that would cause gases to deviate from ideal behavior and properties
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 10, 11, 12

pHet.colorado.edu: pHet Sims Activities - "Concentration", "Molarity", "Sugar and Salt Solutions", "Gas Properties", "States of Matter"

Video clips**:** "October Sky", "Helium vs. Sulfur hexafluoride", "Scuba Diving and Consideration of Gas Laws and Solubility", "Chemistry of Automobile Air Bag Systems"

Crash Course Chemistry video series

PS2.B "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"	
4.0	***Students will be able to*:** • Apply concepts of solubility and lab technique to accurately prepare solutions of exact concentration using both solute and dilution techniques during "Concentration and Kool-Aid" lab experiment. • Prove that colligative properties such as boiling point and freezing point are influenced the concentration of dissolved solutes in water and other solvents through mathematical problem solving.
3.0	***Students will be able to*:** • Construct a free response essay response that effectively communicates the role of intermolecular forces of attraction in explaining how/why a specific solute dissolves in water. • Compare various solution measurement systems such as molarity, molality, percent by mass and percent by volume for how each uses a ratio to quantify concentration.
2.0	***Students will be able to:*** • Identify various factors affecting solubility and solubility rate including temperature, surface area, and pressure • Interpret solubility curve graphs for similarities and differences among different solutes dissolved in water ***Students will recognize and recall specific vocabulary, including:*** • Solute, Solvent, Solution, Concentration, Molarity, Intermolecular Force, Ions, Ion-Dipole Force, Polarity, Hydrogen Bonding Force, Dilution, Colligative Properties
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

PS3.A "These (definitions of energy) are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as either motions of particles or energy stored in fields."	
4.0	***Students will be able to*:** • Prove Avogadro's Law by using data collected during the "Molar Volume of a Gas" experiment to calculate a volume to moles ratio at STP

	• Analyze data through problem solving to connect intermolecular forces factors to the ideal or non-ideal characteristics of various gases
3.0	***Students will be able to*:** • Construct a free response essay response that effectively explains why certain compounds are more likely to exist as gases at STP while others are more likely to exist as liquids or solids. • Compare both direct and inverse relationships among volume, pressure, temperature, and moles through gas law problem solving
2.0	***Students will be able to:*** • Identify properties and characteristics of gases as compared to properties and characteristics of solids and liquids. • List characteristics of gas properties and behavior found within the kinetic-molecular theory of gases ***Students will recognize and recall specific vocabulary, including:*** • Gases, Pressure, Force, Temperature, Volume, Ideal Gas, Real Gas, Volatile, Diffusion, Effusion, Molar Volume
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

Unit Modifications for Special Population Students	
Advanced Learners	Create additional and alternative assignments and assessments to create challenge and foster discovery of knowledge
Struggling Learners	Facilitate access to review materials and remediation activities through OneNote content library and through online textbook content
English Language Learners	Coordinate with ELL advisors to modify activities where appropriate http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing

	• Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

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

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS3-4)

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS3-3), (HS-PS3-4), (HS-PS3-5)

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS3-4), (HS-PS3-5)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS3-4), (HS-PS3-5)

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS3-1), (HS-PS3-2), (HS-PS3-5)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-PS3-1), (HS-PS3-2), (HS-PS3-3), (HS-PS3-4), (HS-PS3-5)

MP.4 Model with mathematics. (HS-PS3-1), (HS-PS3-2), (HS-PS3-3), (HS-PS3-4), (HS-PS3-5)

HSN.Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS3-1), (HS-PS3-3)

HSN.Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS3-1), (HS-PS3-3)

HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS3-1), (HS-PS3-3)

Integration of 21st Century Skills

Indicators:

Career Ready Practices:

CRP2 – Apply appropriate academic and technical skills.
CRP5 – Consider the environmental, social and economic impacts of decisions.
CRP6 – Demonstrate creativity and innovation.
CRP7 – Employ valid and reliable research strategies.
CRP8 – Utilize critical thinking to make sense of problems and persevere in solving them.
CRP10 – Plan education and career paths aligned to personal goals.
CRP11 – Use technology to enhance productivity.
CRP12 – Work productively in teams while using cultural global competence.
9.2 Career Awareness, Exploration, and Preparation
9.2.12.C.1 – Review career goals and determine steps necessary for attainment.
9.2.12.C.3 – Identify transferable career skills and design alternate career plans.
9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources for owning and managing a business.

Unit 6 Title: Energy: Thermodynamics and Kinetics

Unit Description: This unit will highlight and present information about the roles that energy plays in physical and chemical changes. Heat, enthalpy, entropy, and free energy concepts will be emphasized and quantified during the thermodynamics section. Factors affecting reaction rate, rate order, rate laws, reaction mechanisms and catalysts will be emphasized during the kinetics section.

Unit Duration: 4 weeks

Desired Results

Standard(s): Physical Science "Energy": HS-PS3-1, HS-PS3-2, HS-PS3-4

Physical Science "Matter and its Interactions": HS-PS1-4, HS-PS1-5

Indicators: PS3.A "Definitions of Energy", PS3.B "Conservation of Energy and Energy Transfer", PS3.C "Relationship Between Energy and Forces", PS3.D "Energy in Chemical Processes"

Understandings:
Students will understand that…

Heat energy will be either required or released during chemical processes due to chemical bonds breaking and reforming

Heat and mole measurements can be combined to calculate enthalpy change for reactions and indicate if a reaction is exothermic or endothermic

Entropy measures the extent of disorder change during a reaction

Enthalpy and entropy when combined with temperature can be used to calculate free energy and determine the spontaneity of a reaction

The rate of a reaction is best understood through collision theory models that indicate there are several experimental factors that can influence rate of reaction

Rate order can be determined from experimental data and/or graphs

Catalysts play a vital role in reaction kinetics in modern day chemistry

Essential Questions:

What measurements are needed to calculate the quantity of heat associated with a change?

How is knowledge of bond energy useful in determining exothermic/endothermic nature of reactions?

How can heat and mole quantities be used to calculate the change in enthalpy for a reaction?

What indicators present in reaction or chemical equation can be used to predict whether entropy is growing or diminishing during a change?

How are enthalpy, entropy, and temperature combined to calculate free energy and determine the spontaneity of a reaction?

What are the factors that contribute to rate of a reaction at the molecular level?

How can rate order be determined from laboratory data?

Why is a rate-determining step the focal point of a reaction mechanism?

How do catalysts work to speed of reaction rate and why are catalysts so valuable to modern science?

Assessment Evidence

Performance Tasks:

Quizzes:

UNIT 6 QUIZ 1 "Thermodynamics and Spontaneity"

- Explain differences among heat, temperature and specific heat
- Quantify heat using provided data
- Calculate and interpret enthalpy change for various changes
- Explain exothermic and endothermic nature per bond data
- Define entropy and identify entropy gain or loss in reactions
- Calculate free energy to determine spontaneity of changes

UNIT 6 QUIZ 2 "Kinetics"

- List and explain factors that affect reaction rate at the molecular level
- Determine rate order using provided experimental data
- Construct rate law equations and calculate theoretical reaction rates
- Define activation energy and intermediates
- Analyze and interpret reaction mechanism steps and graphs

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: "Specific Heat Capacity"

LAB: "Hess's Law: Additivity of Heats of Reaction"

LAB: "Decomposition of Hydrogen Peroxide"

LAB: "Factors Affecting Reaction Rate"

+

Independent Work and Cooperative Learning Activities:

"Heating Curves Analysis" – Drawing conclusions and solving problems related to role of energy in simple physical changes

"Thermodynamics Problem Solving" – Enthalpy, Entropy and Free Energy calculations from various types of data

- Define catalyst and explain how catalysts work	"Potential Energy Graphs – Solidifying relationships among bonding, energy, and reactions using reaction mechanism PE graphs "Iodine Clock Reaction On-Line Simulator Lab" – Data collection and observations lead to determination of rate order for participating reactants "Famous Catalysts" - Research and share information about how specific catalysts and enzymes have impacted reaction rate "Rate Law Formulation" – Use of experimental data to conclude relationships between reactant concentration and initial rate of reaction

Benchmarks:

UNIT 6 TEST

Learning Plan

Learning Activities:

Chapter 5 – Thermochemistry
Lesson 1 – Heat and Temperature (1-2class periods)

- Discuss differences and relationships among temperature and heat using definitions
- Present method to calculate heat, temperature, and specific heat capacity from each other using lab activity
- Research and share foundational knowledge of energy and its existence and transformation during changes
- Compare and contrast terms exothermic and endothermic using examples
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 5 – Thermochemistry
Lesson 2 – Enthalpy, Bond Enthalpies and Hess's Law (3-4 class periods)

- Define enthalpy as a ratio of heat delivered per moles of matter created/consumed
- Predict and calculate enthalpy change using Lewis structures and bond energy data
- Research and use standard enthalpy values to determine enthalpy change for select reactions
- Connect and conclude relationships among matter and enthalpy change using Hess's law
- Emphasize that exothermic heat release is a more favorable energy change than endothermic heat input
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 19 – Chemical Thermodynamics
Lesson 1 – Entropy (2-3 class periods)

- Define entropy and discuss the Laws of Thermodynamics
- Use chemical equations and reaction descriptions to predict entropy change during reactions
- Quantify entropy change for reactions using standard entropy value data
- Compare and contrast similarities and differences between enthalpy and entropy energy factors
- Emphasize the entropy gain is more favorable than entropy loss in the universe
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 19 – Chemical Thermodynamics
Lesson 2 – Gibbs Free Energy and Spontaneity (4-5 class periods)

- Discuss and share examples of reactions that are spontaneous and reactions that are non-spontaneous
- Combine knowledge of enthalpy and entropy with temperature measurement to determine free energy
- Predict spontaneity through consideration of enthalpy and entropy nature and temperature data
- Observe, quantify and draw conclusions about spontaneity through in-class laboratory activities
- Calculate temperatures at which reactions will switch from spontaneous to non-spontaneous, and vice versa
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 14 – Chemical Kinetics

Lesson 1 – Factors Affecting Reaction Rates (2-3 class periods)

- Brainstorm and list both controllable and uncontrollable factors affecting reaction rate
- Use molecular level collision theory viewpoints to explain how each factor influences reaction rate
- Define activation energy and consider bond reasoning for why activation energy values vary
- Recognize collision orientation as another contributing factor to reaction rate at the molecular level
- Observe impact of temperature change on reaction rate through laboratory activities
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 14 – Chemical Kinetics

Lesson 2 – Concentration, Rate Order and Rate Laws (3-4 class periods)

- Use concentration and rate data from graphs and tables to determine rate order for reactants
- Compare and contrast zero order, first order, and second order reactants
- Extend rate order work to include formation of rate law equations
- Use examples and practice problems to build rate laws equations and solve for specific rate or concentration
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 14 – Chemical Kinetics

Lesson 3 – Reaction Mechanisms and Catalysts (3-4 class periods)

- Discuss why many reactions must occur in a series of collision steps rather than in one single step
- Examine and compare various reaction mechanism using elementary step equations and energy diagrams
- Identify and explain reasoning for selection of rate-determining steps in reaction mechanisms
- Define catalysts and enzymes and examine/discuss function and importance of each
- Observe and discuss impact of a catalyst on a chemical reaction through lab activity
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 5, 19, 14

pHet.colorado.edu: pHet Sims Activities - **"**Reactions and Rate", "Energy Forms and Changes"

Video clips**:** "TedED: Why do reactions happen?", "How Handwarmers Work", "Crash Course Biology: ATP and Respiration", "Spontaneous vs. Non-Spontaneous"

Crash Course Chemistry video series

PS3.A "These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as either motions of particles or energy stored in fields. This last concept includes radiation, a phenomenon in which energy stored in fields moves across space"

4.0	***Students will be able to*:** • Both calculate the Gibbs free energy of a system and rationalize how the contributing factors of enthalpy, entropy and temperature influenced the spontaneity of the change • Analyze data from balanced chemical equations and lab observations to predict and calculate the gain or loss of enthalpy and entropy in a reaction
3.0	***Students will be able to*:** • Construct a free response essay response that effectively explains the relationship between previously learned topics of forces and bonding to the cause of why some reactions are exothermic and others are endothermic • Construct a free response essay response that effectively explains the factors contributing to entropy and entropy change during both physical and chemical changes with reference to the second law of thermodynamics
2.0	***Students will be able to:*** • Identify the definitions of temperature and heat and communicate the relationship between temperature and heat • Recognize that all changes in the physical world can be classified as one of four scenarios based on the various combinations of enthalpy and entropy change that can describe the change ***Students will recognize and recall specific vocabulary, including:*** • Heat, Temperature, Joules, Enthalpy, Entropy, Exothermic, Endothermic, Spontaneous, Non-Spontaneous
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

PS1.B "Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangement 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"	
4.0	***Students will be able to*:** • Deduce rate order and rate determining steps from provided experimental data and reaction mechanisms • Explain factors by which activation energy can be achieved for

	reactions to occur at a fast rate
3.0	***Students will be able to*:** • Interpret potential energy graphs and identify endothermic and exothermic steps within mechanisms • Explain function of catalysts and enzymes in terms of energy factors and collision theory
2.0	***Students will be able to:*** • Discover through data analysis and experimentation that reactant concentrations can have zero effect, direct effect, or exponential effect on the rate of a chemical reaction • Recognize that there are controllable and uncontrollable factors that affect the rate at which reactions convert reactants into products ***Students will recognize and recall specific vocabulary, including:*** Activation energy, Collision orientation, Kinetics, Rate Order, Rate Law, Reaction Mechanism, Intermediate, Activated Complex, Catalyst, Enzyme
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Unit 7 Title: Equilibrium and Acid-Base Chemistry

Unit Description: This unit will highlight and present information about the reversibility of reactions and factors that influence the equilibrium position of specific reactions. Equilibrium constants, reaction quotients, LeChatelier's Principle, and solubility equilibrium will be highlighted to introduce equilibrium. Bronsted-Lowry theory, pH scale, titration, and weak acid-base nature will be used to extend equilibrium knowledge and problem solving.

Unit Duration: 5 weeks

Desired Results

Standard(s): **Physical Science "Matter and its Interactions": HS-PS1-4, HS-PS1-5, HS-PS1-6**

Physical Science "Energy": HS-PS3-2

Indicators: **PS1.B "Chemical Reactions", PS3.A "Definitions of Energy", PS3.B "Conservation of Energy and Energy Transfer", PS3.D "Energy in Chemical Processes"**

Understandings:
Students will understand that…

Collisions between product particles can trigger a competing reverse reaction for many physical and chemical changes

The extent of progress made by forward reaction collisions prior to the onset of the reversible reaction can be measured by a ratio known as the equilibrium constant

Factors of temperature, pressure, and concentration can influence the equilibrium position of a reaction and can be observed per LeChatelier's principle

Acids and bases can be defined in several ways either based on the ions they contain or the behavioral tendencies the display during reactions

Equilibrium can be observed in acid-base reactions and can used to compare and contrast strong and weak nature among acids and bases

The pH scale is used to translate ion concentrations to a reference number between 0 - 14

Why do reverse reactions occur when chemical reactants and particles are studied in an enclosed system?

How can knowledge of gas laws and thermodynamics be used to predict shifting of equilibrium position per LeChatelier's Principle?

What measurements and calculations can be used to calculate the equilibrium constant for a reaction?

How can an equilibrium constant value be used to draw conclusions about the competing energy factors of a forward and reverse reaction?

What ions and behaviors define acids and bases in chemistry?

How do strong and weak acids compare in terms of bond energies, pH and equilibrium constants?

How can ion concentration measurements be used to calculate pH values for aqueous solutions?

What is an equivalence point and how can a lab titration be used to determine an equivalence point?

Assessment Evidence

Performance Tasks:

UNIT 7 QUIZ 1 "Equilibrium and LeChatelier's Principle"

- Define chemical equilibrium
- Build equilibrium constant expressions and calculate K values
- Interpret meaning of provided or calculated K values
- Determine shift responses per LeChatelier's principle
- Identify equilibrium and LeChatelier's principle on graphs
- Explain solubility product equilibrium values

UNIT 7 QUIZ 2 "Acid-Base Equilibrium"

- List defining properties of acids and bases
- Label Bronsted-Lowry acids, bases and conjugate pairs
- Define strong and weak acids and bases
- Explain the role of water in the development of the pH scales
- Calculate pH and ion concentration values for aqueous solutions
- Compare acid solutions using pH and Ka values
- Determine equivalence points from titration data and graphs

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: "LeChatelier's Principle"

LAB: "Using Conductivity to Determine Equivalence Points"

LAB: "Strong vs. Weak Acid-Base Titrations"

+

Independent Work and Cooperative Learning Activities:

"Paper Clip Equilibrium" – Modelling and problem solving for the competition of forward and reverse changes during a reversible reaction

"Equilibrium Constant Determination" – Calculation and interpretation of K values for a variety of reversible reactions

"Equilibrium Graph Analysis – Discovery of LeChatelier's Principle and competition between forward and reverse changes

	"pH and Ion Concentration Math" – Problem solving stressing relationships among pH and molarity for both strong and weak acids/bases "Equilibrium Constants for Weak Acids" – Determination and interpretation of Ka values and conclusions about degrees of ionization "Importance of Buffers" – Find and share a current news article that highlights the importance of preparing and utilizing buffer solutions in science

Benchmarks:

UNIT 7 TEST

Learning Plan

Learning Activities:

Chapter 15 – Chemical Equilibrium
Lesson 1 – Reversible Reactions and the Equilibrium Constant (3-4 class periods)

- Use collision theory models to rationalize the potential reversibility of all reactions
- Practice representing equilibrium position by writing equilibrium constant expression ratios
- Solve equilibrium constant values and explain the meaning behind the size of the K value
- Relate equilibrium constant values to energy and bonding factors the contribute to equilibrium position
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 15 – Chemical Equilibrium
Lesson 2 – LeChatelier's Principle (3-4 class periods)

- Use collision theory models to discuss the potential for reversible reactions to be disrupted from equilibrium
- Read and discuss the impact of temperature, pressure and concentration on equilibrium systems
- Examine graphs that highlight LeChatelier's principle shifting
- Predict responses of equilibrium systems to specific stresses during lab activity
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 17 – Additional Aspects of Aqueous Equilibria
Lesson 1 – Solubility Equilibria (2-3 class periods)

- Revisit the physical property of solubility and examine this change as a reversible process
- Build and solve equilibrium constant equations to discuss relative solubility limits of solutes
- Observe and compare solubility constant product realities for various solutes during lab activities
- Solve and explain molar solubility problems
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 16 – Acid-Base Equilibrium
Lesson 1 – Bronsted-Lowry Acids and Bases (2-3 class periods)

- Read and analyze criteria defining acids and bases in both the Arrhenius and Bronsted-Lowry models
- Highlight reversible nature of acid-base reactions by identifying conjugate acid-base pairs
- Discuss related vocabulary terms such as amphoteric, monoprotic, and polyprotic
- Highlight and discuss physical properties typical of acids and bases
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 16 – Acid-Base Equilibrium
Lesson 2 – pH Scale (2-3 class periods)

- Review student past knowledge and perceptions of the pH scale
- Examine the autoionization of water as a weak acid and weak base species using models and visual
- Solve for the value of the equilibrium constant of water and discuss its central role in the pH scale
- Use log functions to convert between ion concentrations and pH to compare acid and base solutions
- Research and discuss the importance of pH in biochemistry and laboratory experimentation
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 16 – Acid-Base Equilibrium
Lesson 3 – Weak Acids and Bases (2-3 class periods)

- Compare and contrast examples of strong and weak acids and bases
- Analyze and interpret Ka and Kb equilibrium constant values for weak acids and weak bases
- Communicate relationship between bond strength and equilibrium constant for weak acids/bases
- Use I-C-E charts to organize data and complete calculations for Ka and Kb problem solving
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 17 – Additional Aspects of Aqueous Equilibria
Lesson 1 – Acid-Base Titrations (3-4 class periods)

- Model technique and use of laboratory equipment for titrations
- Research and discuss the importance of pinpointing an equivalence point during titrations
- Accurately titrate acids and bases to reach equivalence points during in class lab activities
- Explain function and importance of chemical indicators during acid-base titrations
- Determine the concentration of an acid or base solution using lab data and mole math
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 15, 16, 17

pHet.colorado.edu: pHet Sims Activities - “Reversible Reactions”, “Salts and Solubility”, “pH Scale”, “Acid-Base Solutions”

Video clips: “LeChatelier’s Principle”, “TedED – Haber Process”, “Titration Technique”, “pH Explained”, “Acids and Bases in Food”, “Dangers of Acidosis”

Crash Course Chemistry video series

PS1.B “In many reactions, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present”

4.0	***Students will be able to*:** • Communicate factors that contribute to why specific reversible reactions would have large or small equilibrium constants when studied in an enclosed system • Use LeChatelier's principle to design experimental environments that would allow the forward change progress of a reversible change to prosper and achieve maximum efficiency
3.0	***Students will be able to*:** • Construct equilibrium expressions and use data to accurately calculate equilibrium constant values for reversible reactions • Interpret concentration versus time graphs and draw conclusions about forward versus reaction collision dynamics
2.0	***Students will be able to:*** • Recognize that concentration, pressure, and temperature that will cause predictable shifts to an established equilibrium • Recognize that collisions among particles in an enclosed system explains the theoretical possibility that all reactions are reversible and could establish a state of dynamic equilibrium ***Students will recognize and recall specific vocabulary, including:*** LeChatelier's Principle, Reversible Reaction, Equilibrium Constant, Reaction Quotient, Solubility Product Constant
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

PS3.B "Uncontrolled systems always evolve towards more stable states – that is, toward more uniform energy distribution"	
4.0	***Students will be able to*:** • Explain how the equilibrium constants for all reversible reactions reflect the efficiency of forward and reverse reactions per bond energy data and collision theory factors • Quantify and connect weak and strong nature in acids and bases per the Bronsted-Lowry model

3.0	***Students will be able to*:** • Achieve and observe an equivalence point during the titration of acid and base reactant solutions • Identify and communicate factors contributing to the partial or complete hydrogen ion transfer during acid-base reactions
2.0	***Students will be able to:*** • Discover that the neutralization of acids by bases, and vice versa occurs as a spontaneous reaction due to favorable thermodynamic factors • Recognize that the nature and extent of acid behavior reflects the strength or weakness of energy forces with reactant particles ***Students will recognize and recall specific vocabulary, including:*** Arrhenius Model, Bronsted-Lowry Model, Acid, Base, Conjugate Acid, Conjugate Base, pH, Equivalence Point, Neutralization, Titration, Amphoteric, Monoprotic, Polyprotic, Weak Acid/Base, Strong Acid/Base
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

Unit Modifications for Special Population Students	
Advanced Learners	Create additional and alternative assignments and assessments to create challenge and foster discovery of knowledge
Struggling Learners	Facilitate access to review materials and remediation activities through OneNote content library and through online textbook content
English Language Learners	Coordinate with ELL advisors to modify activities where appropriate http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete

	• Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Indicators:

ELA/Literacy –

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

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS3-4)

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS3-3), (HS-PS3-4), (HS-PS3-5)

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS3-4), (HS-PS3-5)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS3-4), (HS-PS3-5)

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS3-1), (HS-PS3-2), (HS-PS3-5)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-PS3-1), (HS-PS3-2), (HS-PS3-3), (HS-PS3-4), (HS-PS3-5)

MP.4 Model with mathematics. (HS-PS3-1), (HS-PS3-2), (HS-PS3-3), (HS-PS3-4), (HS-PS3-5)

HSN.Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS3-1), (HS-PS3-3)

HSN.Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS3-1), (HS-PS3-3)

HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS3-1), (HS-PS3-3)

Integration of 21st Century Skills

Indicators:

Career Ready Practices:

CRP2 – Apply appropriate academic and technical skills.
CRP5 – Consider the environmental, social and economic impacts of decisions.
CRP6 – Demonstrate creativity and innovation.
CRP7 – Employ valid and reliable research strategies.
CRP8 – Utilize critical thinking to make sense of problems and persevere in solving them.
CRP10 – Plan education and career paths aligned to personal goals.
CRP11 – Use technology to enhance productivity.
CRP12 – Work productively in teams while using cultural global competence.
9.2 Career Awareness, Exploration, and Preparation
9.2.12.C.1 – Review career goals and determine steps necessary for attainment.
9.2.12.C.3 – Identify transferable career skills and design alternate career plans.
9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources for owning and managing a business.

Unit 8 Title: Reduction-Oxidation Chemistry and Electrochemistry

Unit Description: This unit will highlight and present information about specific reactions that involve the gain and loss of electrons through reduction-oxidation processes. Building and balancing half reactions, identifying oxidation states, voltaic cells, and standard reduction potential will be covered. Applications of electrochemistry including batteries, electroplating, and electrolysis is also included.

Unit Duration: 3 weeks

Desired Results

Standard(s): Physical Science "Matter and its Interactions": HS-PS1-1, HS-PS1-2, HS-PS1-4

Physical Science "Energy": HS-PS3-5

Indicators: PS1.A "Structure and Properties of Matter", PS2.B "Types of Interactions", PS1.B "Chemical Reactions", PS3.A "Definitions of Energy", PS3.D "Energy in Chemical Processes"

Understandings:

Students will understand that…

The gain and loss of electrons in chemical reactions corresponds with periodic table properties and tendencies of the elements

Energy changes during reduction and oxidation processes can be measured, and this energy may be used to fuel additional reactions

Cell potential values measured as volts can be used to reinforce similarities and differences among atoms and ions and electron tendencies

Batteries take advantage of the spontaneous reduction-oxidation reactions among atoms and ions to create electrical energy to fuel other processes

Non-spontaneous redox reactions can be driven with the application of external energy from a battery

Essential Questions:

Which atoms/ions are more prone to gain electrons and go through reduction and which are more prone to lose electrons and go through oxidation?

How is energy produced during spontaneous redox reactions?

What are the connections between reduction-oxidation tendencies and periodic table properties such as atomic radius and ionization energy?

How are current measured in amps and cell potential measured in volts similar yet different?

What do some common types of modern batteries and what specific redox reactions generate the spontaneous electromotive force in these batteries?

How are batteries used to power or drive non-spontaneous redox reactions such as electrolysis of water and electroplating of metals?

Assessment Evidence

Performance Tasks:

Quizzes:

UNIT 8 QUIZ 1 "Reduction-Oxidation Reactions"

- Identify oxidation states for atoms, ions and molecules
- Explain difference between oxidation and reduction
- Write half reactions for oxidation and reduction
- Determine standard reduction potential for spontaneous reactions

UNIT 8 QUIZ 2 "Electrochemistry"

- Label components and explain function of components in voltaic cell
- Define anode, cathode, salt bridge
- Identify unique characteristics of common battery types
- Calculate cell potential for theoretical batteries
- Explain how batteries can drive non-spontaneous electrolysis

Other Evidence:

Pre-Lab Assignments and Post-Lab Quizzes for the following experiments:

LAB: "Stoichiometry with Redox Titration"

LAB: "Measuring Cell Potential"

+

Independent Work and Cooperative Learning Activities:

"Identifying Oxidation States" – Labeling oxidation states within balanced redox reaction to monitor the gain and loss of electrons

"Building Redox Reactions" – Use of half reactions to balance both the atoms and the electrons in redox equation

"Predicting Cell Potential" – Computation of voltage created during spontaneous electrochemical reactions using standard reduction potential data

"Types of Batteries" – Research and share information for assigned modern day battery types project

"Why do Batteries Fail?" – Brainstorming activity to generate possible reasons for how/why batteries stop working

Benchmarks:

UNIT 8 TEST

Final Exam

Learning Plan

Learning Activities:

Chapter 4 – Reactions in Aqueous Solution

Lesson 1 – Oxidation-Reduction Reactions (4-5 class periods)

- Determine oxidation states of atoms contained within molecules and polyatomic ions
- Monitor oxidation state change in an equation and create balanced oxidation and reduction half reactions
- Identify oxidizing agents and reducing agents in chemical reactions
- Combine half reactions and balance both matter and electrons to accurately represent a redox change
- Use a balanced redox reaction and measurements to identify an unknown compound during lab activity
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 20 – Electrochemistry

Lesson 1 – Voltaic Cells and Standard Reduction Potential (3-4 class periods)

- Present and discuss list of particles included on the standard reduction potential chart
- Reflect on periodic table knowledge to link reduction tendencies with atomic size and nuclear charge
- Identify the necessary components to construct a voltaic cell that operates from a spontaneous redox reaction
- Compare and contrast the role of anode, cathode, and electrolytic salt bridge in a voltaic cell
- Calculate standard reduction potential using reference data and cell diagrams
- Practice all Lesson 1 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 20 – Electrochemistry

Lesson 2 – Batteries (2-3 class periods)

- Examine the cross-section of a typical dry cell battery for components and engineering
- Associate battery power as the result of spontaneously moving electrons in a redox reaction
- Compare and contrast the redox reactions and resulting cell potential voltage for a variety of household batteries
- Research and discuss the future needs and goals for the batteries in society
- Practice all Lesson 2 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Chapter 20 – Electrochemistry

Lesson 3 – Electrolysis (1-2 class periods)

- Present and discuss the possibilities for non-spontaneous redox reactions to be conducted and used
- Examine the electrolysis of water as an example of forced production of hydrogen and oxygen gas
- Observe and discuss electroplating as a useful application of electrochemistry to modern industry
- Practice all Lesson 3 topics using textbook and worksheet problems
- Use of vocabulary and examples to review and extend understanding

Resources:

Textbook – Chapters 4, 20

pHet.colorado.edu: pHet Sims Activities - "Conductivity", "Battery Voltage"

Video clips: "NOVA – In Search of the Super Battery", "Electroplating Metals", "Hydrogen Vehicles"

Crash Course Chemistry video series

PS3.A "Electrical energy may mean energy stored in a battery or energy transmitted by electric currents"	
4.0	***Students will be able to*:** • Communicate the advantages, limitations and future possibilities for batteries and hydroelectric power in modern industries • Recognize and communicate how batteries can be used to drive non-spontaneous electrochemical reactions for electroplating and electrolysis
3.0	***Students will be able to*:** • Calculate and interpret the cell potential (voltage) generated by exchanged electrons during reduction-oxidation reactions using data from standard reduction potential references • Communicate the function of key components that generate and sustain the electromotive force within modern day batteries
2.0	***Students will be able to:*** • Identify the differences between anodes and cathodes and communicate the function of electrodes, solutions in voltaic cells • Discover the function and importance of a salt bridge and electrolyte solution in batteries ***Students will recognize and recall specific vocabulary, including:*** Anode, Cathode, Voltaic Cell, Cell Potential, Standard Reduction Potential, Current, Voltage, Salt Bridge, Electrolysis
1.0	***With help, partial success at level 2.0 content and level 3.0 content:***
0.0	***Even with help, no success***

PS3.B "The availability of energy limits what can occur in any system"	
4.0	***Students will be able to*:** • Discover, connect, and explain the cause and effect matter and energy factors the drive spontaneous electrochemical reduction-oxidation reactions but also limit non-spontaneous electrochemical reduction-oxidation reactions • Build and balance reduction-oxidation equations using reaction descriptions and with consideration for the Law of Conservation of Matter
3.0	***Students will be able to*:** • Predict whether specific electrochemical reactions will be spontaneous or non-spontaneous using knowledge of bonding and periodic table properties • Deduce factors that contribute to the rate at which electrochemical reactions convert reactants into products during reduction-oxidation changes
2.0	***Students will be able to:*** • Recognize oxidation and reduction in reactions through writing half-reactions and assigning oxidation numbers to atoms and molecules • Label reactants as oxidizing agents or reducing agent when provided with balanced redox equation examples ***Students will recognize and recall specific vocabulary, including:*** Oxidation, Reduction, Oxidation State, Half Reaction, Oxidizing Agent, Reducing Agent
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English Language Learners	Coordinate with ELL advisors to modify activities where appropriate

	http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
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Mathematics -

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MP.4 Model with mathematics. (HS-PS1-4), (HS-PS1-8)

HSN-Q.A.1 Use units to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.2 Define appropriate quantities for descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5),

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