Chemistry Honors Cover Page

Content Area: **Science**
Course(s): **Chemistry Honors**
Time Period:
Length:
Status: **Not Published**

Chemistry Honors
Sayreville War Memorial High School 6 Credits
Full Year

Curriculum Revised: September 2022

Table of Contents:

Statement of Purpose

Chemistry Honors is designed to develop students as independent, critical thinkers who can apply their understanding of chemical theory and concepts to model real world situations. Students will engage in scientific discourse and identify and research areas of technological and environmental concern. Students will learn how to apply appropriate scientific techniques and principles in making responsible decisions. The coursework is designed for the development of student-centered and inquiry-based lessons with the infusion of science literacy.

Summary of the Course:

Chemistry Honors encompasses the quantitative and qualitative study of matter and its changes. The course provides the skills, concepts, and knowledge necessary to answer extended thinking questions. Multiple strategies, technologies, and resources are utilized to transmit and transform information. Various methods are utilized to assess student knowledge and understanding of the material. Students will develop critical thinking skills through a combination of authentic laboratory experiences, problem solving, data collection, and strategic thinking. Students will learn how to utilize technology to analyze and present data. The course is aligned to the New Jersey Core Curriculum Content Standards for Science as well as the three dimensions of the Next Generation Science Standards. All learning styles are addressed through instructional methods and assessments that incorporate scientific reading, writing, and computation.

In order to demonstrate a cohesive and complete implementation plan the following general suggestions are provided:

- The use of various formative assessments are encouraged in order to provide an ongoing method of determining the current level of understanding the students have of the material presented
- Homework, when assigned, should be relevant and reflective of the current teaching taking place in the classroom
- Organizational strategies should be in place that allow the students the ability to take the information gained in the classroom and put it in trms that are relevant to them and their learning
- Instruction should be differentiated to allow students the best opportunity to learn
- Assessments should be varied and assess topics of instruction delivered in class
- Modifications to the curriculum should be included that address students with Individualized Education Plans (IEPs), English Language Learners (ELL), and those requiring other modifications (504 plans)

Unit 1 - Introduction to Chemistry

Content Area: **Science**
Course(s): **Chemistry Honors**
Time Period: **September** Length: **5 weeks**
Status: **Not Published**

Summary of the Unit

This unit introduces students to the requisite knowledge and laboratory techniques that must be applied to be successful in the course. Topics include a basic understanding of what the study of chemistry entails, the scientific method, and the quantitative analytical skills necessary to problem solve throughout the course

Enduring Understandings

- Following safety procedures, using personal protective equipment, and selecting the appropriate equipment or tools will reduce the risk of injury
- Planning, organizing, and analyzing data are essential components of solving problems.
- Chemistry is the study of matter and all changes it undergoes.
- Everyday occurrences of changes in matter are related to energy transfer.
- Substances are classified based on their properties, which is directly related to their atomic makeup.

Essential Questions

- What does Safety First mean and how do we apply it in the chemistry laboratory?
- How do we organize and analyze empirical data?
- What is chemistry and why is it important in daily life?
- What ways do we classify substances and what dictate their classification?
- Why is quantitative analysis important in the study of chemistry?

Summative Assessment and/or Summative Criteria

- Students will be able to use their learning of safety and lab procedures to make informed decisions when selecting and using equipment or tools.
- Students will be able to transfer their learning of the scientific method and data analysis to solve problems and identify sources of error
- Students will be able to use their learning to analyze and communicate how the main components of chemistry, matter, and energy transfer, affect all components of their lives
- Students will be able to accurately measure chemical quantities and communicate those measurements inn appropriate units

This will be demonstrated on performance-based assessments, projects, laboratory assignments, traditional assessments, and quarterly examinations.

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources (including, but not limited to the following sites):

- American Association for the Advancement of Science: http://www.aaas.org/programs
- American Chemical Society: http://www.acs.org/content/acs/en/education.html
- Concord Consortium: Virtual Simulations: http://concord.org/
- International Technology and Engineering Educators Association: http://www.iteaconnect.org/
- National Earth Science Teachers Association: http://www.nestanet.org/php/index.php
- National Science Digital Library: https://nsdl.oercommons.org/
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: http://www.naaee.net/

- Phet: Interactive Simulations https://phet.colorado.edu/
- Science NetLinks: http://www.aaas.org/program/science-netlinks

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmarks/Assessments	Standards
What is Chemistry? 2 days	Identify the five traditional areas of chemistry Identify current areas of research in chemistry and their practical applications	Slides Presentation Students research current advancements in different areas of science that incorporates these five areas of chemistry	Research article summary/discussion	HS-PS1-3
The Scientific Method & Laboratory Safety 3 days	Identify laboratory equipment and its uses Identify and implement safe laboratory procedures Identify the steps of the scientific method and apply them to solve practical problems inside and outside of the laboratory	Problem Set - Students use the steps of the scientific method in order to solve teacher-created problems Equipment Scavenger Hunt - Students identify lab equipment and their location in the laboratory Myth Busters- Students watch a segment of the TV show and identify which steps of the scientific method were utilized and which were skipped, as well as the laboratory and safety equipment used	Antifreeze Lab - Students analyze a table of experimental data that was collected to solve a problem and present it using the appropriate graph after determining the correct equipment and procedure for its collection. Students also draw inferences from the data and explain possible sources of error.	HS-PS1-3

Data Collection & Analysis 10 days	Analyze data and interpret its meaning, identifying any sources of error Display data using the appropriate graph Appropriately measure quantities using the correct tools and units Convert units of scientific measurement Convert molar quantities	Graphing Data Activity Students collect and display various types of data using different types of graphs and analyze the findings Problem Set - Students use Dimensional Analysis to convert between units and solve practical problems Mole Conversion Activity - Students use dimensional analysis to convert between molar quantites after taking measurements in the lab	Antifreeze Lab - Students analyze a table of experimental data that was collected to solve a problem and present it using the appropriate graph after determining the correct equipment and procedure for its collection. Students also draw inferences from the data and explain possible sources of error.	HS-PS1-3
Classification of Matter 3 days	Identify classifications of matter (element, compound, homogenous vs. heterogeneous mixtures) Differentiate properties of matter as intensive vs. extensive Differentiate samples of purpose of classification Separate matter based on differences in their physical and	Classifying matter activity Students must classify matter and draw conclusions about their properties	Separation of Mixtures Lab Students design and carry out a procedure to separate a complex mixture Chemical & Physical Changes Lab Students carry out a large number of procedures in the lab and identify whether they resulted in a chemical or physical change and explain their rationale for their decision.	HS-PS1-3 HS-PS2-3

	chemical properties Identify and differentiate chemical and physical changes			
States of Matter due to Energy Transfer 2 days	Explain that the state of matter is directly related to the energy of its particles applying the Kinetic Theory of matter	Graphing Activity – Students create heating curve of water from solid to gas	Graphing Activity analysis and compare it to another substance	HS-PS1-3 HS-PS2-3

SCI.HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
SCI.HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

Suggested Modifications for Special Education, ELL and Gifted Students

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

- Internet for up-to-date resources such as journal articles (ex. Newsela, Actively Learn) and simulations (ex. YouTube, Discovery Education, CK12, PheT)
- Education focused websites, including the Google Platform, to provide group forums to discuss topics
- Online programs (ex. such as Kahoot, EdPuzzle, Quizziz, PearDeck) to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

Career Readiness, Life Literacies, and Key Skills:

- All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

Mathematics

- Use units as a way 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.
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Engineering

- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Language Arts

- Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- Analyze the relationships among concepts in a text, including relationships among key terms.
- 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.
- Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- 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.
- Draw evidence from informational texts to support analysis, reflection, and research.

LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.WHST.9-10.7	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.
LA.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
LA.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.
MA.N-Q.A.1	Use units as a way 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.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).

Unit 2 - Structure & Properties of Matter

Content Area: **Science**
Course(s): **Chemistry Honors**
Time Period: **October**
Length: **4 weeks**
Status: **Not Published**

Summary of the Unit

In this unit of study, students use investigations, simulations, and models to make sense of the substructure of atoms and to provide more mechanistic explanations of the properties of substances. Chemical reactions, including rates of reactions and energy changes, can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms. Students are able to use the periodic table as a tool to explain and predict the properties of elements. Students are expected to communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. The crosscutting concepts of structure and function, patterns, energy and matter, and stability and change are called out as the framework for understanding the disciplinary core ideas. Students use developing and using models, planning and conducting investigations, using mathematical thinking, and constructing explanations and designing solutions. Students are also expected to use the science and engineering practices to demonstrate proficiency with the core ideas.

Enduring Understandings

- In the universe, atoms are the fundamental building blocks of all matter
- Atoms can be unstable and emit radiation
- Electron movement can be explained by the duality of particles and waves
- Modern atomic theory suggests that electrons may be located in regions of high probability
- The placement of elements on the periodic table is based on specific properties and characteristics of elements, which follow a pattern when organized in order of increasing atomic number.

Essential Questions

- What does the subatomic structure of a substance predict about its properties?
- What does the properties of a substance tell me about its subatomic makeup?
- What does an element’s placement on the periodic table tell me about its subatomic structure and chemical and physical properties?

Summative Assessment and/or Summative Criteria

- Given an element from the periodic table, students will be able to predict atomic structure and electron arrangement
- Students will be able to explain the placement of elements on the periodic table and predict patterns in chemical and physical properties

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources (including, but not limited to the following sites):

- American Association for the Advancement of Science: http://www.aaas.org/programs
- American Chemical Society: http://www.acs.org/content/acs/en/education.html
- Concord Consortium: Virtual Simulations: http://concord.org/
- International Technology and Engineering Educators Association: http://www.iteaconnect.org/
- National Earth Science Teachers Association: http://www.nestanet.org/php/index.php
- National Science Digital Library: https://nsdl.oercommons.org/
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: http://www.naaee.net/
- Phet: Interactive Simulations https://phet.colorado.edu/
- Science NetLinks: http://www.aaas.org/program/science-netlinks

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmarks/Assessments	Standards
Atomic Structure 12 days	Solve for non-routine problems on isotopes, calculating numbers of subatomic particles Formulate electron configurations and Aufbau diagrams of elements and ions by applying the Aufbau principle, Hund's rule, and the Pauli exclusion principle Apply knowledge of atomic structure to predict chemical behavior	Beanium LAB- Calculate the atomic mass of a fictional element by analyzing its isotope make-up Drawing Diagrams Activity- Students draw Aufbau diagrams and write electron configurations (long-hand & noble gas core)	Common written asessment in which the students demonstrate their mastery of the general objectives	HS-PS1-1 HS-PS1-8 HS-PS3-5
Periodic Table 8 days	Connect the placement of elements on the periodic table to each other and prove the various trends Analyze patterns in the periodic trends of atomic size, ionization energy, and electronegativity Determine the identity of missing elements based upon the properties of other elements in the group	Operation Periodic Table Lab Students create a periodic table from a list of fictional elements Graphing Periodic Trends Lab Students research and use Google sheets to graph values for atomic size, ionization energy, and electronegativity	Common written asessment in which the students demonstrate their mastery of the general objectives	HS-PS1-1 HS-PS1-3 HS-PS2-6

SCI.HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
SCI.HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
SCI.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
SCI.HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
SCI.HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Suggested Modifications for Special Education, ELL and Gifted Students

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

- Internet for up-to-date resources such as journal articles (ex. Newsela, Actively Learn) and simulations (ex. YouTube, Discovery Education, CK12, PheT)
- Education focused websites, like Google Platform, to provide group forums to discuss topics
- Online programs (ex. such as Kahoot, EdPuzzle, Quizziz, PearDeck) to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

Career Readiness, Life Literacies, and Key Skills

- All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

Mathematics

- Determine a level of accuracy appropriate to limitations on measurement when reporting quantities representing periodic trends for main group elements based on patterns of electrons in the outermost energy level of atoms.
- Considering the outermost energy level of atoms, define appropriate quantities for descriptive modeling of periodic trends for main group elements based on patterns of electrons in outermost energy levels.
- Use units as a way to understand the outcome of a simple chemical reaction involving main group elements based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. Choose and interpret units consistently in chemical reactions.
- Determine and interpret the scale and origin in graphs and data displays representing patterns of chemical properties, outer electron states of atoms, trends in the periodic table, and patterns of chemical properties.
- Determine a level of accuracy appropriate to limitations on measurement when reporting quantities of simple chemical reactions.
- Use units as a simple way to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. Choose and interpret units comparing the structure of substances at the bulk scale to infer the strength of electrical forces between particles. Choose and interpret the scale and origin in graphs and data displays comparing the structure of substances and the bulk scale and electrical forces between particles.
- Determine a level of accuracy appropriate to limitations on measurements of the strength of electrical forces between particles.

English Language Arts/Literacy

- Translate information from the periodic table about the patterns of electrons in the outermost energy level of atoms into words that describe the relative properties of elements.
- Write an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties of elements using well-chosen, relevant, and sufficient facts; extended definitions; and concrete details from students' own investigations, models, theories, simulations, and peer review.
- Develop and strengthen explanations for the outcome of a simple chemical reaction by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties of elements.
- Draw evidence from informational texts about the outermost electron states of atoms, trends in the periodic table, and patterns of chemical properties of elements to construct a rigorous explanation of the outcome of a simple chemical reaction.
- Cite specific textual evidence comparing the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- Conduct short as well as more sustained research projects to compare the structure of substances at the bulk scale and use this research to infer the strength of electrical forces between particles.
- Gather applicable information from multiple reliable sources to support the claim that electrical forces between particles can be used to explain the structure of substances at the bulk scale.
- Develop evidence comparing the structure of substances at the bulk scale and the strength of electrical forces between particles.

LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
LA.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.
MA.N-Q.A.1	Use units as a way 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.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

Unit 3 - Bonding & Chemical Reactions

Content Area: **Sample Content Area**
Course(s): **Chemistry Honors** Time
Period: **2nd Marking Period**
Length: **9 weeks**
Status: **Not Published**

Summary of the Unit

In this unit of study, students develop and use models, plan and conduct investigations, use mathematical thinking, and construct explanations and design solutions as they develop an understanding of the substructure of atoms and to provide more mechanistic explanations of the properties of substances. Chemical reactions can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms. Students also apply an understanding of the process of optimization and engineering design to chemical reaction systems. The crosscutting concepts of patterns, energy and matter, and stability and change are the organizing concepts for these disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models, planning and conducting investigations, using mathematical thinking, and constructing explanations and designing solutions.

Enduring Understandings

- The type of chemical bond an element forms can be linked to its valence electrons and its location on the periodic table, as that explains its mechanism to satisfying the Octet Rule
- A compound's structure and shape can be determined through an understanding of the interactions between valence electrons while intermolecular forces determine its properties
- Chemical equations are used to represent chemical reactions and show that mass can neither be created nor destroyed
- There are different types of chemical reactions that can be observed in everyday life
- Mass and mole ratios between different compounds in a reaction can answer quantitative questions between reactants and products

Essential Questions

- Where do atoms go during a chemical reaction?
- Why do elements form chemical bonds and how does this bonding determine a compound's properties?
- Why must the mass of reactants equal the mass of products in chemical reactions?
- What characteristics are used to classify chemical reactions?
- How can we quantify something we can't see? How do we know we are right?

Summative Assessment and/or Summative Criteria

- Differentiate between ionic, covalent, and metallic bonds, predict bond formation, and accurately represent a compound using chemical formulas, proper nomenclature, and shape
- Construct Lewis structures and predict molecular shape
- Compare and contrast intermolecular forces and determine when they are present
- Develop a logical argument as to how delocalized electrons explain various properties of metals
- Apply the law of conservation of mass to write balanced chemical equations
- Cite evidence of a chemical reaction
- Classify chemical reactions and predict products, writing balanced chemical equations

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources (including, but not limited to the following sites):

- American Association for the Advancement of Science: http://www.aaas.org/programs
- American Chemical Society: http://www.acs.org/content/acs/en/education.html
- Concord Consortium: Virtual Simulations: http://concord.org/
- International Technology and Engineering Educators Association: http://www.iteaconnect.org/
- National Earth Science Teachers Association: http://www.nestanet.org/php/index.php
- National Science Digital Library: https://nsdl.oercommons.org/
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: http://www.naaee.net/
- Phet: Interactive Simulations https://phet.colorado.edu/
- Science NetLinks: http://www.aaas.org/program/science-netlinks

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmarks/Assessments	Standards
Chemical Bonding 20 days	Utilize learning of atomic structure to predict the formation and characteristics of ionic, covalent, and metallic bonds Differentiate between ionic, covalent, and metallic bonds in terms of valence	Practice worksheets on ionic charges, using the criss-cross rule, and ionic, covalent, and acid nomenclature and formula- writing Graphic organizer differentiating types of bonding	Precipitate Lab – students apply knowledge of ionic bonding to predict precipitates and write a formal lab report Formal Bonding Exam	HS-PS1-1 HS-PS1-3
	electrons, and be able to analyze a list of formulas or names Predict oxidation numbers based on location on periodic table Apply concepts of ionic and covalent bonding to effectively represent compounds using chemical formulas and names (including binary and oxyacids)	VSEPR Theory Lab – students predict molecular shape and draw lewis structures as well as construct 3D representatations of molecules		

	Compare and contrast different intermolecular forces and recognize in which compounds they are present Develop a logical argument as to how delocalized electrons explain various properties of metals Construct Lewis structures and predict molecular shape Differentiate between the three bond types, predict bond formation, and accurately represent a compound using a chemical formula, proper nomenclature, and shape			

Writing and Balancing Chemical Equations 10 days	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction Use mathematical concepts to communicate the proportional relationships between masses of atoms in the reactants and products and the translation of these relationships to the macroscopic scale, using the mole as the conversion from the atomic to the macroscopic scale. Use the fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, to describe and predict chemical reactions.	RAP method – students use atom inventories to balance reactions on practice worksheets Students complete chemical reactions and predict the products Balancing Race – students race to accurately balance as many equations as they can in a given amount of time	Precipitate lab – students apply knowledge of precipitates to write full equations in lab report Activity Series Lab – students observe numerous single replacement reactions and use their data to create an activity series Chemical Reaction Lab - students mix different substances in the lab, observe the reaction, and predict the products of the reaction, writing complete balanced equations, in a formal report	HS-PS1-1 HS-PS1-7
Stoichiometry 15 days	Apply knowledge of elements and compounds to determine the amounts of reactants and products in chemical reactions Determine the	Students convert chemical quantities on practice worksheets and practical laboratory problems S'mores Stoichiometry – students use s'mores to demonstrate the concept of limiting and excess reagent	Percent Composition of Gum lab – students develop a procedure to determine the percent of sugar in gum and then carry it out in lab Stoichiometry Practice Problem Set – students complete a formal	HS-PS1-1 HS-PS1-7

	limiting and excess reagent and determine the amounts of each Calculate the empirical formula of a compound		problem set to demonstrate mastery of the stoichiometric concepts Formal Stoichiometry Assessment	

SCI.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
SCI.HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
SCI.HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Suggested Modifications for Special Education, ELL and Gifted Students

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

- Internet for up-to-date resources such as journal articles (ex. Newsela, Actively Learn) and simulations (ex. YouTube, Discovery Education, CK12, PheT)
- Education focused websites, like Google Platform, to provide group forums to discuss topics
- Online programs (ex. such as Kahoot, EdPuzzle, Quizziz, PearDeck) to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

Career Readiness, Life Literacies, and Key Skills

- All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

English Language Arts/Literacy

- Construct short as well as more sustained research projects to answer how to increase amounts of products in a chemical system. Synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Mathematics

- Represent an explanation that atoms, and therefore mass, are conserved during a chemical reaction symbolically and manipulate the representing symbols. Make sense of quantities and relationships about the conservation of atoms and mass during chemical reactions symbolically and manipulate the representing symbols.
- Use units as a way to understand the conservation of atoms and mass during chemical reactions; choose and interpret units consistently in formulas representing proportional relationships between masses of atoms in the reactants and products and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale; choose and interpret the scale and origin in graphs and data displays representing the conservation of atoms and mass in chemical reactions.
- Define appropriate quantities for the purpose of descriptive modeling of the proportional relationships between masses of atoms in the reactants and products and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities representing proportional relationships between masses of atoms in the reactants and products and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale

MA.K-12.2	Reason abstractly and quantitatively.
LA.WHST.9-10.7	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.
MA.K-12.4	Model with mathematics.
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
LA.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.
MA.N-Q.A.1	Use units as a way 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.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).

Unit 4 - Chemical Systems

Content Area: **Science**
Course(s): **Chemistry Honors**
Time Period: **3rd Marking Period**
Length: **10 weeks**
Status: **Not Published**

Summary of the Unit

In this unit of study, students explore different types of chemical systems with an emphasis placed on energy transfer and the relationship between reactants and products. Understanding the flow of energy through systems as well as the equilibria reached between components of a reaction is important to understand chemistry on a large scale. Focus will be put on chemical systems in the environment and how they affect climate. Students apply mathematical concepts to develop evidence to support explanations of the interactions of reactants and products and develop models to communicate these explanations. Students are expected to develop and use models, plan and conduct investigations, use mathematical thinking, and construct explanations and design solutions as they demonstrate proficiency with the disciplinary core ideas.

Enduring Understandings

- The behavior of gases is dependent on Kinetic Molecular Theory and can be predicted by mathematical relationships between pressure, temperature, volume, and molar quantities.
- Concentration of a solution is an important chemical quantity and maximum concentration, or solubility, is affected by many different factors
- Everyday substances can be analyzed both qualitatively and quantitatively to determine if they are an acid or a base
- Energy is conserved during all chemical and physical processes
- All reactions work towards equilibrium
- Reaction rates are influenced by several factors

Essential Questions

- How does Kinetic Molecular theory explain the behavior of all matters, including gases?
- What factors affect solubility of a solution?
- What are the qualitative and quantitative differences between acids and bases?
- How is energy involved in endothermic and exothermic processes?
- How does collision theory affect reaction rate and how do chemical reactions maintain equilibrium?

Summative Assessment and/or Summative Criteria

- Explain and predict the behavior of gases under experimental conditions
- Prove solubility of a substance and interpret its solubility using a solubility curve
- Identify a substance as an acid or a base using multiple evidences and evaluate the function based on specific properties
- Relate the law of conservation of energy to chemical and physical process, both in the lab and everyday life
- Quantitatively and qualitatively predict changes in equilibrium based on Le Chatelier's principle

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources (including, but not limited to the following sites):

- American Association for the Advancement of Science: http://www.aaas.org/programs
- American Chemical Society: http://www.acs.org/content/acs/en/education.html
- Concord Consortium: Virtual Simulations: http://concord.org/
- International Technology and Engineering Educators Association: http://www.iteaconnect.org/
- National Earth Science Teachers Association: http://www.nestanet.org/php/index.php
- National Science Digital Library: https://nsdl.oercommons.org/
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: http://www.naaee.net/
- Phet: Interactive Simulations https://phet.colorado.edu/
- Science NetLinks: http://www.aaas.org/program/science-netlinks

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmarks/Assessments	Standards
Thermochemistry – the Energy of Phase Changes & Reactions 8 days	Calculate the amount of heat absorbed or released while heating an object Calculate enthalpy of a reaction Relate the law of the conservation of energy to chemical and physical processes in everyday life Explain the greenhouse effect and how it is exacerbated by human interaction with the environment	Thermochemistry practice problems Hess's law problem set Diagramming energy transfers Greenhouse effect demonstration	Calorimetry lab – students create a calorimeter to measure the heat content in a piece of metal Heating curve lab – students create a heating curve for water Thermochemistry Assessment	HS-PS3-1
Kinematics of Gases 7 days	Analyze data and graph representing the relationships between pressure, volume, and temperature of a gas	Practice Problem Set – students practice practical laboratory problems and try to identify instances of gas laws in daily life	Popcorn Lab – students develop a procedure to determine the amount of pressure required for a kernel of popcorn to pop and then carry it out in the laboratory	HS-PS3-1 HS-PS1-5

	Explain how the Kinetic Molecular Theory and the behavior of gases are related to the changes observed in pressure, volume, and temperature	SCUBA Lab – students research the science of SCUBA and apply their knowledge of the gas laws to explain it	Formal Gases Assessment	
Solutions 15 days	Differentiate between concentrated and dilute solutions and calculate concentration Explain how to make solutions and then make them in the lab Demonstrate that a substance is an acid or a base through multiple indicators such as formula of the compound, pH calculations, chemical and physical properties of the compound, and analysis with litmus and/or pH	Molarity Calculation practice problems/dilutions problems Solution stoichiometry problems Acid/base mathematical and conceptual problems Acid/Base Classification activity	Making a solution LAB – Students prepare a stock solution and dilute it Solution Stoichiometry Challenge – students are given a practical laboratory problem to solve that involves percent yield, stoichiometry, and solutions Titration Lab - Students will determine the molarity of an unknown base using a strong acid	HS-PS3-1 HS-PS1-5

	paper			
Reaction Rates & Equillibrium 10 days	Describe how factors such as concentration, temperature, surface area, and agitation affect the rate of a reaction Describe how a catalyst affects the rate of a reaction Examine a potential energy diagram and determine the number of intermediates and whether a reaction is endothermic or exothermic Write Keq expressions and determine whether the reaction factors the reactants or products Predict equilibrium shifts utilizing Le Chatelier's Principle	Diagram effect of a catalyst Practice problems – equilibrium constants, precipitate formation, solubility product constants, Weak Acids & Bases, Buffer Systems, etc. Le Chatelier's principle predictions worksheet Carbon Cycle Activity - Students explain how the carbon cycle is effected (equillibrium shifts) due to man's impact on atmospheric CO_2 levels Ocean Acidification Activity - students research the chemistry of the ocean and explain what the impact of increased atmospheric CO_2 impacts the ocean	Keq/Ksp problem set Le Chatelier's Lab – Students predict and demonstrate the equilibrium shift that results from manipulation of reaction parameters Formal Reaction Rates & Equillibrium Assessment	HS-PS1-2 HS-PS1-7 HS-ESS3-6 HS-ESS3-4

SCI.HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
SCI.HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
SCI.HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
SCI.HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
SCI.HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
SCI.HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Suggested Modifications for Special Education, ELL and Gifted Students

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

- Internet for up-to-date resources such as journal articles (ex. Newsela, Actively Learn) and simulations (ex. YouTube, Discovery Education, CK12, PheT)
- Education focused websites, like Google Platform, to provide group forums to discuss topics
- Online programs (ex. such as Kahoot, EdPuzzle, Quizziz, PearDeck) to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

Career Readiness, Life Literacies, and Key Skills

- All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

English Language Arts/Literacy

- 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.
- Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- Draw evidence from informational texts to support analysis, reflection, and research.
- 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.

Mathematics

- Model with mathematics.
- Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- Write a function that describes a relationship between two quantities.

MA.A-REI.B	Solve equations and inequalities in one variable
MA.K-12.2	Reason abstractly and quantitatively.
LA.WHST.9-10.7	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.
MA.A-REI.B.4	Solve quadratic equations in one variable.
MA.K-12.4	Model with mathematics.
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
LA.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.
MA.N-Q.A.1	Use units as a way 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.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
MA.A-REI.B.4b	Solve quadratic equations by inspection (e.g., for ² = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).

Unit 5 - Applied Chemistry

Content Area: **Science**
Course(s): **Chemistry Honors**
Time Period: **4th Marking Period**
Length: **6 weeks**
Status: **Not Published**

Summary of the Unit

In this unit of study, students will study chemistry as it applies to other sciences. First, students will study biochemistry and construct explanations for the role of energy in the cycling of matter in organisms. They apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. The crosscutting concept of matter and energy provides students with insights into the structures and processes of organisms. Students are expected to develop and use models, plan and conduct investigations, use mathematical thinking, and construct explanations and design solutions as they demonstrate proficiency with the disciplinary core ideas. Next, energy and matter are studied further by investigating the processes of nuclear fusion and fission that govern the formation, evolution, and workings of the solar system in the universe. Some concepts studied are fundamental to science and demonstrate scale, proportion, and quantity, such as understanding how the matter of the world formed during the Big Bang and within the cores of stars over the cycle of their lives.

Enduring Understandings

- The process of photosynthesis converts light energy to stored energy by converting carbon dioxide plus water into sugars plus released oxygen.
- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within a system.
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another.
- Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles.
- Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.
- Sugar molecules contain carbon, hydrogen, and oxygen: Their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.
- Nuclear processes, including fusion, fission, and radioactive decay of unstable nuclei, involve release or absorption of energy.
- The total number of neutrons plus protons does not change in any nuclear process.
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons are conserved.
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

Essential Questions

- How does photosynthesis transform light energy into stored chemical energy?
- How does cellular respiration result in a net transfer of energy?
- How do elements of a sugar molecule combine with other elements and what molecules are formed?
- Why is fusion considered the Holy Grail for the production of electricity?
- How do stars produce elements?

Summative Assessment and/or Summative Criteria

Students will create a research presentation to explain and analyze current research in an area of applied chemistry

Resources

Board approved textbooks, Teacher resource binder, Student generated resources, Internet web resources (including, but not limited to the following sites):

- American Association for the Advancement of Science: http://www.aaas.org/programs
- American Chemical Society: http://www.acs.org/content/acs/en/education.html
- Concord Consortium: Virtual Simulations: http://concord.org/
- International Technology and Engineering Educators Association: http://www.iteaconnect.org/
- National Earth Science Teachers Association: http://www.nestanet.org/php/index.php
- National Science Digital Library: https://nsdl.oercommons.org/
- National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
- North American Association for Environmental Education: http://www.naaee.net/
- Phet: Interactive Simulations https://phet.colorado.edu/
- Science NetLinks: http://www.aaas.org/program/science-netlinks

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Benchmarks/Assessments	Standards
Organic Chemistry & Biochemistry 15 days	Provide a mechanistic explanation for how photosynthesis transforms light energy into stored chemical energy. Construct an evidence-based model, to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. Illustrate the inputs and outputs of the process of photosynthesis and cellular	Demonstrations Teacher-prepared resources Visual presentations Labs/Experiments	Organic molecule nomenclature and structure assessment Diagram project – energy transfer and photosynthesis Research paper – Current issues in bio- or nuclear chemistry	HS-PS1-2 HS-PS1-4 HS-LS1-5 HS-LS1-7 HS-LS1-6

	respiration Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large, carbon-based molecules.			
Nuclear Chemistry 15 days	Develop models based on evidence to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. Use simple qualitative models based on evidence to illustrate the scale of energy released in nuclear processes relative to other kinds of transformations.	Graphic organizer that compares, contrasts, and diagrams fusion, fission, and radioactive decay Diagram life cycle of a star Radioactive decay practice problems	Nuclear chemistry assessment Research paper – Current issues in bio- or nuclear chemistry	HS-PS1-8 HS-ESS1-3 HS-ESS1-1 HS-ESS1-2 HS-ESS1-6

	Develop models based on evidence to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of alpha, beta, and gamma radioactive decays. Communicate scientific ideas in multiple formats (including orally, graphically, textually, and mathematically) about the way stars, over their life cycles, produce elements. Communicate scientific ideas about how in nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.			

SCI.HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
SCI.HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
SCI.HS-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
SCI.HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
SCI.HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
SCI.HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
SCI.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
SCI.HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
SCI.HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
SCI.HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Suggested Modifications for Special Education, ELL and Gifted Students

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide English Language Learners students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Suggested Technological Innovations/Use

- Internet for up-to-date resources such as journal articles (ex. Newsela, Actively Learn) and simulations (ex. YouTube, Discovery Education, CK12, PheT)
- Education focused websites, like Google Platform, to provide group forums to discuss topics
- Online programs (ex. such as Kahoot, EdPuzzle, Quizziz, PearDeck) to assess and/or poll students before, during, and after unit lesson

Cross Curricular/21st Century Connections

Career Readiness, Life Literacies, and Key Skills

- All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

English Language Arts/Literacy

- Make strategic use of digital media in presentations to enhance understanding of how photosynthesis transforms light energy into stored chemical energy.
- Use digital media in presentations to enhance understanding of the inputs and outputs of the process of cellular respiration.
- Cite specific textual evidence to support how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large, carbon-based molecules.
- Use evidence from multiple sources to clearly communicate an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large, carbon- based molecules.
- Revise an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large, carbon-based molecules by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant.
- Draw evidence from informational texts to describe how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large, carbon-based molecules.

Mathematics

- Reason abstractly and quantitatively.
- Model with mathematics.
- Use units as a way 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
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Interpret expressions that represent a quantity in terms of its context.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

MA.K-12.2	Reason abstractly and quantitatively.
LA.WHST.9-10.7	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.
MA.K-12.4	Model with mathematics.
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
LA.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.
MA.N-Q.A.1	Use units as a way 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.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).