SCN214 Chemistry Honors (BA-10/20/2016)

Last Updated: Wednesday, October 4, 2017 by Rachel Villanova
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STATEMENT OF PURPOSE

Chemistry I Honors is designed to challenge and stimulate the intellect of the highly motivated science student in grades 10, 11, or 12. The course enables the students to learn the principles of chemistry through experimentation, observation, and problem-solving. Descriptive and theoretical concepts weave current social issues and career opportunities into the program. The course provides the tools needed to function as a chemically literate citizen.

Since a strong knowledge and understanding of mathematic principles is required to be successful in chemistry, students need to be proficient in exponential notation, significant figures, dimensional analysis, plotting graphs, reading graphical information, and using algebraic functions to solve problems.

The students will obtain a broad overview of the principles of chemistry. They will learn about the chemical reactivity of elements and compounds, convey the importance of a field that boasts a lively history along with a highly dynamic future, as students gain an understanding of the fragile chemical world we live in.

Students will acquire valuable skills, which can be used for further study at the college level, for employment, and/or personal use. Separately we assess students to gauge progress and inform instruction. For students in grades 9 through 12 are administered in the form of a midterm and final exam for full year courses. *Special Note: Only final exams are administered at the end of quarter courses and semester courses.

RATIONALE

Chemistry I Honors is a full year course open to sophomores, juniors and seniors who exhibit highly proficient math skills and who are seeking a challenging scientific experience. This course is aligned with the New Jersey Student Learning Standards for Science (NJSLS), the New Jersey Student Learning Standards for Technology (NJSLS for Tech) and the 21st century Career Ready Practices. Using a variety of materials and resources, the course reinforces and augments the educational skills of scientific interpretation, problem- solving, critical analysis, and technology research. District initiatives in assessment and critical reading and writing are also being emphasized.

General Goals:

- learn the structure and arrangement of the elements in the periodic table in order that their properties might be presented and predictions made.
- learn the principles of chemical bonding to derive the 3-D structures of molecules.
- learn the behavior of the states of matter.
- learn the principles of reactivity including the rates of chemical processes along with the factors controlling the rates.
- learn about acid and base reactions.
- learn how thermodynamics can be used to tie together chemical equilibrium.
- learn how environmental issues are tied to the field of chemistry.
- develop a critical sense of wonder and curiosity about scientific and technological endeavors.
- use science and technology to acquire new knowledge and solve problems, so that they may improve the quality of their own lives and the lives of others.
- develop critical thinking skills with which to address science-related societal, economic, ethical and environmental issues.
- build a solid foundation of scientific skill and knowledge that will provide opportunities for them to pursue progressively higher levels of study, for science-related occupations, and engages them in science-related activities appropriate to their interests and abilities.

THE LIVING CURRICULUM

Curriculum guides are designed to be working documents. Teachers are encouraged to make notes in the margins. Written comments can serve as the basis for future revisions. In addition, the teachers and administrators are invited to discuss elements of the guides as implemented in the classroom and to work collaboratively to develop recommendations for curriculum reforms as needed.

AFFIRMATIVE ACTION

During the development of this course of study, particular attention was paid to material, which might discriminate on the basis of sex, race, religion, national origin, or creed. Every effort has been made to uphold both the letter and spirit of affirmative action mandates as applied to the content, the texts and the instruction inherent in this course.

MODIFICATIONS AND ADAPTIONS: For guidelines on how to modify and adapt curricula to best meet the needs of all students, instructional staff should refer to the Curriculum Modifications and Adaptations (http://njcdd.org/wp-content/uploads/2016/08/tools-teacherspart2.pdf). Instructional staff of students with Individualized Education Plans (IEPs) must adhere to the recommended modifications outlined in each individual plan.

EVALUATION / ASSESSMENT

MARKING PERIOD GRADES

Long and Short Term Assessments which may include: 90%

- Tests, quizzes, and/or worksheets
- Authentic assessments
- Technology applications
- Projects, reports, presentations
- Laboratory investigations
- Data Analysis
- Analysis of assigned readings

Daily Assessments which may include: 10%

- Active engagement in class activities
- Demonstration of knowledge and understanding of course material
- Skills and safety practices during lab investigations
- Do Now/Exit Questions
- Homework

Final Grade – Full Year Course

Full Year Course

- Each marking period shall count as 20% of the final grade (80% total).

The midterm assessment will count as 10% of the final grade, and the final assessment will count as 10% of the final grade.

Benchmark assessments for students in grades 9 through 12 are administered in the form of a midterm and final exam for full year courses. *Special Note: Only final exams are administered at the end of quarter courses and semester courses

COURSE PROFICIENCIES

Course: **SCN214** Title: **CHEMISTRY I HONORS**

In accordance with district policy as mandated by the New Jersey Administrative Code and the New Jersey Student Learning Standards and Common Core State Standard Connections, the following are proficiencies required for the successful completion of the above-named course.

The student will:

1. demonstrate the ability to work collaboratively and safely conduct chemical investigations.
2. understand the power of observation and how it is used to formulate scientific laws and theories.

3. demonstrate an understanding of scientific measurement in Chemistry.
4. identify the location, charge, and relative mass of each subatomic particle (electron, neutron, proton).
5. describe the development of the modern atomic theory, including basic knowledge of key scientists and their experiments.
6. understand products of nuclear decay. Explain the basic difference between a fission reaction and a fusion reaction.
7. discuss the concept of half-life and research the half-lives of various radioactive elements as a means to discuss the long-term effects of radioactive elements.
8. discuss and explain the contributions of Mendeleev and Moseley in the creation and development of the modern periodic table.
9. identify and describe the arrangement of elements on the periodic table.
10. predict the trends in metallic character, atomic radius, first ionization energy, reactivity and electronegativity within a group of period of elements.
11. predict and write the electron configuration for selected elements; (long and noble gas) for an element given its position in the periodic table.
12. describe the 7 types of electromagnetic radiation and be able to compare them in terms of relative wavelength, frequency, and energy.
13. predict and explain the number and types of bonds formed (i.e. ionic, polar covalent, covalent, metallic) by an element and between elements as determined by valence electrons and electronegativity.
14. name and write chemical formulas for ionic compounds, and molecular compounds. Understand that transitions metals have multiple oxidation states.
15. model the molecular structure of various pure substances, and be able to predict: VSEPR geometry hybridization of central atom polarity of the molecule.
16. identify the strongest intermolecular forces present in a covalent compound and use this to explain the relative boiling/melting points of selected covalent compounds.
17. define matter, differentiate between solid, liquid, and gas, and read and interpret a phase diagram.
18. differentiate between pure substances/mixtures, elements/compounds, homogeneous/heterogeneous mixtures.
19. calculate density given mass and volume, or calculate relationships between density, mass, and volume.
20. demonstrate an understanding of Avogadro's number and the mole in terms of mass, particle number and volume as it relates to atoms and molecules.
21. calculate the percent composition of each element in a compound. Determine/calculate the percent of water in a hydrate.
22. use percent composition data to calculate the empirical formula of a compound. Use molar mass data to then determine the molecular formula of the compound.
23. classify, write, and balance selected chemical equations, including translating a word equation into a chemical equation using symbols and formulas.
24. qualitatively differentiate between an endothermic and exothermic reaction.
25. demonstrate their understanding of stoichiometric relationships in given chemical reactions.
26. classify reactants of redox reactions as substance oxidized, substance reduced, oxidizing agent, and/or reducing agent.
27. describe how temperature, concentration, surface area, catalyst, and inhibitor affect the rate of a reaction.
28. interpret a potential energy diagram.
29. explain fundamental properties of ideal gases based on kinetic molecular theory.
30. explain how pressure, temperature, volume, number of particles and intermolecular forces affect the behavior of gas.

31. given a set of conditions, use the most appropriate mathematical equation to calculate a change in P, T, V, or n.
32. given a set of conditions, use the ideal gas law to solve for P, T, V, n. Calculate the quantity (grams, moles, particles, volume) of product from given reactants or vice versa (Gas Stoichiometry).
33. calculate the partial pressures of a gas mixture.
34. apply Graham's law to perform calculations involving movement of gases.
35. explain why real gases deviate from ideal gases. Explain the conditions under which gases behave most ideally and least ideally.
36. understand the nature of energy as it related to chemical reactions.
37. Use specific heat capacity to explain changes in temperature of a substance..
38. state and understand the second law of thermodynamics.
39. understand the quantitative and qualitative aspects of solution chemistry.
40. identify the use of colligative properties in real-life phenomena.
41. demonstrate a knowledge of the various acid-base definitions.
42. Determine the pH, pOH and molarity of acidic and basic solutions.
43. define and explain dynamic equilibrium.
44. write equilibrium expressions for a chemical reaction, and calculate the equilibrium constant for selected reactions.
45. apply Le Chatelier's principles to determine the direction the equilibrium will shift.

SCN214 Chemistry Honors				
Unit	**Essential Questions**	**Enduring Understanding**	**Suggested Activities**	**Evaluation / Assessment**
Scientific Methodology and Safety *(Week 1, 4 Weeks)*	a) What are the necessary components of a safe Chemistry laboratory experience?	a) Investigation is prominent in any Science course and crucial to the expansion of our knowledge. Safety in these investigations is of critical importance as the materials being used in a Chemistry lab are potentially quite dangerous. A thorough understanding of, and respect for, safety guidelines are vital to a successful Science experience. Safety guidelines are designed to prevent accidents from occurring, and yield quality results.	• Thoroughly review and discuss safety guidelines in a Science classroom. Carefully read and sign a safety contract, keeping a copy in their work-folder for easy reference. • Use the contents of a "black box" to conduct an experiment which forms and tests hypotheses. • Use power of observation and deductive reasoning to determine the internal configuration of a sealed box. • Utilize the Spec 20 to assess how light absorbance and percent transmission is connected to concentration of color. • Create a chromatogram to separate the various colors in an ink sample.	**Oral: Discussion** • thoroughly review and discuss safety guidelines in a Science classroom. Carefully read and sign a safety contract, keeping a copy in their work-folder for easy reference. **Performance: Lab Assignment** use the contents of a "black box" to conduct an experiment which forms and tests hypotheses.

			• Estimate the mass and volume of various lab objects, and then measure the actual quantities. This data will then be collected on the computer and graphed as a comparison of actual vs. estimated value. • Solve a series of problems designed to strengthen their skills and ability to utilize dimensional analysis.	

Standards
NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 11-12
Reading: Science & Technical Subjects
Craft and Structure
NJSLSA.R4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
RST.11-12.4. 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 11–12 texts and topics.
NJSLSA.R6 Assess how point of view or purpose shapes the content and style of a text.
RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
NJ: 2016 SLS: Mathematics
NJ: HS: Num/Quantity
Quantities
HSN-Q.A. Reason quantitatively and use units to solve problems.
HSN-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.
HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
NJ: 2016 SLS: Science

NJ: HS Engineering Design
HS-ETS1 Engineering Design
Performance Expectations

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.

NGSS: Science and Engineering Practices
NGSS: 9-12

Practice 1. Asking questions (for science) and defining problems (for engineering)
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Practice 2. Developing and using models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

Practice 3. Planning and carrying out investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.

Practice 4. Analyzing and interpreting data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Practice 5. Using mathematics and computational thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

Practice 6. Constructing explanations (for science) and designing solutions (for engineering)
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

Practice 7. Engaging in argument from evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. **Practice 8. Obtaining, evaluating, and communicating information** **Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.** Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. 				
Atomic Structure and Nuclear Chemistry *(Week 5, 3 Weeks)*	a) How can one explain the structure, properties, and interactions of matter?	a) The chemical elements are fundamental building materials and all matter can be understood in terms of atoms. b) Each element has characteristic properties.	• In pairs create a KWL chart regarding the structure of the atom and development of atomic theory. • Isotope Lab –pHET Build an Atom or Candy Isotope Lab. • Compose a lab report with written conclusion. • Research desired information using the Internet or written text in order to construct a timeline outlining the scientists and major events involved in the development of the atomic theory. • Explore how many times greater the mass of a copper atom is than a magnesium atom, practice laboratory technique with measuring mass and filtration, locate sources of variation and potential error in the class'	

			experimental results. (Atomic Mass Activity). ● Explore the path marbles take as they roll in a “black box” potentially striking an unseen target. ● Observe video clip of cathode ray tube. Compose a written conclusion explaining the significance of Thomson’s results. ● Identify the number of protons and neutrons in the nucleus before and after nuclear decay. ● Contribute to a class discussion of isotopic mass, isotopes. ● Identify the emitted particles (i.e. alpha, beta, electrons, and gamma) in nuclear decay. ● Model the relationships between fission, fusion, and radioactive decay in terms of the changes in the composition of the nucleus and the energy released during each process. ● Interconvert between the half-life of a nuclide and the amount of time remaining.	

			• Radiometric Dating Lab - http://www.nsta.org/images/news/legacy/scope/0604/jordanradiometrics.pdf -(Use worksheet and/or radiometric dating lab)	

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
NJSLSA.R3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
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.
Craft and Structure
NJSLSA.R4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
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.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.9-10.7. Translate quantitative or technical oinformation 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.
NJ: 2016 SLS: Science
NJ: HS Earth & Space Sciences
HS-ESS1 Earth's Place in the Universe
Performance Expectations

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 in the form of radiation.

HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

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.

NJ: HS Physical Sciences
HS-PS1 Matter and Its Interactions
Performance Expectations

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.

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.

HS-PS3 Energy
Performance Expectations

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.

NJ: HS Engineering Design
HS-ETS1 Engineering Design
Performance Expectations

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
ETS1: Engineering Design
ETS1.C: Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HSETS1-2) (secondary to HS-PS1-6) (secondary to HS-PS2-3)

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP2. Apply appropriate academic and technical skills.

CRP3. Attend to personal health and financial well-being.

CRP4. Communicate clearly and effectively and with reason.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP12. Work productively in teams while using cultural global competence.

The Periodic Table and Trends *(Week 8, 4 Weeks)*	a) How can one explain the structure, properties, and interactions of matter?	a) The valence electrons in an atom play an important role in explaining the properties, reactivity, and stability of an atom. b) The patterns of the Periodic Table are related to the atom's valence electrons, and provides a useful way to organize this information.	• Complete the Alien Periodic Table Activity • Observe, test (conductivity, acid reactivity, magnetism, metal/nonmetal), record and analyze physical and chemical properties of several elements. • Graph data to reveal trends And/or Metal reactivity lab (single replacement type lab) • Demonstrate an understanding of electron configuration by successful manipulation of Electron Configuration Battleship activity. • Complete a worksheet on writing accurate electron configurations • Complete pHET simulation on shapes of orbitals • Complete the Flame test lab. Relate results of the flame test lab to emission spectra and how this	

			is used to support the Big Bang Theory.	

NJ: 2016 SLS: Science
NJ: HS Earth & Space Sciences
HS-ESS1 Earth's Place in the Universe
Performance Expectations

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.

NJ: HS Physical Sciences
HS-PS1 Matter and Its Interactions
Performance Expectations

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.

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.

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.

HS-PS4 Waves and Their Applications in Technologies for Information Transfer
Performance Expectations

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices

Career Ready Practices CRP2. Apply appropriate academic and technical skills. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. 				
Bonding and Nomenclature *(Week 12, 3 Weeks)*	a) How do particles combine to form the variety of matter one observes?	a) Atoms bond in different ways depending on their atomic structure and thus their properties. b) The polarity of molecules reflects the nature of the geometry of the molecules including the constituent atoms, the atomic distances, and the bond angles.	• Explore the difference between ionic and covalent bonds through pattern recognition related to placement of elements in bond on periodic table. • Observe electron clouds of bonding atoms as properties such as atomic size and electronegativity change in order to understand the difference among ionic, polar covalent, and covalent bonds at the atomic scale, then compose a written description of the electrostatic force between the ions in an ionic bond. • ***Introduce*** Unit challenge: with your partner, design a piece of artwork to hang in a studio that accurately highlights a variety of important aspects of bonding. Groups will provide a	

			two minute explanation of the type of artwork that they intend on designing, with the goal o to teach and aesthetically engage spectators. ● “Ion Speed Dating” ● Complete a worksheet on naming and formula writing. ● model the molecular structure of various pure substances, and be able to predict: ● VSEPR geometry hybridization of central atom polarity of the molecule. ● Carousel share designed models collect and give peer feedback, revise models as needed. ● Conduct an online simulation of molecular polarity. ● Molecular Polarity Via Capillary Action Lab. ● Complete a lab comparing the properties of water vs. ethanol.	
NJ: 2016 SLS: Science **NJ: HS Physical Sciences** **HS-PS1 Matter and Its Interactions** **Performance Expectations**				

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.

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.

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.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS2 Motion and Stability: Forces and Interactions
Performance Expectations

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

NJ: HS Engineering Design
HS-ETS1 Engineering Design
Performance Expectations

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Matter and It's Changes *(Week 15, 3 Weeks)*	a) How does one characterize, and predict, the changes that occur when substances react?	a) Matter (and changes in matter) can be described, organized, and classified for understanding.	• Work in pairs to analyze and interpret phase diagrams • Create a flowchart to classify various materials as an element, a compound, or a mixture. • Design a procedure to separate a mixture.	**Performance: Lab Assignment** Lab report or activity answers will be assessed

			• Create a density column of sugar solutions. • Analyze the effects of climate change (temperature and precipitation) and their associated impacts through a lab or activity. • Climate Impacts Graph Matching Activity - https://scied.ucar.edu/activity/climate-impacts-graph-matching	

NJ: 2016 SLS: Mathematics
NJ: HS: Num/Quantity
Quantities
HSN-Q.A. Reason quantitatively and use units to solve problems.
HSN-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.
HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
NJ: 2016 SLS: Science
NJ: HS Earth & Space Sciences
HS-ESS3 Earth and Human Activity
Performance Expectations

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

NJ: HS Physical Sciences
HS-PS1 Matter and Its Interactions
Performance Expectations

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.

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.

HS-PS3 Energy
Performance Expectations

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.

NJ: HS Engineering Design
HS-ETS1 Engineering Design
Performance Expectations

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Introduction To Moles *(Week 18, 3 Weeks)*	a) Why is the mole an important measurement in chemistry? b) How is the mole used in chemical calculations?	a) The mole is used to quantify matter. b) Compound can be analyzed for its percent composition.	• Use knowledge of mole concept to interconvert measurements of mole, mass, gas volume and number of molecules. • Design a concept map illustrating the interrelationship between the mole, mass, Avogadro's number and gas volume at Standard Temperature and Pressure(STP). • Research several selected websites to investigate the mole concept. Design a brochure, booklet, advertisement, poster, or *PowerPoint* presentation.	

			• Complete activity on percent composition of Oreos. • Complete the Copper Sulfate Hydrate Lab. • Complete Magnesium Oxide lab.	
NJ: 2016 SLS: Mathematics **NJ: HS: Num/Quantity** **Quantities** **HSN-Q.A. Reason quantitatively and use units to solve problems.** HSN-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. HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **NJ: 2016 SLS: Science** **NJ: HS Physical Sciences** **HS-PS1 Matter and Its Interactions** **Performance Expectations** HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Copyright © State of New Jersey, 1996 - 2016.				
Chemical Reactions and Stoichiometry *(Week 21, 3 Weeks)*	a) How does the law of conservation of matter apply to balance chemistry equations? b) What are the main types of chemical reactions? c) How does stoichiometry predict the quantities of products/reactants from given amounts of reactants/products?	a) The law of conservation of matter means that all the atoms of each element during the reaction cannot be created nor destroyed; instead the atoms are rearranged to form products. The coefficients give the ratio of reactants to products. b) There are five general classification of chemical reactions; synthesis, decomposition, single replacement, double replacement, and combustion.	• Complete a classification of reactions lab. • Complete the pHET simulation/activity on balancing chemical equations. • Complete single replacement/activity series lab. • Complete a precipitate lab practical.	

		c) Stoichiometry uses dimensional analysis to convert the reactant into products or vice versa.	• Complete the reaction in the bag lab (FLINN). • Conduct several laboratory investigations involving predicting the mass of product formed in selected chemical reactions, and then experimentally verifying the results. • Complete activity series lab if not already done, and discuss in terms of redox.	

NJ: 2016 SLS: Mathematics
NJ: HS: Num/Quantity
Quantities
HSN-Q.A. Reason quantitatively and use units to solve problems.
HSN-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.
HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
NJ: 2016 SLS: Science
NJ: HS Physical Sciences
HS-PS1 Matter and Its Interactions
Performance Expectations

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.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Collision Theory/Reactions Rates *(Week 24, 2 Weeks)*	a) What factors impact the rate of a chemical reaction, and how is the rate changed for each factor? b) What is a catalyst? How does a catalyst work?	a) Chemical reaction rates change with conditions under which they occur. b) Potential energy diagrams can be used to interpret the enthalpy and activation energy of a reaction.	• Conduct several laboratory investigations depicting how different factors change rate Ex: perform a lab measuring the rate of reaction between iodine and starch at various concentrations. • Interpret and create potential energy diagrams.	

NJ: 2016 SLS: Science
NJ: HS Physical Sciences
HS-PS1 Matter and Its Interactions
Performance Expectations

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-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.

HS-PS2 Motion and Stability: Forces and Interactions
Performance Expectations

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.*

Gases *(Week 26, 4 Weeks)*	a) How does the kinetic molecular theory explain the behavior of gases? b) How is the pressure, temperature, and volume of a gas related?	a) The behavior of gases in response to changes in pressure, temperature, volume and the number of particles can be calculated.		

	c) How is stoichiometry applied to the gaseous phase?	b) The combined gas law related the pressure, volume, and temperature of an ideal gas. c) Stoichiometry along with the ideal gas law can fully describe the volume of gases produced/ consumed in chemical reactions.		
NJ: 2016 SLS: Mathematics **NJ: HS: Num/Quantity** **Quantities** **HSN-Q.A. Reason quantitatively and use units to solve problems.** HSN-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. HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **NJ: 2016 SLS: Science** **NJ: HS Physical Sciences** **HS-PS2 Motion and Stability: Forces and Interactions** **Performance Expectations** 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.* **NJ: HS Engineering Design** **HS-ETS1 Engineering Design** **Performance Expectations** HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 				
Thermochemistry *(Week 30, 3 Weeks)*	a) How are the system, surroundings, and universe defined in thermochemistry? b) What is the difference between temperature and heat energy? c) What is specific heat capacity? Why does it take	a) The law of conservation of energy explains how the total energy is unchanged in open, closed, and isolated systems. b) Temperature is a measure of average kinetic energy of the molecules in a substance and is related to but not the same as heat.	• Practice converting between units of energy. • Interpret heating/cooling curves.	

	more heat to change the temperature of water compared to metals? d) What factors affect the spontaneity of a chemical reaction?	c) Specific heat capacity explains why more heat is needed to change the temperature of different substances.	• Conduct an experiment measuring the enthalpy of formation. • Research the Internet and write a brief paper on one type of alternative energy source. Advantages and disadvantages will be established and presented. • Conduct a laboratory experiment measuring the enthalpy change. • Solve enthalpy change problems (handout/worksheet). • Solve various word-problems exploring the mathematical relationship between ΔS, ΔH and ΔG. • Analyze and investigate the types of heat transfer. Make sure to relate convection (heat transfer) to how Earth's crust has formed (convection currents)	

NJ: 2016 SLS: Science
NJ: HS Earth & Space Sciences
HS-ESS2 Earth's Systems
Performance Expectations

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

NJ: HS Physical Sciences
HS-PS1 Matter and Its Interactions
Performance Expectations

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS3 Energy
Performance Expectations

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.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP5. Consider the environmental, social and economic impacts of decisions.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

Solutions *(Week 33, 3 Weeks)*	a) How do you measure concentration of a solution? b) What factors affect the solubility of gases and solids in liquids? c) What are practical applications of colligative properties?	a) A solution can be identified as saturated, unsaturated or supersaturated based on its composition and temperature, and by interpretation of a solubility curve. b) Concentration can be measured in and converted between units such as: molarity, molality, mole fraction, mass	• Solve concentration problems. • Classify solutions types based on a solubility curve. • Prepare several accurate solutions of	

		percent, parts per million, and parts per billion. c) Amount of solute dissolved in a solution can used to lower the freezing point, elevate the boiling point, and reduce vapor pressure	given molarity and verify concentration via titration. ● Complete a lab based on measuring the temperature change based on the amount of solute/solvent. ● Determine the molecular weight of solute dissolved in a solvent by measurement of the freezing point depression. ● Class discussion on how intra- and intermolecular forces determine the properties of liquids and solids. ● Complete a lab based on measuring the temperature change based on the amount of solute/solvent. In addition to colligative properties, lab should relate the properties of water to its effects on Earth	

NJ: 2016 SLS: Science
NJ: HS Earth & Space Sciences
HS-ESS2 Earth's Systems
Performance Expectations

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

NJ: HS Physical Sciences

HS-PS1 Matter and Its Interactions
Performance Expectations

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.

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.

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.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP5. Consider the environmental, social and economic impacts of decisions.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

Acid Base Chemistry *(Week 36, 3 Weeks)*	a) What are acids and based? What are properties of acids and bases? b) What is pH, and how does it measure the concentration of acids and bases? c) How do acids and bases react with one another?	a) Distinguish between acids and bases based on their reactions with water. b) Identity acids and bases based on physical properties. c) Determine the concentration of acids and bases using pH, pOH, $[H^+]$, and $[OH^-]$. d) Describe and write neutralization reactions.	• pHET Acid Base Solutions Simulations. • Practice identifying acid, bases, conjugate acid and base pairs. • Use titration equipment to determine the molarity of an unknown acidic or basic using the titration technique.	

			• Explore the mathematical relationship among molarity, H+ ions, OH- ions, and pH and data to formulate conclusions about the kinetics of chemical reactions.	
NJ: 2016 SLS: Science **NJ: HS Physical Sciences** **HS-PS1 Matter and Its Interactions** **Performance Expectations** 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. 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. HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. 				
Equilibrium *(Week 39, 2 Weeks)*	a) What is dynamic equilibrium? b) What factors affect chemical equilibrium? c) How can you use Le Chatelier's principle to predict the effect of changes of concentration, temperature, volume and pressure on a system at equilibrium?	a) Chemical equilibrium occurs when reversible reactions occur at the same rate. b) The four factors that affect chemical equilibrium are temperature, pressure, concentration, and volume. c) Systems are equilibrium will respond to alleviate external stress and reestablish equilibrium.	• Class discussion. • Straw demo. • Problem solving handout. • Predict the effect of certain stressors on a chemical reaction using Le Chatelier's Principle. • Design and conduct a lab to observe the physical effects caused when stress is applied to a system.	**Other: Quiz** Quiz Unit Test **Performance: Lab Assignment** Formal lab report will be assessed using teacher-designed rubric Students will peer-edit lab report for experimental de- sign, clarity, and accuracy

NJ: 2016 SLS: Science **NJ: HS Physical Sciences** **HS-PS1 Matter and Its Interactions** **Performance Expectations** HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* 				

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