CHEMISTRY MATTERS
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Standards Alignment Crosswalk

UNIT 1: INTRODUCTION TO CHEMISTRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: What is Chemistry?	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment B: Hypotheses and Models	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment C: Investigating the Problem	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment D: Experimental Design	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment E: Performing an Experiment	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment F: Analyzing Data	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment G: Engaging in Argumentation	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.

UNIT 2: INTRODUCTION TO MATTER

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Properties of Matter	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces.		S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. c. Plan and carry out investigations to compare and contrast chemical (i.e., reactivity, combustibility) and physical (i.e., density, melting point, boiling point) properties of matter. d. Construct an argument based on observational evidence to support the claim that when a change in a substance occurs, it can be classified as either chemical or physical. (Clarification statement: Evidence could include ability to separate mixtures, development of a gas, formation of a precipitate, change in energy, color, and/or form.)
Segment B: Density Lab Results and Crush Lab	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intramolecular forces to identify substances based on chemical and physical properties.		S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. c. Plan and carry out investigations to compare and contrast chemical (i.e., reactivity, combustibility) and physical (i.e., density, melting point, boiling point) properties of matter. d. Construct an argument based on observational evidence to support the claim that when a change in a substance occurs, it can be classified as either chemical or physical. (Clarification statement: Evidence could include ability to separate mixtures, development of a gas, formation of a precipitate, change in energy, color, and/or form.)

UNIT 2: INTRODUCTION TO MATTER

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Physical Properties and Phase Change	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intramolecular forces to identify substances based on chemical and physical properties. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. a. Ask questions to compare and contrast models depicting the particle arrangement and motion in solids, liquids, gases, and plasmas. SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. b. Develop and use models to describe the movement of particles in solids, liquids, gases, and plasma states when thermal energy is added or removed. Construct an argument based on observational evidence to support the claim that when a change in a substance occurs, it can be classified as either chemical or physical. (Clarification statement: Evidence could include ability to separate mixtures, development of a gas, formation of a precipitate, change in energy, color, and/or form.)

UNIT 2: INTRODUCTION TO MATTER

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Phase Change Demonstrations	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intramolecular forces to identify substances based on chemical and physical properties. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. a. Ask questions to compare and contrast models depicting the particle arrangement and motion in solids, liquids, gases, and plasmas.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. b. Develop and use models to describe the movement of particles in solids, liquids, gases, and plasma states when thermal energy is added or removed. Construct an argument based on observational evidence to support the claim that when a change in a substance occurs, it can be classified as either chemical or physical. (Clarification statement: Evidence could include ability to separate mixtures, development of a gas, formation of a precipitate, change in energy, color, and/or form.)

UNIT 2: INTRODUCTION TO MATTER

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Chemical Properties	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intramolecular forces to identify substances based on chemical and physical properties.		S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. a. Develop and use a model to compare and contrast pure substances (elements and compounds) and mixtures. (Clarification statement: Include heterogeneous and homogeneous mixtures. Types of bonds and compounds will be addressed in high school physical science.)
Segment F: Mixtures	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intramolecular forces to identify substances based on chemical and physical properties.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. a. Develop and use a model to compare and contrast pure substances (elements and compounds) and mixtures. (Clarification statement: Include heterogeneous and homogeneous mixtures. Types of bonds and compounds will be addressed in high school physical science.)

UNIT 2: INTRODUCTION TO MATTER

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment G: Separating Mixtures	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties.		S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. a. Develop and use a model to compare and contrast pure substances (elements and compounds) and mixtures. (Clarification statement: Include heterogeneous and homogeneous mixtures. Types of bonds and compounds will be addressed in high school physical science.)
Segment H: Chromatography Results and Mixtures Challenge	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties.		

UNIT 3: ATOMIC STRUCTURE

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Atomic Models	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. a. Evaluate the merits and limitations of different models of the atom in relation to relative size, charge, and position of protons, neutrons, and electrons in the atom.	SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure. a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes. (Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) b. Analyze and interpret data to determine trends of the following: • Number of valence electrons • Types of ions formed by main group elements • Location and properties of metals, non-metals, and metalloids • Phases at room temperature c. Use the Periodic Table as a model to predict the above properties of main group elements.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

UNIT 3: ATOMIC STRUCTURE

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment B: The Periodic Table	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. a. Evaluate the merits and limitations of different models of the atom in relation to relative size, charge, and position of protons, neutrons, and electrons in the atom. d. Construct an explanation that relates the relative abundance of isotopes of a particular element to the atomic mass of the element.	SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure. a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes. (Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) b. Analyze and interpret data to determine trends of the following: • Number of valence electrons • Types of ions formed by main group elements • Location and properties of metals, non-metals, and metalloids • Phases at room temperature c. Use the Periodic Table as a model to predict the above properties of main group elements.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

UNIT 3: ATOMIC STRUCTURE

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Characteristics of Electrons	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. a. Evaluate the merits and limitations of different models of the atom in relation to relative size, charge, and position of protons, neutrons, and electrons in the atom. b. Construct an argument to support the claim that the proton (and not the neutron or electron) defines the element's identity. e. Construct an explanation of light emission and the movement of electrons to identify elements. f. 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 (including atomic radii, ionization energy, and electronegativity of various elements).	SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure. a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes. (Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) b. Analyze and interpret data to determine trends of the following: • Number of valence electrons • Types of ions formed by main group elements • Location and properties of metals, non-metals, and metalloids • Phases at room temperature c. Use the Periodic Table as a model to predict the above properties of main group elements.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

UNIT 3: ATOMIC STRUCTURE

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Periodic Trends Part I	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. a. Evaluate the merits and limitations of different models of the atom in relation to relative size, charge, and position of protons, neutrons, and electrons in the atom. b. Construct an argument to support the claim that the proton (and not the neutron or electron) defines the element's identity. f. 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 (including atomic radii, ionization energy, and electronegativity of various elements). g. Develop and use models including electron configuration of atoms and ions to predict an element's chemical properties.	SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure. a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes. (Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) b. Analyze and interpret data to determine trends of the following: • Number of valence electrons • Types of ions formed by main group elements • Location and properties of metals, non-metals, and metalloids • Phases at room temperature c. Use the Periodic Table as a model to predict the above properties of main group elements.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

UNIT 3: ATOMIC STRUCTURE

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Periodic Trends Part II	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. f. 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 (including atomic radii, ionization energy, and electronegativity of various elements). g. Develop and use models including electron configuration of atoms and ions to predict an element's chemical properties.	SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure. a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes. (Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) b. Analyze and interpret data to determine trends of the following: • Number of valence electrons • Types of ions formed by main group elements • Location and properties of metals, non-metals, and metalloids • Phases at room temperature c. Use the Periodic Table as a model to predict the above properties of main group elements.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

UNIT 3: ATOMIC STRUCTURE

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: Electron Configuration Part I	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. f. 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 (including atomic radii, ionization energy, and electronegativity of various elements). g. Develop and use models including electron configuration of atoms and ions to predict an element's chemical properties.		
Segment G: Electron Configuration Part II	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. g. Develop and use models including electron configuration of atoms and ions to predict an element's chemical properties.		
Segment H: Configuration Lab Results and Fireworks	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. e. Construct an explanation of light emission and the movement of electrons to identify elements. f. 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 (including atomic radii, ionization energy, and electronegativity of various elements). g. Develop and use models including electron configuration of atoms and ions to predict an element's chemical properties.		

Standards Alignment Crosswalk

UNIT 4: BONDING

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Introduction to Bonding	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)	SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds. a. Analyze and interpret data to predict properties of ionic and covalent compounds. (Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.)	
Segment B: Chemical Bonding	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. f. 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 (including atomic radii, ionization energy, and electronegativity of various elements). SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of inter- and intra- molecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties. d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)	SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds. a. Analyze and interpret data to predict properties of ionic and covalent compounds. (Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.)	

UNIT 4: BONDING

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Intramolecular Bonding	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intramolecular forces to identify substances based on chemical and physical properties. d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)	SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds. a. Analyze and interpret data to predict properties of ionic and covalent compounds. (Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.)	

UNIT 4: BONDING

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Comparing Types of Bonds	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties. c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (Clarification statement: 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.) d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)	SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds. a. Analyze and interpret data to predict properties of ionic and covalent compounds. (Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.) b. Develop and use models to predict formulas for stable, binary ionic compounds based on balance of charges. c. Use the International Union of Pure and Applied Chemistry (IUPAC) nomenclature for translating between chemical names and chemical formulas. (Clarification statement: Limited to binary covalent and binary ionic, containing main group elements, compounds but excludes polyatomic ions.)	

UNIT 4: BONDING

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Intermolecular Bonding	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties. c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (Clarification statement: 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.) d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)		

UNIT 4: BONDING

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: Melting Results and Molecular Modeling	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties. c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (Clarification statement: 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.) d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)	SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds. a. Analyze and interpret data to predict properties of ionic and covalent compounds. (Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.)	

UNIT 5: CHEMICAL REACTIONS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Balancing Equations	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).	SPS3. Obtain, evaluate, and communicate information to support the Law of Conservation of Matter. a. Plan and carry out investigations to generate evidence supporting the claim that mass is conserved during a chemical reaction. (Clarification statement: Limited to synthesis, decomposition, single replacement, and double replacement reactions.) b. Develop and use a model of a chemical equation to illustrate how the total number of atoms is conserved during a chemical reaction. (Clarification statement: Limited to chemical equations that include binary ionic and covalent compounds and will not include equations containing polyatomic ions.)	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. f. Construct an explanation based on evidence to describe conservation of matter in a chemical reaction including the resulting differences between products and reactants. (Clarification statement: Evidence could include models such as balanced chemical equations.)

UNIT 5: CHEMICAL REACTIONS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment B: Types of Reactions	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. f. Develop and use bonding models to predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).	SPS3. Obtain, evaluate, and communicate information to support the Law of Conservation of Matter. a. Plan and carry out investigations to generate evidence supporting the claim that mass is conserved during a chemical reaction. (Clarification statement: Limited to synthesis, decomposition, single replacement, and double replacement reactions.)	

UNIT 5: CHEMICAL REACTIONS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Reactivity and Predicting Products	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. f. Develop and use bonding models to predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).		

UNIT 5: CHEMICAL REACTIONS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Identifying Unknown Samples I	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. f. Develop and use bonding models to predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).		

UNIT 5: CHEMICAL REACTIONS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Identifying Unknown Samples II	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds. f. Develop and use bonding models to predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Dimensional Analysis	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.)		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment B: The Mole	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. d. Construct an explanation that relates the relative abundance of isotopes of a particular element to the atomic mass of the element. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Percent Composition and Empirical Formulas	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.)		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Stoichiometric Calculations	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.)		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Limiting Reactants	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) e. Plan and carry out an investigation to demonstrate the conceptual principle of limiting reactants.		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: Combustion Lab	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.)		

UNIT 6: THE MOLE AND STOICHIOMETRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment G: Combustion Lab Results	SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e. synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate: • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement for elements c and d: Emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and is not on memorization and rote application of problem-solving techniques.) e. Plan and carry out an investigation to demonstrate the conceptual principle of limiting reactants.		

UNIT 7: SOLUTIONS, ACIDS, AND BASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: What is a Solution?	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. a. Develop a model to illustrate the process of dissolving in terms of solvation versus dissociation. b. Plan and carry out an investigation to evaluate the factors that affect the rate at which a solute dissolves in a specific solvent.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	
Segment B: Solubility	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. a. Develop a model to illustrate the process of dissolving in terms of solvation versus dissociation. b. Plan and carry out an investigation to evaluate the factors that affect the rate at which a solute dissolves in a specific solvent.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	

UNIT 7: SOLUTIONS, ACIDS, AND BASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Solution Concentration	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. c. Use mathematics and computational thinking to evaluate commercial products in terms of their concentrations (i.e., molarity and percent by mass). d. Communicate scientific and technical information on how to prepare and properly label solutions of specified molar concentration.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	
Segment D: Dilution	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. c. Use mathematics and computational thinking to evaluate commercial products in terms of their concentrations (i.e., molarity and percent by mass). d. Communicate scientific and technical information on how to prepare and properly label solutions of specified molar concentration.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	

UNIT 7: SOLUTIONS, ACIDS, AND BASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Dilution Lab Results	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. c. Use mathematics and computational thinking to evaluate commercial products in terms of their concentrations (i.e., molarity and percent by mass). d. Communicate scientific and technical information on how to prepare and properly label solutions of specified molar concentration.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	
Segment F: Colligative Properties	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. e. Develop and use a model to explain the effects of a solute on boiling point and freezing point.		

UNIT 7: SOLUTIONS, ACIDS, AND BASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment G: Acids and Bases Part I	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds. SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (Clarification statement: Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.)	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. d. Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases. (Clarification statement: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-. e. Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.	

UNIT 7: SOLUTIONS, ACIDS, AND BASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment H: Acids and Bases Part II	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (Clarification statement: Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.) g. Ask questions to evaluate merits and limitations of the Arrhenius and Bronsted-Lowry models of acid and bases	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. d. Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases. (Clarification statement: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-. e. Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.	
Segment I: Titration Lab Results and pH	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (Clarification statement: Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.) h. Plan and carry out an investigation to explore acid-base neutralization.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. d. Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases. (Clarification statement: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-. e. Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.	

UNIT 7: SOLUTIONS, ACIDS, AND BASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment J: pH Lab Results	SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (Clarification statement: Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.) h. Plan and carry out an investigation to explore acid-base neutralization.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. d. Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases. (Clarification statement: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-. e. Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.	

UNIT 8: CHEMICAL THERMODYNAMICS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: The Laws of Thermodynamics	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated).	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system. d. Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection).

UNIT 8: CHEMICAL THERMODYNAMICS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment B: Specific Heat	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels).	

UNIT 8: CHEMICAL THERMODYNAMICS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Heat Transfer	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (Clarification statement: 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.) g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system. d. Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection).

UNIT 8: CHEMICAL THERMODYNAMICS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Greenhouse Lab Results and Calorimetry	SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system. d. Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection).

UNIT 8: CHEMICAL THERMODYNAMICS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Calorimetry Lab	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	

UNIT 8: CHEMICAL THERMODYNAMICS

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: Calorimetry Lab Results	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (Clarification statement: 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.) g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out investigations to determine that a new chemical has formed by identifying indicators of a chemical reaction (specifically precipitate formation, gas evolution, color change, water production, and changes in energy to the system should be investigated). SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Reaction Rates	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)		

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment B: Reaction Rate Lab	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)		

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Reaction Rate Lab Results and Catalysts	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) c. Construct an explanation of the effects of a catalyst on chemical reactions and apply it to everyday examples. SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)		

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Kinetic Molecular Theory	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) c. Construct an explanation of the effects of a catalyst on chemical reactions and apply it to everyday examples. SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.) c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. b. Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems. (Clarification statement: Using specific gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)	

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Ideal Gas Law	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. b. Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems. (Clarification statement: Using specific gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)	

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: Air Bag Lab	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. b. Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems. (Clarification statement: Using specific gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)	

UNIT 9: KINETICS AND GASES

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment G: Air Bag Lab Results	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. b. Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems. (Clarification statement: Using specific gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)	

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Chemical Equilibrium	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment B: The Equilibrium Constant Part I	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: The Equilibrium Constant Part II	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Le Chatelier's Principle	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Smog Lab	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: Smog Lab Results	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 10: INTRODUCTION TO EQUILIBRIUM

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment G: How Temperature Affects Equilibrium	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 11: NUCLEAR CHEMISTRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Radioactivity	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements.	SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. a. Develop a model that illustrates how the nucleus changes as a result of fission and fusion.	
Segment B: Nuclear Fission and Types of Radiation	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements.	SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. a. Develop a model that illustrates how the nucleus changes as a result of fission and fusion. c. Construct arguments based on evidence about the applications, benefits, and problems of nuclear energy as an alternative energy source.	
Segment C: Half-Life	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements.	SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. b. Use mathematics and computational thinking to explain the process of half-life as it relates to radioactive decay. (Clarification statement: Limited to calculations that include whole half-lives.)	

UNIT 11: NUCLEAR CHEMISTRY

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Nuclear Fusion	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. c. Construct an explanation, based on scientific evidence, of the production of elements heavier than hydrogen by nuclear fusion.	SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. a. Develop a model that illustrates how the nucleus changes as a result of fission and fusion. c. Construct arguments based on evidence about the applications, benefits, and problems of nuclear energy as an alternative energy source.	
Segment E: Real World Nuclear Chemistry	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements.	SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. a. Develop a model that illustrates how the nucleus changes as a result of fission and fusion. c. Construct arguments based on evidence about the applications, benefits, and problems of nuclear energy as an alternative energy source.	

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment A: Introduction to Chemistry Review	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in chemistry.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.	These foundational concepts are not explicitly stated in the GSEs but are essential for understanding main ideas and engaging in problem solving in physical science.
Segment B: Introduction to Matter Review	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces. b. Construct an argument by applying principles of inter- and intra-molecular forces to identify substances based on chemical and physical properties. SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. b. Construct an explanation using a heating curve as evidence of the effects of energy and intermolecular forces on phase changes.	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. a. Ask questions to compare and contrast models depicting the particle arrangement and motion in solids, liquids, gases, and plasmas. SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves. SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. a. Develop and use a model to compare and contrast pure substances (elements and compounds) and mixtures. (Clarification statement: Include heterogeneous and homogeneous mixtures. Types of bonds and compounds will be addressed in high school physical science.) b. Develop and use models to describe the movement of particles in solids, liquids, gases, and plasma states when thermal energy is added or removed. c. Plan and carry out investigations to compare and contrast chemical (i.e., reactivity, combustibility) and physical (i.e., density, melting point, boiling point) properties of matter. d. Construct an argument based on observational evidence to support the claim that when a change in a substance occurs, it can be classified as either chemical or physical. (Clarification statement: Evidence could include ability to separate mixtures, development of a gas, formation of a precipitate, change in energy, color, and/or form.)

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment C: Atomic Structure Review	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. a. Evaluate merits and limitations of different models of the atom in relation to relative size, charge, and position of protons, neutrons, and electrons in the atom. b. Construct an argument to support the claim that the proton (and not the neutron or electron) defines the element's identity. c. Construct an explanation based on scientific evidence of the production of elements heavier than hydrogen by nuclear fusion. d. Construct an explanation that relates the relative abundance of isotopes of a particular element to the atomic mass of the element. e. Construct an explanation of light emission and the movement of electrons to identify elements. f. 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 (i.e. including atomic radii, ionization energy, and electronegativity). g. Develop and use models, including electron configuration of atoms and ions, to predict an element's chemical properties.	SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure. a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes. (Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) b. Analyze and interpret data to determine trends of the following: • Number of valence electrons • Types of ions formed by main group elements • Location and properties of metals, non-metals, and metalloids • Phases at room temperature c. Use the Periodic Table as a model to predict the above properties of main group elements.	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment D: Bonding Review	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of inter- and intra- molecular forces. b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties. c. Construct an explanation about the importance of molecular-level structure in the functioning of designed material. (Clarification statement: 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.) d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)	SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds. a. Analyze and interpret data to predict properties of ionic and covalent compounds. (Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity.) b. Develop and use models to predict formulas for stable, binary ionic compounds based on balance of charges. c. Use the International Union of Pure and Applied Chemistry (IUPAC) nomenclature for translating between chemical names and chemical formulas. (Clarification statement: Limited to binary covalent and binary ionic, containing main group elements, compounds but excludes polyatomic ions.)	

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment E: Chemical Reactions Review	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds. f. Develop and use bonding models to predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds.	SPS3. Obtain, evaluate, and communicate information to support the Law of Conservation of Matter. a. Plan and carry out investigations to generate evidence supporting the claim that mass is conserved during a chemical reaction. (Clarification statement: Limited to synthesis, decomposition, single replacement, and double replacement reactions.) b. Develop and use a model of a chemical equation to illustrate how the total number of atoms is conserved during a chemical reaction. (Clarification statement: Limited to chemical equations that include binary ionic and covalent compounds and will not include equations containing polyatomic ions.)	S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter. f. Construct an explanation based on evidence to describe conservation of matter in a chemical reaction including the resulting differences between products and reactants. (Clarification statement: Evidence could include models such as balanced chemical equations.)

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment F: The Mole and Stoichiometry Review	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. d. Construct an explanation that relates the relative abundance of isotopes of a particular element to the atomic mass of the element. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. a. Use mathematics and computational thinking to balance chemical reactions (i.e., synthesis, decomposition, single replacement, double replacement, and combustion) and construct 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. b. Plan and carry out an investigation to determine that a new chemical has been formed by identifying indicators of a chemical reaction (e.g., precipitate formation, gas evolution, color change, water production, and changes in energy to the system). c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate. • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (Clarification statement: For elements c and d emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.) e. Plan and carry out an investigation to demonstrate the conceptual principle of limiting reactants.		

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment G: Solutions, Acids, and Bases Review	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds. SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases. a. Develop a model to illustrate the process of dissolving in terms of solvation versus dissociation. b. Plan and carry out an investigation to evaluate the factors that affect the rate at which a solute dissolves in a specific solvent. c. Use mathematics and computational thinking to evaluate commercial products in terms of their concentrations (i.e., molarity and percent by mass). d. Communicate scientific and technical information on how to prepare and properly label solutions of specified molar concentration. e. Develop and use a model to explain the effects of a solute on boiling point and freezing point. f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (Clarification statement: Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.) g. Ask questions to evaluate merits and limitations of the Arrhenius and Bronsted-Lowry models of acid and bases. h. Plan and carry out an investigation to explore acid-base neutralization.	SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions. a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions. b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent. c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility. d. Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases. (Clarification statement: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-. e. Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.	

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment H: Chemical Thermodynamics Review	SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds. g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy. SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. b. Plan and carry out an investigation to determine that a new chemical has been formed by identifying indicators of a chemical reaction (e.g., precipitate formation, gas evolution, color change, water production, and changes in energy to the system).	SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system. d. Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection).

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment I: Kinetics and Gases Review	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) c. Construct an explanation of the effects of a catalyst on chemical reactions and apply it to everyday examples. SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes. a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.) c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.	SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion. b. Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems. (Clarification statement: Using specific gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)	

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment J: Introduction to Equilibrium Review	SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction. a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.) b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.) d. Refine the design of a chemical system by altering the conditions that would change forward and reverse reaction rates and the amount of products at equilibrium. (Clarification statement: Emphasis is on the application of LeChatelier's principle.)		

UNIT 12: REVIEW

Segment	HS Chemistry Standard	HS Physical Science Standard	MS Physical Science Standard
Segment K: Nuclear Chemistry Review	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. c. Construct an explanation, based on scientific evidence, of the production of elements heavier than hydrogen by nuclear fusion.	SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. a. Develop a model that illustrates how the nucleus changes as a result of fission and fusion. b. Use mathematics and computational thinking to explain the process of half-life as it relates to radioactive decay. (Clarification statement: Limited to calculations that include whole half-lives.) c. Construct arguments based on evidence about the applications, benefits, and problems of nuclear energy as an alternative energy source.	