CHEMISTRY/HONORS Curriculum

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Chemistry Course Information	
CURRICULUM/CONTENT AREA	**COURSE LENGTH**
Science	1 year
GRADE LEVEL	**DATE LAST REVIEWED**
10-12	2016 Approved Curricular Docs 2023 Evaluation of Program
PREREQUISITE(s) ***if applicable***	**BOARD APPROVAL DATE**
Algebra II completion or concurrent enrollment for Honors Chemistry is highly recommended	*December 2024*
PRIMARY RESOURCE ***if applicable***	
Inspire Chemistry by McGraw Hill, 2020 Supplemental: Storylines by All Species Education Consulting, OpenSciEd Chemistry	

Desired Results

COURSE DESCRIPTION

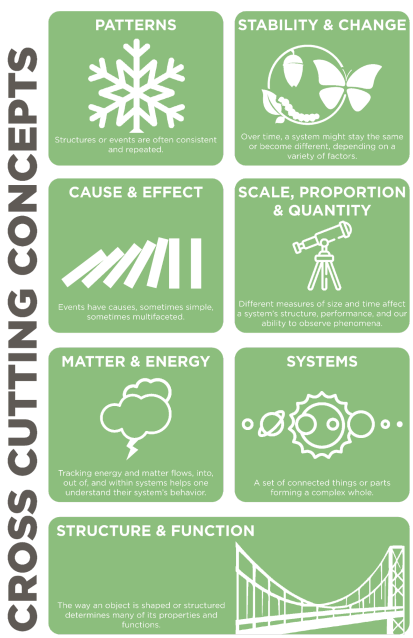
Chemistry is an essential course designed to provide a comprehensive introduction to the fundamental principles of chemistry that prepare students for future academic success. Through hands-on laboratory experiments, collaborative projects, and inquiry-based investigations, students will develop key skills in scientific reasoning, problem-solving, and data analysis. Emphasis will be placed on the scientific method, safety practices, and effective communication of scientific ideas. By the end of the course, students are equipped with the knowledge and skills to pursue further studies in science and to apply chemical principles in everyday life.
Beyond the chemistry curriculum, each unit in Chemistry Honors is explored in greater depth and at a faster pace.

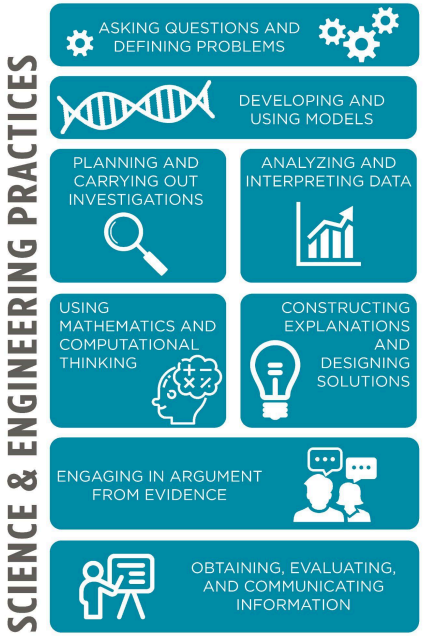
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying	**Unit 1: Structure and Properties of Matter** ➔ *How can chemistry help you understand the world?* ➔ *Why do scientists use standardized units?* ➔ *What are elements and compounds?*

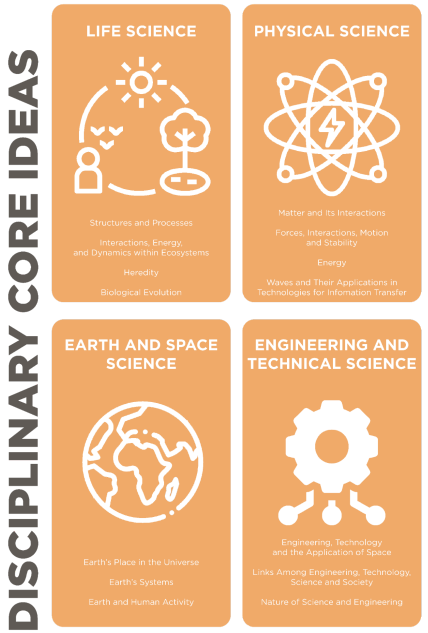
them. **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Scale, Proportion, and Quantity:** In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. **Systems and Models:** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. **Energy and Matter:** Tracking energy and matter flows, into, and out of, and within systems helps one understand their system's behavior. **Structure and Function:** The way an object is shaped or structured determines many of its properties and functions. **Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control the rates of change are critical elements to consider and understand.	➔ *What are the differences between physical and chemical properties and changes?* ➔ *What is matter made of?* ➔ *How has our understanding of matter changed over time?* ➔ *Are all atoms identical?* ➔ *Why are some nuclei radioactive?* ➔ *What is the nature of light?* ➔ *Why does each element produce its own unique atomic spectrum (colors)?* ➔ *How are electrons arranged in atoms?* ➔ *What can we learn about the periodic table?* ➔ *How can you use the periodic table to predict an element's properties?* **Unit 2: Chemical Bonding and Reactions** ➔ *Why do elements form compounds?* ➔ *What are the names and formulas of ionic compounds?* ➔ *What are the names and formulas of covalent compounds?* ➔ *What shapes do molecules form?* ➔ *What forces exist between molecules?* ➔ *How are chemical reactions modeled?* ➔ *What are the different types of chemical reactions?* ➔ *What do chemical formulas say about mole relationships?* ➔ *How do you determine the amounts of products and reactants involved in chemical reactions?* ➔ *Do you always get the calculated amount of product out of a reaction?* ➔ *How do you know if you have enough of a reactant to produce a desired amount of product?* **Unit 3: Applications of the Structure and Properties of Matter** ➔ *Why does water naturally exist as a solid, liquid and gas on earth?* ➔ *Do all gasses behave the same way?* ➔ *How does Kinetic Molecular Theory allow us to predict and describe the behavior of gasses?* ➔ *What are the properties of solids, liquids, and gasses?* ➔ *What causes a substance to change phases?* ➔ *How do we know if energy will be absorbed or released in a phase change?* ➔ *How are gasses temperature, volume, pressure , and moles related?* ➔ *How can displaying (graphing) data help you interpret it?* ➔ *Do all mixtures have a uniform composition?* ➔ *How can you describe the concentration of a solution?* ➔ *Why do some substances dissolve in water while others do not?* ➔ *What are acids and bases?* ➔ *What makes an acid or base strong or weak?* ➔ *What is pH?*

	➔ *What happens when an acid and base react?* Phenomenon may include but are not limited to: How do fireworks get their colors? How can understanding chemical bonding and reactions support fire safety? How does ocean chemistry affect coral reefs? Can we create enough electricity in the modern world? What role do batteries play in sustainable energy?

3 Dimensional Standards







Cross Cutting Concepts BY GRADE BAND AND UNIT	Unit 1	Unit 2	Unit 3
Standard SCI.CC1 - Patterns Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.	X	X	X
Standard SCI.CC2 - Cause and Effect Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and	X	X	X

designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.			
Standard SCI.CC3 - Scale, Proportion, and Quantity Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	x	x	x
Standard SCI.CC4 - Systems and System Models Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.	x	x	x
Standard SCI.CC5 - Energy and Matter Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	x	x	x
Standard SCI.CC6 - Structure and Function Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.	x	x	x
Standard SCI.CC7 - Stability and Change Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.	x	x	x

Science and Engineering Practices by GRADE BAND and UNIT	Unit 1	Unit 2	Unit 3
standard SCI.SEP1 - **A.Asking Questions** Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following: • Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. • Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model or an explanation • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.	x	x	x

• Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design. **B.Defining Problems** Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. • Clarify and refine an engineering problem.			
Standard SCI.SEP2 - Developing and Using Models Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: • 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. • Design a test of a model to ascertain its reliability. • Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. • Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.	x	x	x
Standard SCI.SEP3 - Planning and Conducting Investigations Students plan and carry out investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models: This includes the following: • Individually and collaboratively plan an investigation or test a design to produce data that can serve as evidence to build and revise models, support explanations for phenomena, and refine solutions to problems. Consider possible variables or effects and evaluate the investigation's design to ensure variables are controlled. • Individually and collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence. • In the design, decide on types, how much, and accuracy of data needed to produce reliable measurements. Consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points, or to improve performance relative to criteria for success.	x	x	x
Standard SCI.SEP4 - Analyze and Interpret Data Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: • Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. • Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. • Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data.	x	x	x

• Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation or model of a proposed process or system. • Analyze data to optimize design features or characteristics of system components relative to criteria for success.			
Standard SCI.SEP5 - Mathematics and Computational Thinking Students use 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. This includes the following: • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and algorithmic representations of phenomena or design solutions to describe and support claims and explanations. • Apply techniques of algebra and functions to represent and solve scientific and engineering problems. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, and others).	x	x	x
Standard SCI.SEP6 - **A.Construct Explanations** Students create explanations that are supported by multiple and independent student generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. • and revise an explanation based on valid and reliable evidence obtained from a variety of sources, including students' own investigations, models, theories, simulations, and peer review. • Explanations should reflect 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. • Apply scientific ideas, principles, and evidence to provide an explanation of phenomena taking into account possible, unanticipated effects. • Apply scientific reasoning, theory, and models to link evidence to the claim and to assess the extent to which the reasoning and data support the explanation. B. **Design Solutions** Students create designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Design, evaluate, and refine a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, and prioritized criteria. Consider tradeoffs. • Apply scientific ideas, principles, and evidence to solve design problems, taking into account possible unanticipated effects.	x	x	x
Standard SCI.SEP7 - Engage in Arguments Students use appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science. This includes the following: • 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. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	x	x	x

• Respectfully provide and receive critiques on scientific arguments by probing reasoning and evidence, by challenging ideas and conclusions, by responding thoughtfully to diverse perspectives, and by determining what additional information is required to resolve contradictions. • Construct, use, and present oral and written arguments or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments. Consider relevant factors (e.g. economic, societal, environmental, and ethical considerations).			
Standard SCI.SEP8 - Obtain, evaluate, and Communication Information Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. • Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible. • Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.	x	x	x

Disciplinary Core Ideas by GRADE BAND and UNIT			
PHYSICAL SCIENCE			
Standard SCI.PS1			
A. **STRUCTURE AND FUNCTION:** The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.	x		x
B. **CHEMICAL REACTIONS:** Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.		x	x
C. **NUCLEAR PROCESSES:** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.	x		
Standard SCI.PS2			
A. **TYPES OF INTERACTIONS:** Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields. Attraction and repulsion between electric charges	x	x	

at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects			
Standard SCI.PS3			
A. **CONSERVATION OF ENERGY AND ENERGY TRANSFER:** The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).	x	x	x
B. **ENERGY IN CHEMICAL PROCESSES AND EVERYDAY LIFE:** Sunlight is captured by plants and used in a chemical reaction to produce sugar molecules for storing this energy. This stored energy can be released by respiration or combustion, which can be reversed by burning those molecules to release energy	x	x	x
Standard SCI.PS4			
A. **WAVE PROPERTIES:** The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.	x		
B. **ELECTRO-MAGNETIC RADIATION:** Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation	x		
Standard: SCI.ETS3:			
A. **SCIENCE AND ENGINEERING ARE UNIQUE WAYS OF THINKING WITH DIFFERENT PURPOSES:** • Science is both a body of knowledge that represents current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. These processes differentiate science from other ways of knowing. • Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. • Science and engineering innovations may raise ethical issues for which science and engineering, by themselves, do not provide answers and solutions.	x	x	x
B. **SCIENCE AND ENGINEERING USE MULTIPLE APPROACHES TO CREATE NEW KNOWLEDGE AND SOLVE PROBLEMS:** • Scientists use a variety of methods, tools, and techniques to develop theories. A scientific theory is an explanation of some aspect of the natural word, based on evidence that has been repeatedly confirmed through observation, experimentation (hypothesis-testing), and peer review. • The certainty and durability of science findings varies based on the strength of supporting evidence. Theories are usually modified if they are not able to accommodate new evidence. • Engineers use a variety of approaches, tools, and techniques to define problems and develop solutions to those problems. Successful engineering solutions meet stakeholder needs and safety requirements, and are economically viable. Trade-offs in design aspects balance competing demands.	x	x	x

UNIT 1: *Structure and Properties of Matter*

In this unit, the students will explore the nature of matter. They will be introduced to what Chemistry is and will gain tools for the study of Chemistry. Students will learn that everything is made of matter, and this matter can undergo physical and chemical changes. As the unit evolves, students will learn that the atom is the fundamental building block of matter. Students will learn that the atoms of each element have a unique arrangement of electrons and that the valence electrons primarily contribute to the chemical properties of the element. Students will learn how periodic trends in the properties of atoms allow us to predict physical and chemical properties. Throughout, they will differentiate between mixtures, compounds and elements and will be able to relate physical and chemical properties to physical and chemical changes.

UNIT 1 DESIRED RESULTS

ESSENTIAL QUESTIONS:

1. *How can chemistry help you understand the world?*
2. *Why do scientists use standardized units?*
3. *What are elements and compounds?*
4. *What are the differences between physical and chemical properties and changes?*
5. *What is matter made of?*
6. *How has our understanding of matter changed over time?*
7. *Are all atoms identical?*
8. *Why are some nuclei radioactive?*
9. *What is the nature of light?*
10. *Why does each element produce its own unique atomic spectrum (colors)?*
11. *How are electrons arranged in atoms?*
12. *What can we learn about the periodic table?*
13. *How can you use the periodic table to predict an element's properties?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts (CCC)	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ Standard SCI.CC1 - Patterns	➔ Standard SCI.SEP1 - ◆ A.Asking Questions	➔ Standard SCI.PS1
➔ Standard SCI.CC2 - Cause and Effect	➔ Standard SCI.SEP2 - Developing and Using Models	➔ Standard SCI.PS2- B
➔ Standard SCI.CC3 - Scale, Proportion, and Quantity	➔ Standard SCI.SEP3 - Planning and Conducting Investigations	➔ Standard SCI.PS3- B, D

➔ Standard SCI.CC4 - Systems and System Models	➔ Standard SCI.SEP4 - Analyze and Interpret Data	➔ Standard SCI.PS4- A, B
➔ Standard SCI.CC5 - Energy and Matter	➔ Standard SCI.SEP5 - Mathematics and Computational Thinking	➔ Standard: SCI.ETS3
➔ Standard SCI.CC6 - Structure and Function	➔ Standard SCI.SEP6 - ◆ A.Construct Explanations	
➔ Standard SCI.CC6 - Structure and Function	➔ Standard SCI.SEP7 - Engage in Arguments	
➔ Standard SCI.CC7 - Stability and Change	➔ Standard SCI.SEP8 - Obtain, evaluate, and Communication Information	

3 DIMENSIONAL LEARNING TARGETS

Module 1: Introduction to Chemistry (includes Matter-Properties and Changes)

HS-ETS-3B SCIENCE AND ENGINEERING ARE UNIQUE WAYS OF THINKING WITH DIFFERENT PURPOSES: Science is both a body of knowledge that represents current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. These processes differentiate science from other ways of knowing.

- Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time.
- Science and engineering innovations may raise ethical issues for which science and engineering, by themselves, do not provide answers and solutions.

HS-ETS-3C SCIENCE AND ENGINEERING USE MULTIPLE APPROACHES TO CREATE NEW KNOWLEDGE AND SOLVE PROBLEMS:

- Scientists use a variety of methods, tools, and techniques to develop theories. A scientific theory is an explanation of some aspect of the natural word, based on evidence that has been repeatedly confirmed through observation, experimentation (hypothesis-testing), and peer review.
- The certainty and durability of science findings varies based on the strength of supporting evidence. Theories are usually modified if they are not able to accommodate new evidence.
- Engineers use a variety of approaches, tools, and techniques to define problems and develop solutions to those problems. Successful engineering solutions meet stakeholder needs and safety requirements, and are economically viable. Trade-offs in design aspects balance competing demands.

- I can define Chemistry and explain the role of Chemistry as a Central Science.
- I can describe and apply scientific approaches to problem solving.
- I can use the metric system to measure and calculate using these measurements.
- I can distinguish between accuracy and precision, and calculate percent error.
- I can identify significant figures in measurements, and perform mathematical operations using significant figures. HONORS- more advanced algebra application
- I can calculate density using mass and volume.
- I can distinguish between physical and chemical properties and physical and chemical changes of matter.
- I can classify matter as a pure substance/mixture.
- I can describe how the properties of solids, liquids, and gasses relate to the arrangements and interactions of the particles that compose them.
- I can describe heat changes in terms of system and surroundings during a phase change.

- I can calculate the heat released or absorbed during a temperature change or **(HONORS-phase change).**

Module 2: Atomic Theory

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.

[Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

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.

[Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]

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

[Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.][Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]

HS-PS4-3. Evaluate the claims, evidence, and reasoning 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.

[Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.]

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.

[Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]

- I can, from the quantum mechanical model, identify and describe elements and their arrangement in the periodic table.
- I can, from the quantum mechanical model, describe the structure of an atom/ion/isotope in terms of protons, neutrons, and electrons.

- I can use the Aufbau principle, the Pauli exclusion principle, and Hund's rule to determine the electron configuration for any element/ion and express electron configurations using orbital and noble gas notation.
- I can determine the number of valence electrons for an atom or ion using electron configuration.
- I can describe the electromagnetic spectrum in terms of wavelength, frequency, and energy and explain the mathematical relationship between speed, wavelength, energy, and frequency of electromagnetic radiation.
- I can describe how electromagnetic radiation behaves as both a wave and a particle.
- **HONORS-**I can use wave-particle duality to describe the photoelectric effect and the nature of light and their relationship to the quantum mechanical model of the atom.
- I can compare and contrast nuclear fission and nuclear fusion in terms of the processes involved and the energy released, and describe the types of particles and radiation emitted during radioactive decay.
- **HONORS-**I can describe the concept of half-life and its significance in radioactive decay.
- I can evaluate the advantages and disadvantages of using nuclear energy compared to other energy sources.

Module 3: Periodicity (Periodic Table and Periodic Law)

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.

[Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

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.

[Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]

- I can predict the following patterns of properties and behaviors:
  - The number and charges in stable ions that form from atoms in a group of the periodic table.
  - The trend in reactivity, ionization energy, and electronegativity of atoms down a group, and across a row in the periodic table, based on attractions of outermost (valence) electrons to the nucleus.
    - **HONORS-The trend in successive ionization energies for an element.**
  - The relative sizes of atoms both across a row and down a group in the periodic table.

UNIT 1 ASSESSMENT EVIDENCE

Performance is evaluated in terms of... Students will show their learning by...

Performance Task Description(s):

Module 1: Introduction to Chemistry (includes Matter-Properties and Changes)

HS-ETS-3B SCIENCE AND ENGINEERING ARE UNIQUE WAYS OF THINKING WITH DIFFERENT PURPOSES:

- *Science is both a body of knowledge that represents current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. These processes differentiate science from other ways of knowing.*
- *Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time.*
- *Science and engineering innovations may raise ethical issues for which science and engineering, by themselves, do not provide answers and solutions.*

HS-ETS-3C SCIENCE AND ENGINEERING USE MULTIPLE APPROACHES TO CREATE NEW KNOWLEDGE AND SOLVE PROBLEMS:

- *Scientists use a variety of methods, tools, and techniques to develop theories. A scientific theory is an explanation of some aspect of the natural word, based on evidence that has been repeatedly confirmed through observation, experimentation (hypothesis-testing), and peer review.*
- *The certainty and durability of science findings varies based on the strength of supporting evidence. Theories are usually modified if they are not able to accommodate new evidence.*
- *Engineers use a variety of approaches, tools, and techniques to define problems and develop solutions to those problems. Successful engineering solutions meet stakeholder needs and safety requirements, and are economically viable. Trade-offs in design aspects balance competing demands.*

Module 2: Atomic Theory

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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

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. [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]

HS-PS4-3. Evaluate the claims, evidence, and reasoning 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. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.]

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. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]

Module 3: Periodicity (Periodic Table and Periodic Law)

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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

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. [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills-Examples for Targeted Data Collection*
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  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (formative and summative assessments)*

- ➔ *Extensions & College/Career Readiness may include:*
  - All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

UNIT 2: *Chemical Bonding and Reactions*

In this unit, the students will learn how ionic compounds are held together by chemical bonds formed by the attraction of oppositely charged ions and how covalent bonds are formed by atoms sharing one or more pairs of electrons. Students will learn that chemical reactions in and around them transform reactions into products, resulting in the absorption or release of energy. Students will learn that the mole represents a very large number of extremely small particles and that chemists use mole ratios in stoichiometric calculations to predict the amount of reactants used and products formed in any specific reaction.

UNIT 2 DESIRED RESULTS

ESSENTIAL QUESTIONS:

1. *Why do elements form compounds?*
2. *What are the names and formulas of ionic compounds?*
3. *What are the names and formulas of covalent compounds?*
4. *What shapes do molecules form?*
5. *What forces exist between molecules?*
6. *How are chemical reactions modeled?*
7. *What are the different types of chemical reactions?*
8. *What do chemical formulas say about mole relationships?*
9. *How do you determine the amounts of products and reactants involved in chemical reactions?*
10. *Do you always get the calculated amount of product out of a reaction?*
11. *How do you know if you have enough of a reactant to produce a desired amount of product?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ Standard SCI.CC1 - Patterns	➔ Standard SCI.SEP1 - ◆ A.Asking Questions	➔ Standard SCI.PS1
➔ Standard SCI.CC2 - Cause and Effect	➔ Standard SCI.SEP2 - Developing and Using Models	➔ Standard SCI.PS2- B
➔ Standard SCI.CC3 - Scale, Proportion, and Quantity	➔ Standard SCI.SEP3 - Planning and Conducting Investigations	➔ Standard SCI.PS3- B, D
➔ Standard SCI.CC4 - Systems and System Models	➔ Standard SCI.SEP4 - Analyze and Interpret Data	➔ Standard: SCI.ETS3

➔ Standard SCI.CC5 - Energy and Matter	➔ Standard SCI.SEP5 - Mathematics and Computational Thinking	
➔ Standard SCI.CC6 - Structure and Function	➔ Standard SCI.SEP6 - ◆ A.Construct Explanations	
➔ Standard SCI.CC7 - Stability and Change	➔ Standard SCI.SEP7 - Engage in Arguments	
	➔ Standard SCI.SEP8 - Obtain, evaluate, and Communication Information	

3 DIMENSIONAL LEARNING TARGETS

Module 4: Chemical Bonding (Ionic and Molecular)

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.

[Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

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

[Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

[Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to systems containing two objects.]

- I can explain why atoms form chemical bonds.
- I can differentiate between types of bonds (ionic, covalent, metallic), and compare the properties of the compounds formed.
- I can write chemical formulas and names for various compounds.
- I can draw the Lewis dot structure for a molecule, and predict its geometry, shape, bond angles and polarity.
- **HONORS- I can explain resonance structures of molecules.**
- I can describe how polarity influences molecular properties.

- HONORS- I can describe and predict various types of intermolecular forces between molecules.

Module 5: The Mole

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

[Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

- I can relate molar mass, mass, and the mole for elements and compounds.
- I can define and determine an Empirical formula, and explain its application to Ionic/ molecular compounds. HONORS- more advanced algebra application
- I can determine a Molecular formula, and explain its relationship with its empirical formula. HONORS- more advanced algebra application
- I can calculate the percent composition by mass of an element in a compound. HONORS- more advanced algebra application

Module 6: Chemical Reactions

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.

[Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

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.

[Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

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

[Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

- I can identify observations that indicate a chemical reaction is occurring.

- I can describe chemical reactions, with balanced chemical equations.
- I can classify chemical reactions, (**HONORS- Oxidation, reduction reactions**) and predict the outcomes of the reactions.
- **HONORS- I can write molecular, ionic, and net ionic equations.**
- I can describe heat changes in terms of system and surroundings during a chemical reaction.
- **HONORS- I can use collision theory to describe how the rate of reaction can be changed.**

Module 7: Stoichiometry

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

[Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

- I can calculate the mass of reactant/ product given the mass of a different reactant/ product.
- I can identify the limiting/ excess reactant in a chemical reaction. **HONORS- more advanced algebra application**
- I can compare the actual yield to the theoretical yield of the product to determine the percent yield.
- **HONORS- I can complete stoichiometry problems using gas volume or solution molarity.**

UNIT 2 ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

Module 4: Chemical Bonding (Ionic and Molecular)

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. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the

changes in energy of the objects due to the interaction. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to systems containing two objects.]

Module 5: The Mole

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

Module 6: Chemical Reactions

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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

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. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

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Module 7: Stoichiometry

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - ◆ *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - ◆ *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*

- *Lab analysis questions and write-ups*
- *Assess unit vocabulary terms*
- *Evaluate student investigation tasks*
- *Assess key unit concepts (Formative and summative assessments)*

➔ *Extensions & College/Career Readiness may include:*
- All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

UNIT 3: *Applications of the Structure and Properties of Matter*

In this unit, students will learn about kinetic molecular theory, and the properties of solids, liquids, and gasses. Students will learn that gases respond in predictable ways to change in pressure, temperature, volume, and number of particles. Students will explore that most of the matter that makes up our world occurs in mixtures. Students will understand that chemical reactions absorb or release energy, but they never create or destroy energy. Students will learn that every chemical reaction proceeds at a definite rate, but the rate can be sped up or slowed down by changing the conditions of the reaction. Students will understand that the concentrations of hydrogen ions and hydroxide ions determine whether an aqueous solution is acidic, basic, or neutral.

UNIT 3 DESIRED RESULTS

ESSENTIAL QUESTIONS:

1. *Why does water naturally exist as a solid, liquid and gas on earth?*
2. *Do all gasses behave the same way?*
3. *How does Kinetic Molecular Theory allow us to predict and describe the behavior of gasses?*
4. *What are the properties of solids, liquids, and gasses?*
5. *What causes a substance to change phases?*
6. *How do we know if energy will be absorbed or released in a phase change?*
7. *How are gasses temperature, volume, pressure , and moles related?*
8. *How can displaying (graphing) data help you interpret it?*
9. *Do all mixtures have a uniform composition?*
10. *How can you describe the concentration of a solution?*
11. *Why do some substances dissolve in water while others do not?*
12. *What are acids and bases?*

13. *What makes an acid or base strong or weak?*
14. *What is pH?*
15. *What happens when an acid and base react?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ Standard SCI.CC1 - Patterns	➔ Standard SCI.SEP1 - ◆ A.Asking Questions	➔ Standard SCI.PS1
➔ Standard SCI.CC2 - Cause and Effect	➔ Standard SCI.SEP2 - Developing and Using Models	➔ Standard SCI.PS3- B, D
➔ Standard SCI.CC3 - Scale, Proportion, and Quantity	➔ Standard SCI.SEP3 - Planning and Conducting Investigations	➔ Standard: SCI.ETS3
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➔ Standard SCI.CC6 - Structure and Function	➔ Standard SCI.SEP6 - ◆ A.Construct Explanations	
➔ Standard SCI.CC7 - Stability and Change	➔ Standard SCI.SEP7 - Engage in Arguments	
	➔ Standard SCI.SEP8 - Obtain, evaluate, and Communication Information	

3 DIMENSIONAL LEARNING TARGETS

Module 8: States of Matter – Gases

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.

[Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

- I can explain the relationship between particle collisions and gas pressure.
- I can describe the behavior of Ideal and non-Ideal gasses using kinetic molecular theory..
- I can use the gas laws to predict the behavior of a gas when pressure, temperature, volume, (HONORS- moles) change.
- I can utilize the gas laws to calculate the changes in pressure, volume, temperature, (HONORS- moles) of gas.
- I can apply gas laws to real life situations.

Module 9: Mixtures and Solutions

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.

[Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

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

[Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

- I can distinguish between homogeneous and heterogeneous mixtures.
- I can quantify the concentration of solutions.
- I can describe the solution process, including factors that affect the rate of dissolving and solubility.

Module 10: Acids and Bases

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

[Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

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.

[Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations

showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

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).

[Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

- I can classify a solution as an acid or a base, based on its chemical formula and properties.
- I can write the name OR chemical formula for an acid.
- I can describe and quantify the Concentration (molarity) of a solution.
- I can calculate molarity from the titration data.
- I can predict products of a neutralization reaction.
- **HONORS- I can compare strong and weak acids and bases in terms of ionization.**
- **HONORS- I can calculate the pH and pOH for acidic and basic solutions.**

UNIT 3 ASSESSMENT EVIDENCE

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Performance Task Description(s):

Module 8: States of Matter – Gases

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. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

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