Academic Chemistry

Unit 1: Foundations in Chemistry

Stage 1: Desired Results

Standards & Indicators:

NJSLS Science:

- 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-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Science and Engineering Practices(SEP)

- **Developing and Using Models-** Modeling in 9–12 builds on K–8 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. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)
- **Obtaining, Evaluating, and Communicating Information -** Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)

Disciplinary Core Ideas (DCI)

- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)
- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4)
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6)

Crosscutting Concepts (CCC)

- **Energy and Matter**- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)
- **Structure and Function** - Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
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).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly

Academic Chemistry

		for global issues where diverse solutions are needed.

Central Idea/Enduring Understanding:

- Chemistry, defined as the study of matter and its interactions, and is also known as the "Central Science". This is because Chemistry influences the study of all other sciences, since everything known to man either is made up of matter or interacts with matter in some way. Chemistry is a broad category of science, and can be further divided into specific areas of study, some of which overlap with other science disciplines such as Biology and Physics
- Experimental design and modeling are essential tools for the study of chemistry. Honing skills and giving opportunities to design and carry out experimental research to answer open-ended questions is the cornerstone of real science.
- Dressing appropriately and following laboratory safety rules will reduce the incidence and severity of accidents and help keep students safe.

Essential/Guiding Question:

- What is matter?
- Why is chemistry considered the central science?
- Do all scientists do science in the same way?
- What type of gear is acceptable to wear during a lab?
- What is the appropriate procedure to follow to discard broken glassware?
- What is cross contamination?
- Why are safety goggles important in the lab?
- What is an appropriate way to investigate a problem?
- How do scientists communicate with each other globally?
- What careers in chemistry could I persue?

Content:

The Study of Chemistry (Timberlake- 1.1)

- The Scientific Method (Timberlake-1.2)
- Experimental Design
- Laboratory Safety

Skills(Objectives):

Define matter

- Compare and contrast the overlap of the five traditional areas of chemistry
- Determine how study of chemistry interacts with the studies biology and physics
- Identify how scientists do science
- Create driving questions to be answered through experimentation
- Work in a chemistry lab safely and effecively
- Research careers in chemistry

Interdisciplinary Connections:

- Further developing communication skills through critical reading
- Comparing areas of study in science
- Developing real world appreciation for foundational learning
- **ELA NJSLS**
  - SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
  - RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
  - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **Math NJSLS**
  - 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

Academic Chemistry

Stage 2: Assessment Evidence

Performance Task(s):

- Manipulatives: Cup stacks
- Activity: Three Hole Bottle
- Lab: Observation and Experiment- Introduction to the Scientific Method
- Project: Careers in Chemistry

Other Evidence:

Pre Assessment

- Quiz
- Post Assessment

Stage 3: Learning Plan

Learning Opportunities/Strategies:

Resources:

- Textbook: Basic Chemistry Fifth Edition: Timberlake and Timberlake
- Three Hole Bottle- POGIL Project
- Flinn Lab: Observation and Experiment-Introduction to the Scientific Method

LGBT and Disabilities Resources:

- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:

- Learning for Justice
- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List
- Respect Ability: Fighting Stigmas, Advancing Opportunities
- NJDOE Diversity, Equity & Inclusion Educational Resources
- Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be given advanced level reading material. Formative assessments will be used to determine students' level of comprehension. Students may be given an additional assignment when their work is completed.	Lessons will be designed based on student learning styles. Formative assessments will be used to determine students' level of comprehension. Students will be given choices when appropriate to choose	Formative assessments will be used to determine students' level of comprehension. Students will be offered tutoring with the teacher or use weekly school tutoring. Teacher will develop an 8 minute model to	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are

Academic Chemistry

Students will be given choices when appropriate to choose their end product for a lesson.	their end product for a lesson.	help the student prior to referring student to I&RST Students will be given choices when appropriate to choose their end product for assessment.	not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit : Classification of Matter

Stage 1: Desired Results

Standards & Indicators:
NJSLS Science:

- HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
- MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- 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.

Science and Engineering Practices(SEP)

- **Developing and Using Models-** Modeling in 9–12 builds on K–8 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. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)
- **Constructing Explanations and Designing Solutions-** 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 knowledge, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1)

Disciplinary Core Ideas (DCI)

- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)
- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4)
- Resource availability has guided the development of human society. (HS-ESS3-1)
- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

Crosscutting Concepts (CCC)

- **Energy and Matter**- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)

Academic Chemistry

- **Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1).
- **Influence of Engineering, Technology, and Science on Society and the Natural World-** Modern civilization depends on major technological systems. (HS-ESS3-1)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGl.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.
9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).	Accurate information may help in making valuable and ethical choices.

Central Idea/Enduring Understanding:

- We can best understand chemical knowledge by observing and representing matter at multiple levels. These levels range from the unbelievably tiny subatomic level to the macroscopic level that we can see with our eyes. It is also important to recognize that the tiniest levels influence what occurs and is observed at higher levels.
- All changes in and interactions of matter are associated with changes in energy. These changes in energy can be analyzed to understand and explain these changes and interactions on the atomic, molecular, and macroscopic levels.
- Neither matter nor energy can be created or destroyed; however, they may be converted to other forms of energy or matter.
- Plastic pollution globally is having a huge impact on the world and how we live. The composition of plastics and what we love about plastics is also the reason plastics are so harmful.

Essential/Guiding Question:

- How are intensive and extensive properties used to classify matter?
- Compare and contrast pure substances and mixtures.
- How does a physical change occur with respect to energy at the molecular level?
- How does a chemical change occur with respect to energy at the molecular level?
- How do plastics differ?
- Propose a sustainable solution for the overproduction of plastics.

Content:

- Classification of Matter (Timberlake 3.1)
- Properties of Matter (Timberlake 3.2)
- Energy and Mass Conservation of Matter (Timberlake- Chapter 3.4-3.6)

Skills(Objectives):

- Define matter
- Explain the difference between Intensive and. extensive properties of matter

Academic Chemistry

	● Differentiate between atoms, compounds, molecules, and substances ● Differentiate between pure substances and mixtures ● Identify the chemical symbols of elements and name elements, given their symbols ● Research the composition of plastics

Interdisciplinary Connections:

- Materials chemistry: production of plastics and its global impact on the environment.
- **ELA NJSLS**
  - SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
  - RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
  - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **Math NJSLS**
  - 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

Stage 2: Assessment Evidence

Performance Task(s):	Other Evidence:
● Activity: Nuts and Bolts ● Lab: 1 + 2 + 3 = Black ● Project: What's the Deal with Plastics?	● Pre Assessment ● Quiz ● Post Assessment

Stage 3: Learning Plan

Learning Opportunities/Strategies:

- Team building activities
- Cooperative learning activities
- Online learning websites
- Internet research
- Student driven activities

Resources:

- Textbook: Basic Chemistry Fifth Edition: Timberlake and Timberlake
- Activity handout: Nuts and Bolts
- POGIL: Classification of Matter
- PBS Documentary: The Problem with Plastics

LGBT and Disabilities Resources:

- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:

- Learning for Justice
- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List
- Respect Ability: Fighting Stigmas, Advancing Opportunities
- NJDOE Diversity, Equity & Inclusion Educational Resources

Academic Chemistry

	• Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be given advanced level reading material. Formative assessments will be used to determine students' level of comprehension. Students may be given an additional assignment when their work is completed. Students will be given choices when appropriate to choose their end product for a lesson.	Lessons will be designed based on student learning styles. Formative assessments will be used to determine students' level of comprehension. Students will be given choices when appropriate to choose their end product for a lesson.	Formative assessments will be used to determine students' level of comprehension. Students will be offered tutoring with the teacher or use weekly school tutoring. Teacher will develop an 8 minute model to help the student prior to referring student to I&RST Students will be given choices when appropriate to choose their end product for assessment.	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit 3: Atoms and the Periodic Table

Stage 1: Desired Results

Standards & Indicators:

NJSLS Science:

- 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.

Science and Engineering Practices(SEP)

- **Developing and Using Models-** Modeling in 9–12 builds on K–8 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. Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)
- **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 and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how

Academic Chemistry

much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HSPS1-3)

Disciplinary Core Ideas (DCI)

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3)

Crosscutting Concepts (CCC)

- **Patterns -** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.(HS-PS1-1),(HS PS1-3)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
9.4.12.TL.4	Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.

Central Idea/Enduring Understanding:

- Chemistry, defined as the study of matter and its interactions, and is also known as the "Central Science". This is because Chemistry influences the study of all other sciences, since everything known to man either is made up of matter or interacts with matter in some way. Chemistry is a broad category of science, and can be further divided into specific areas of study, some of which overlap with other science disciplines such as Biology and Physics
- Matter, on all levels, has predictable properties that can be related to structures of the elements that make up that matter. These properties, resulting from the electronic and atomic structures, are responsible for behavior of elements, compounds, and mixtures on all levels. The periodic table is a useful tool for the organization of these properties on the elemental level.

Essential/Guiding Question:

- How did the structure of the atom evolve from the time of Democritus to the present day?
- When looking at an elemental key on the periodic table, how do you determine the number of protons, neutrons and electrons for a specific element?
- Draw Bohr models of an atom
- What is an isotope?
- What is an ion?
- What are the similarities and differences between metals, nonmetals, metalloids?
- How did the structure of the atom model change throughout time?
- Compare and contrast atoms and isotopes.
- How do you calculate the average atomic mass for an element?
- Using coulombic attraction, determine the trends of atomic radius, ionic radius, ionization energy, and electronegativity.

Content:

- History of the atom (Timberlake Chapter 4.3)

Skills(Objectives):

- Explain how modern atomic theory was developed.

Academic Chemistry

• Bohr Model (alternate resources) • Isotopes (Timberlake Chapter 4.4-4.5) • Calculate average atomic mass (Timberlake 4.5) • Basics of the Periodic table (Timberlake Chapter 4.2) • Coulombic attractions (alternate resources) • Periodic trends (Timberlake chapter 5.6)	• Name the 3 subatomic particles. • Identify the mass, charge, and placement of each particle. • Describe an isotope • Explain the difference between isotopes of the same element • Use the natural abundance of common isotopes to calculate the atomic mass that appears on the periodic table • Apply the concept of atomic abundance to determine the abundance of different isotopes. • Draw the Bohr model for any atom given • Explore the periodic table to identify location of elements, periods and groups. • Explain trends in atomic radii, ionization energy, ionic radii and electronegativity of an element according to it's placement on the periodic table

Interdisciplinary Connections:

- Using algebra to solve for the average atomic mass of an element.
- **ELA NJSLS**
  - SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
  - RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
  - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **Math NJSLS**
  - 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 display

Stage 2: Assessment Evidence

Performance Task(s): • Webquest-The Evolution of Chemistry • Lab: Isotopes and Atomic Mass • Lab: Metal, Nonmetal, or Metalloid? • Lab: Periodic Trends	**Other Evidence:** • Pre Assessment • Quiz • Post Assessment

Stage 3: Learning Plan

Learning Opportunities/Strategies: • Team building activities • Cooperative learning activities • Online learning websites • Internet research • Student driven activities	**Resources:** • Textbook: Basic Chemistry Fifth Edition: Timberlake and Timberlake • POGIL: Isotopes • POGIL: Coulombic Attraction • POGIL: Periodic Trends LGBT and Disabilities Resources:

Academic Chemistry

	• LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books DEI Resources: • Learning for Justice • GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be given advanced level reading material. Formative assessments will be used to determine students' level of comprehension. Students may be given an additional assignment when their work is completed. Students will be given choices when appropriate to choose their end product for a lesson.	Lessons will be designed based on student learning styles. Formative assessments will be used to determine students' level of comprehension. Students will be given choices when appropriate to choose their end product for a lesson.	Formative assessments will be used to determine students' level of comprehension. Students will be offered tutoring with the teacher or use weekly school tutoring. Teacher will develop an 8 minute model to help the student prior to referring student to I&RST Students will be given choices when appropriate to choose their end product for assessment.	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit 4: Chemical Bonding

Stage 1: Desired Results

Standards & Indicators:

NJSLS Science:

- 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.

Academic Chemistry

- HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles

Science and Engineering Practices(SEP)

- **Developing and Using Models-** Modeling in 9–12 builds on K–8 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. Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)
- **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 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.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) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)
- **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 and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS PS1-3)

Disciplinary Core Ideas (DCI)

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)(HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3)

Crosscutting Concepts (CCC)

- **Patterns -** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.(HS-PS1-1),(HS PS1-2)(HS PS1-3)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.

Central Idea/Enduring Understanding:	Essential/Guiding Question:
• Chemistry, defined as the study of matter and its interactions, and is also known as the "Central Science". This is because Chemistry influences the study of all other sciences, since everything known to man	• What is the mathematical relationship between wavelength, frequency, and energy of a photon? • What happens to the wavelength of a wave when you increase its frequency?

Academic Chemistry

either is made up of matter or interacts with matter in some way. Chemistry is a broad category of science, and can be further divided into specific areas of study, some of which overlap with other science disciplines such as Biology and Physics ● Matter, on all levels, has predictable properties that can be related to structures of the elements that make up that matter. These properties, resulting from the electronic and atomic structures, are responsible for behavior of elements, compounds, and mixtures on all levels. The periodic table is a useful tool for the organization of these properties on the elemental level. ● Communicating information about chemical concepts is highly dependent upon understanding the symbolism and conventions used to represent matter and information about matter. There is no one best way to represent matter because each representation has distinct strengths and weaknesses. The appropriate representation to use in a given situation depends on purposes for the representation.	● How do emission spectra and absorption spectra differ? ● At the atomic level, what happens to the electrons so that we see color on the macroscopic scale? ● What rules are needed to draw an orbital diagram for electron configuration? ● Compare and contrast ionic, metallic, and covalent bonding. ● How would you determine the stability of a covalent compound using resonance? ● How are the naming systems for ionic and covalent compounds similar? different? ● How do ionic compounds form? ● How does metallic bonding affect the properties of metals? ● Using electronegativities and electron shape to determine the nature of a bond. (ionic, covalent, polar covalent) ● Compare and contrast the types and strengths of intramolecular forces with intermolecular forces.
Content: ● Electromagnetic Spectrum/ Calculations (Timberlake Chapter 5.1-5.2) ● Electron Configuration for atoms and ions (Timberlake Chapter 5.3-5.5) ● Orbital Diagrams (Timberlake Chapter 5.4) ● Lewis dot structures for atoms and ions (Timberlake Chapter 10.1) ● Ionic bonding (Timberlake 6.1-6.2) ● Metallic bonding (alternate resources) ● Covalent bonding (Timberlake 6.5) ● Nomenclature (Timberlake 6.3- 6.5) ● Polarity (Timberlake Chapter 10.4-10.5) ● Intramolecular vs. Intermolecular forces (Timberlake Chapter 10.6)	**Skills(Objectives):** ● Express the relationship between wavelength and frequency ● Explain what causes the emission spectra and why it is different for different elements ● Describe how the frequencies of emitted light are related to changes in electron energies ● Compare the wavelength, frequency, and energy of electromagnetic radiation ● Identify the lowest and highest energy transition in an atomic emission spectrum. ● Explain atomic emission spectra correlate with the energy levels in atoms. ● Explain how the frequencies of light are related to changes in electron energies ● Explain how atomic spectra correlate with the energy levels in atoms ● Draw orbital diagrams and write electron configurations for any element ● Using charge of an ion to write the correct ionic formula ● Given the name of an ionic compound or molecular compound write the correct formula ● Draw the Lewis structures for molecular compounds, polyatomic ions or metallic structures

Academic Chemistry

	• Produce formulas and names for various molecular compounds, ionic compounds including polyatomic ions • Compare and contrast ionic, covalent and metallic bonding • Using electronegativity values determine the polarity of compound • Use the three dimensional structure of a molecule to classify it as polar or nonpolar • Describe the intermolecular forces between ions, polar covalent molecules, and nonpolar covalent molecules.

Interdisciplinary Connections:

- Use algebra to determine the frequency, wavelength, and energy of a photon.
- **ELA NJSLS**
  - SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
  - RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
  - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **Math NJSLS**
  - 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 display

Stage 2: Assessment Evidence

Performance Task(s):	Other Evidence:
• Lab: Atomic Spectra • Lab: Strength of Covalent Bonds	• Pre Assessment • Quiz • Post Assessment

Stage 3: Learning Plan

Learning Opportunities/Strategies:	Resources:
• Team building activities • Cooperative learning activities • Online learning websites • Internet research • Student driven activities	• Textbook: Basic Chemistry Fifth Edition: Timberlake and Timberlake • POGIL: Electron Energy and Light • POGIL: Electron Configurations • POGIL: Ions • POGIL: Naming Ionic Compounds • POGIL: Polyatomic Ions • POGIL: Metals • POGIL: Naming Molecular Compounds • POGIL: Forces of Attraction LGBT and Disabilities Resources: • LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth

Academic Chemistry

	• LGBTQ+ Books DEI Resources: • Learning for Justice • GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be given advanced level reading material. Formative assessments will be used to determine students' level of comprehension. Students may be given an additional assignment when their work is completed. Students will be given choices when appropriate to choose their end product for a lesson.	Lessons will be designed based on student learning styles. Formative assessments will be used to determine students' level of comprehension. Students will be given choices when appropriate to choose their end product for a lesson.	Formative assessments will be used to determine students' level of comprehension. Students will be offered tutoring with the teacher or use weekly school tutoring. Teacher will develop an 8 minute model to help the student prior to referring student to I&RST Students will be given choices when appropriate to choose their end product for assessment.	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit 5: Scientific Measure and Chemical Reactions

Stage 1: Desired Results

Standards & Indicators:

NJSLS Science:

- 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-PS1-4. 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.

Academic Chemistry

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

Science and Engineering Practices(SEP)

- **Developing and Using Models-** Modeling in 9–12 builds on K–8 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. Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4).
- **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 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.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) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)
- **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 9–12 builds on K–8 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. Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Disciplinary Core Ideas (DCI)

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)(HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3)
- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)
- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4)
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7)

Crosscutting Concepts (CCC)

- **Patterns -** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.(HS-PS1-1),(HS PS1-2)
- **Energy and Matter-** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)
- **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly

Academic Chemistry

		for global issues where diverse solutions are needed.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.

Central Idea/Enduring Understanding:	Essential/Guiding Question:
• Chemistry, defined as the study of matter and its interactions, and is also known as the "Central Science". This is because Chemistry influences the study of all other sciences, since everything known to man either is made up of matter or interacts with matter in some way. Chemistry is a broad category of science, and can be further divided into specific areas of study, some of which overlap with other science disciplines such as Biology and Physics • Matter, on all levels, has predictable properties that can be related to structures of the elements that make up that matter. These properties, resulting from the electronic and atomic structures, are responsible for behavior of elements, compounds, and mixtures on all levels. The periodic table is a useful tool for the organization of these properties on the elemental level. • The mole is the chemist's invaluable unit for specifying the amount of material.	• How do you use significant digits for precision of measurements? • Why is the mole an important measurement in chemistry? • How can the molecular formula of a compound be determined experimentally? • How do I convert between different chemical species in a given reaction? • How do scientists express the degree of uncertainty in their measurements? • How is dimensional analysis used to solve problems? • How do chemical reactions obey the law of conservation of mass? • How can you predict the products of a chemical reaction? • How are balanced chemical equations used in stoichiometric calculations? • How can you calculate amounts of reactants and products in chemical equations?

Content:	Skills(Objectives):
• Scientific Notation (Timberlake Chapter 1.5) • Significant Figures (Timberlake Chapter 2.2-2.3 • Accuracy and precision (Alternate resource) • Metric system/ Dimensional analysis (Timberlake Chapter 2.4-2.6) • Moles conversions (Timberlake Chapter 7.1-7.3) • Percent Composition (Timberlake Chapter 7.4) • Determining empirical formulas and molecular formulas (Timberlake 7.5-7.6) • Types of reactions (Timberlake Chapter 8.3)	• Write a standard number in scientific notation and vice versa • Identify a number as measured or exact • Determine the number of significant figures in a measured number • Calculate answers to give the correct number of significant figures • Write the names and abbreviations for the metric or SI units used in measurements of length, volume, mass, temperature and time. • Write conversion factors for two units that describe the same quantity • Convert between the number of atoms/particles to moles. • Calculate the molecular mass of a given substance. • Use the molecular mass of a substance to convert between moles of a substance and mass of a substance.

Academic Chemistry

• Balancing equations (Timberlake Chapter 8.2) • Stoichiometry (Timberlake Chapter 9.1-9.3) • Limiting reactants (Timberlake Chapter 9.4)	• Determine the percent mass of an element in a compound • Determine the empirical formula of a compound • Calculate percent composition • Use percent composition to identify what compound they are given • Explain why percent composition is always calculated by mass not by chemical formula • Predict products provided the reactants in a chemical equation. • Balance chemical equations • Determine the reaction type based on the chemical equation.

Interdisciplinary Connections:

- Use algebra to complete calculations of composition and yields for chemical reactions.
- **ELA NJSLS**
  - SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
  - RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
  - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **Math NJSLS**
  - Model with mathematics.

Stage 2: Assessment Evidence

Performance Task(s): • Lab: Accuracy and Precision • Lab: Instrumentation and Significant Figures • Lab: Classifying Chemical Reactions	**Other Evidence:** • Pre Assessment • Quiz • Post Assessment

Stage 3: Learning Plan

Learning Opportunities/Strategies: • Team building activities • Cooperative learning activities • Online learning websites • Internet research • Student driven activities	**Resources:** • Textbook: Basic Chemistry Fifth Edition: Timberlake and Timberlake • POGIl Significant Digits and Measurement • POGIL: Significant Zeros • POGIL: Shall We Dance • POGIL: Types of Chemical Reactions • POGIL: Relative Mass and the Mole • POGIL: Mole Ratio • POGIL: Basic Stoichiometry • POGIL: Limiting and Excess Reactants LGBT and Disabilities Resources: • LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books

Academic Chemistry

	DEI Resources: ● Learning for Justice ● GLSEN Educator Resources ● Supporting LGBTQIA Youth Resource List ● Respect Ability: Fighting Stigmas, Advancing Opportunities ● NJDOE Diversity, Equity & Inclusion Educational Resources ● Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be given advanced level reading material. Formative assessments will be used to determine students' level of comprehension. Students may be given an additional assignment when their work is completed. Students will be given choices when appropriate to choose their end product for a lesson.	Lessons will be designed based on student learning styles. Formative assessments will be used to determine students' level of comprehension. Students will be given choices when appropriate to choose their end product for a lesson.	Formative assessments will be used to determine students' level of comprehension. Students will be offered tutoring with the teacher or use weekly school tutoring. Teacher will develop an 8 minute model to help the student prior to referring student to I&RST Students will be given choices when appropriate to choose their end product for assessment.	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Academic Chemistry

Pacing Guide

Course Name	Content/Resources	Standards
UNIT 1: Foundations of Chemistry		
10 # Days	**CHAPTER** Timberlake 1	• HS-PS1-4 • HS-PS2-6 • 9.2.12.CAP.7 • 9.4.12.CT.1
UNIT 2: Classification of Matter		
14 # Days	**CHAPTERS** Timberlake & Timberlake 3	• HS-ESS3-1 • MS-PS1-4 • HS-PS1-4 • 9.4.12.GCA.1 • 9.4.12.IML.6
UNIT 3: Atoms and the Periodic Table		
18 # Days	**CHAPTERS** Timberlake & Timberlake 4, 5	• HS-PS1-1 • HS-PS1-3 • 9.4.12.TL.1 • 9.4.12.TL.4
UNIT 4: Chemical Bonding		
23# Days	**CHAPTERS** Timberlake & Timberlake 5, 6, 10	• HS-PS1-1 • HS-PS1-2 • HS-PS1-3 • 9.4.12.TL.1 • 9.4.12.TL.3
UNIT 5: Scientific Measure and Chemical Reactions		
25 # Days	**CHAPTERS** Timberlake & Timberlake 2, 7, 8, 9	• HS-PS1-1 • HS-PS1-2 • HS-PS1-4 • HS-PS1-7 • 9.4.12.TL.2 • 9.4.12.TL.4