PHYSICAL SCIENCE (CHEMISTRY)

Topics Grades Pre-K – 2	Topics Grades 3 – 5	Topics Grades 6 – 8	Topics High School
States of Matter, Kinetic Molecular Theory, and Thermochemistry Pages S7–S9	**States of Matter, Kinetic Molecular Theory, and Thermochemistry** Page S10–S11	**States of Matter, Kinetic Molecular Theory, and Thermochemistry** Page S12–S13	**States of Matter, Kinetic Molecular Theory, and Thermochemistry** Page S14–S15
--	**Forms of Energy** Pages S16–S18	**Forms of Energy** Page S19–S20	**Forms of Energy** Page S21
--	--	**Elements, Compounds and Mixtures; Atomic Structure and Nuclear Chemistry** Pages S22–S23	**Elements, Compounds and Mixtures; Atomic Structure and Nuclear Chemistry** Page S25, S28
--	--	--	**Periodicity** **Chemical Bonding** **Reactions and Stoichiometry** **Solutions, Rates of Reaction, and Equilibrium** **Acids and Bases and Oxidation-Reduction Reactions** Pages S25–S31

Science and Technology/ Engineering

Physical Science (Chemistry)

Pre-K–2

CONTENT Science and Technology/Engineering

STRAND Physical Science (Chemistry)

Learning Standards for:

- Properties of Materials and Matter
- States of Matter, Kinetic Molecular Theory, and Thermochemistry

Grade Level: Pre-K–2

Topic	Learning Standards as written		Essence of the Standard(s)
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry	**2**	Identify objects and materials as solid, liquid, or gas. Recognize that solids have a definite shape and that liquids and gases take the shape of their container.	♦ Identify objects and materials as solid, liquid, or gas ♦ Recognize characteristics of solids, liquids, and gases

ENTRY POINTS and ACCESS SKILLS to Physical Science (Chemistry) Standards in Grades Pre-K–2

Less Complex ⟷ **More Complex**

	ACCESS SKILLS The student will:	ENTRY POINTS The student will:	The student will:	The student will:
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry	♦ Track materials related to states of matter, temperature of objects, or forms of energy ♦ Shift focus from materials to speaker in an activity related to states of matter, temperature of objects, or forms of energy ♦ Grasp materials related to states of matter, temperature of objects, or forms of energy ♦ Use two hands to hold materials related to states of matter, temperature of objects, or forms of energy ♦ Release materials related to states of matter, temperature of objects, or forms of energy (e.g., release materials to participate in experiments on changing water to ice and vice versa)	♦ Match objects that are liquids ♦ Match objects that are solids ♦ Group objects as solids, liquids, or gases	♦ Identify a given material or object as a solid, liquid, or gas ♦ Describe the characteristics of solids, liquids, or gases	♦ Compare and contrast solids, liquids, or gases ♦ Describe the effect of placing a solid, liquid, or gas into a container (e.g., changes based on shape of its container or remains unchanged) *Continue to address skills and concepts in this strand that approach grade-level expectations*

Less Complex ← → **More Complex**

	ACCESS SKILLS The student will:	ENTRY POINTS The student will:
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry (continued)	♦ Move materials related to states of matter, temperature of objects, or forms of energy ♦ Orient materials related to states of matter, temperature of objects, or forms of energy ♦ Manipulate objects related to states of matter, temperature of objects, or forms of energy ♦ Locate objects partially hidden or out of sight needed in an activity related to states of matter, temperature of objects, or forms of energy ♦ Use one object to act on another in an activity related to states of matter, temperature of objects, or forms of energy ♦ Turn on technology in an activity related to states of matter, temperature of objects, or forms of energy ♦ Imitate action in an activity related to states of matter, temperature of objects, or forms of energy ♦ Initiate cause-and-effect response during an activity related to states of matter, temperature of objects, or forms of energy ♦ Sustain through response in an activity related to states of matter, temperature of objects, or forms of energy ♦ Gain attention during activity related to states of matter, temperature of objects, or forms of energy ♦ Make a request during an activity (e.g., request a turn) related to states of matter, temperature of objects, or forms of energy ♦ Choose within a specified amount of time (e.g., 30 seconds) from an errorless array in an activity related to states of matter, temperature of objects, or forms of energy ♦ Respond to materials related to states of matter, temperature of objects, or forms of energy ♦ Attend visually, aurally, or tactilely to materials related to states of matter, temperature of objects, or forms of energy	

CONTENT Science and Technology/Engineering

STRAND Physical Science (Chemistry)

Learning Standards for:

- Properties of Materials and Matter
- States of Matter, Kinetic Molecular Theory, and Thermochemistry

Grade Level: 3–5

Topic	Learning Standards as written		Essence of the Standard(s)
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry	**2**	Compare and contrast solids, liquids, and gases based on the basic properties of these states of matter.	♦ Compare and contrast states of matter: solid, liquid, gas ♦ Describe changes in states of water
	3	Describe how water can be changed from one state to another by adding or taking away heat.	

ENTRY POINTS to
Physical Science (Chemistry) Standards in Grades 3–5

Less Complex → **More Complex**

	The student will:	**The student will:**	**The student will:**
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry	♦ Differentiate objects that are either solid, liquid, or gas ♦ Identify the change in state of water from a liquid to a solid, and vice versa ♦ Identify the solid, liquid, and gaseous states of the same material *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Compare changes from water (liquid) to gas (vapor) and vice versa ♦ Compare changes from water (liquid) to ice (solid), and vice versa	♦ Describe the conditions needed to produce water, ice, and gas *Continue to address skills and concepts in this strand that approach grade-level expectations*

CONTENT Science and Technology/Engineering
STRAND Physical Science (Chemistry)

Learning Standards for:

- Properties of Materials and Matter
- States of Matter, Kinetic Molecular Theory, and Thermochemistry

Grade Level: 6–8

Topic	Learning Standards as written		Essence of the Standard(s)
States of Matter, Kinetic Theory, and Thermo-chemistry	**9**	Recognize that a substance (element or compound) has a melting point and a boiling point, both of which are independent of the amount of the sample.	♦ Define and differentiate between the following: • melting and boiling points • physical and chemical changes ♦ Identify and explain heat and motion of particles
	10	Differentiate between physical changes and chemical changes.	
	15	Explain the effect of heat on particle motion through a description of what happens to particles during a change in phase.	

ENTRY POINTS to
Physical Science (Chemistry) Standards in Grades 6–8

Less Complex → **More Complex**

	The student will:	The student will:	The student will:
States of Matter, Kinetic Theory, and Thermo-chemistry	♦ Identify a physical change ♦ Identify a chemical change ♦ Identify the freezing and boiling points of water *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Distinguish between a physical change or chemical change ♦ Describe how objects and materials undergo melting, boiling, or freezing	♦ Describe that liquids have different boiling and freezing points ♦ Describe the difference between a physical change and a chemical change ♦ Describe the effect of heat on particles *Continue to address skills and concepts in this strand that approach grade-level expectations*

CONTENT Science and Technology/Engineering

STRAND Physical Science (Chemistry)

Learning Standards for:

- States of Matter, Kinetic Molecular Theory, and Thermochemistry

Science and Technology/ Engineering

Chemistry

High School

Grade Level: High School

Topic	Learning Standards as written		Essence of the Standard(s)
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry	**1.1**	Identify and explain physical properties (such as density, melting point, boiling point, conductivity, and malleability) and chemical properties (such as the ability to form new substances). Distinguish between chemical and physical changes.	♦ Identify and describe the following: • physical and chemical properties used to classify matter • difference between chemical and physical changes • three normal states of matter ♦ Use various chemical laws to explain behavior of gases, and the relationships among pressure, volume, temperature, and number of particles in a gas sample ♦ Use the ideal gas law to perform calculations ♦ Describe and contrast the properties of gases, liquids, and solids, using the kinetic molecular theory
	1.3	Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.	
	6.1	Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and the number of particles in a gas sample (Avogadro's hypothesis). Use the combined gas law to determine changes in pressure, volume, and temperature.	
	6.2	Perform calculations using the ideal gas law. Understand the molar volume at 273K and 1 atmosphere (STP).	
	6.3	Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.	

ENTRY POINTS to
Physical Science (Chemistry) Standards in High School

Less Complex → **More Complex**

	The student will:	The student will:	The student will:
States of Matter, Kinetic Molecular Theory, and Thermo-chemistry	♦ Identify physical properties of matter ♦ Identify chemical properties of matter *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Give examples of physical properties of matter ♦ Give examples of chemical properties of matter ♦ Classify matter by physical properties ♦ Classify matter by chemical properties ♦ Identify materials that have undergone a physical change (can be returned to original material by performing a physical change; e.g., ice to water to ice) ♦ Identify materials that have undergone a chemical change (cannot be returned to original material; e.g., rusting) ♦ Describe changes in volume as a result of changes in temperature and/or pressure	♦ Compare and contrast physical and chemical properties of matter ♦ Explain molecular level changes in a gas as the temperature/pressure changes ♦ Describe how materials can undergo either a physical or chemical change ♦ Distinguish between chemical and physical changes *Continue to address skills and concepts in this strand that approach grade-level expectations*

CONTENT Science and Technology/Engineering
STRAND Physical Science (Chemistry)
Learning Standards for:

- Forms of Energy

Grade Level: 3–5

Topic	Learning Standards as written		Essence of the Standard(s)
Forms of Energy	**4**	Identify the basic forms of energy (light, sound, heat, electrical, and magnetic). Recognize that energy is the ability to cause motion or create change.	♦ Identify basic forms of energy ♦ Demonstrate the transference of energy from one form to another
	5	Give examples of how energy can be transferred from one form to another.	

ENTRY POINTS and ACCESS SKILLS to Physical Science (Chemistry) Standards in Grades 3–5

Less Complex ⟷ **More Complex**

	ACCESS SKILLS	ENTRY POINTS		
	The student will:	**The student will:**	**The student will:**	**The student will:**
Forms of Energy	♦ Track materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Shift focus from materials to speaker in an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Grasp materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Use two hands to hold materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Release materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic)	♦ Compare objects based on forms of energy (e.g., hot/cold, moving/still, loud/quiet, magnetic/ nonmagnetic) ♦ Identify objects or visual representations of objects based on forms of energy (e.g., hot/cold, moving/still, loud/quiet, magnetic/ nonmagnetic) ♦ Identify basic forms of energy	♦ Match each basic form of energy to its uses (e.g., electrical to light)	♦ Give examples of each basic form of energy *Continue to address skills and concepts in this strand that approach grade-level expectations*

Less Complex ← → **More Complex**

	ACCESS SKILLS The student will:	ENTRY POINTS The student will:
Forms of Energy (continued)	♦ Move materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Orient materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Manipulate objects related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Locate objects partially hidden or out of sight needed in an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Use one object to act on another in an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) (e.g., use a drum stick to make a drum vibrate) ♦ Turn on technology in an activity related to basic forms of energy(i.e., light, sound, heat, electrical, and/or magnetic) ♦ Imitate action in an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Initiate cause-and-effect response during an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Sustain through response in an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Gain attention during activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Make a request during an activity (e.g., request a turn) related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Choose within a specified amount of time (e.g., 30 seconds) from an errorless array in an activity related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Respond to materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic) ♦ Attend visually, aurally, or tactilely to materials related to basic forms of energy (i.e., light, sound, heat, electrical, and/or magnetic)	

CONTENT Science and Technology/Engineering

STRAND Physical Sciences (Chemistry and Physics)

Learning Standards for:

- Forms of Energy

Grade Level: 6 – 8

Topic		Learning Standards as written	Essence of the Standard(s)
Forms of Energy	**13**	Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.	♦ Define and compare potential and kinetic energy ♦ Identify and explain the following: • states of matter at the molecular level • heat movement and equilibrium
	14	Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.	
	16	Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.	

Less Complex → **More Complex**

	The student will:	The student will:	The student will:
Forms of Energy	♦ Demonstrate the impact of heating on the movement of molecules ♦ Identify objects as having potential or kinetic energy ♦ Record readings from a temperature gauge *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Identify that the energy of an object is related to its position (e.g., a car parked on a hill has potential energy; a moving car has kinetic energy) ♦ Describe how the temperature of objects can be changed or controlled ♦ Record predictions about an object or material based on the likelihood that its temperature will either rise or fall	♦ Compare and contrast kinetic and potential energy ♦ Describe how heat moves and equilibrium is achieved (e.g., hot items will cool down over time) ♦ Evaluate predictions about an object or material based on the likelihood that its temperature will either rise or fall *Continue to address skills and concepts in this strand that approach grade-level expectations*

Science and Technology/ Engineering

Chemistry

High School

CONTENT Science and Technology/Engineering
STRAND Physical Science (Chemistry)
Learning Standards for:

- Forms of Energy

Grade Level: High School

Topic	Learning Standards as written		Essence of the Standard(s)
Forms of Energy	**6.4**	Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.	♦ Explain the law of conservation of energy ♦ Explain endothermic and exothermic processes ♦ Recognize the tendency toward disorder and randomness
	6.5	Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).	

ENTRY POINTS to Physical Science (Chemistry) Standards in High School

Less Complex ⟷ **More Complex**

	The student will:	**The student will:**	**The student will:**
Forms of Energy	♦ Identify forms of electrical energy ♦ Identify forms of mechanical energy ♦ Classify processes as either an endothermic (absorbs energy) or exothermic (releases energy) process *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Explain the transfer of energy from one type to another (e.g., mechanical to heat, chemical to electrical) ♦ Identify examples of endothermic and/or exothermic processes ♦ Describe reactions that occur more readily when heat is added (e.g., dissolution of sugar in water)	♦ Illustrate how chemical reactions can produce heat (i.e., exothermic), such as explosions or plaster hardening ♦ Explain how energy is transferred from an object when it strikes or collides with another object (e.g., bowling ball striking pins, marbles colliding) *Continue to address skills and concepts in this strand that approach grade-level expectations*

CONTENT Science and Technology/Engineering
STRAND Physical Science (Chemistry)
Learning Standards for:

- Elements, Compounds and Mixtures; Atomic Structure and Nuclear Chemistry

Grade Level: 6–8

Topic	Learning Standards as written		Essence of the Standard(s)
Elements, Compounds, and Mixtures; Atomic Structure and Nuclear Chemistry	**5**	Recognize that there are more than 100 elements that combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter.	♦ Define and differentiate between the following: • elements and compounds • atoms and molecules • pure substances and mixtures
	6	Differentiate between an atom (the smallest unit of an element that maintains the characteristics of that element) and a molecule (the smallest unit of a compound that maintains the characteristics of that compound).	
	7	Give basic examples of elements and compounds.	
	8	Differentiate between mixtures and pure substances.	

ENTRY POINTS and ACCESS SKILLS to Physical Science (Chemistry) Standards in Grades 6–8

Less Complex → **More Complex**

	ACCESS SKILLS The student will:	ENTRY POINTS The student will:	The student will:	The student will:
Elements, Compounds, and Mixtures; Atomic Structure and Nuclear Chemistry	♦ Match picture to picture using pictures of solid objects ♦ Track materials related to pure substances or mixtures, or models of molecular structure ♦ Shift focus from materials to speaker in an activity related to pure substances or mixtures, or models of molecular structure ♦ Grasp materials related to pure substances or mixtures, or models of molecular structure ♦ Use two hands to hold materials related to pure substances or mixtures, or models of molecular structure (e.g., use two hands to participate in experiments to remove salt from sand by adding water and filtering the mixture)	♦ Give examples of elements ♦ Match elements to their symbol in the periodic table	♦ Describe elements that can combine to form a compound ♦ Identify elements based on their symbols in the periodic table	♦ Illustrate how atoms combine to form molecules ♦ Classify substances as either mixtures (soil, sea salt) or pure substances (water, diamonds, table salt) *Continue to address skills and concepts in this strand that approach grade-level expectations*

Less Complex ⟷ **More Complex**

	ACCESS SKILLS The student will:	ENTRY POINTS The student will:
Elements, Compounds, and Mixtures; Atomic Structure and Nuclear Chemistry (continued)	♦ Release materials related to pure substances or mixtures, or models of molecular structure ♦ Move materials related to pure substances or mixtures, or models of molecular structure ♦ Orient materials related to pure substances or mixtures, or models of molecular structure ♦ Manipulate objects related to pure substances or mixtures, or models of molecular structure ♦ Locate objects partially hidden or out of sight needed in an activity related to pure substances or mixtures, or models of molecular structure ♦ Use one object to act on another in an activity related to pure substances or mixtures, or models of molecular structure ♦ Turn on technology in an activity related to pure substances or mixtures, or models of molecular structure ♦ Imitate action in an activity related to pure substances or mixtures, or models of molecular structure ♦ Initiate cause-and-effect response during an activity related to pure substances or mixtures, or models of molecular structure ♦ Sustain through response in an activity related to pure substances or mixtures, or models of molecular structure ♦ Gain attention during activity related to pure substances or mixtures, or models of molecular structure ♦ Make a request during an activity (e.g., request a turn) related to pure substances or mixtures, or models of molecular structure ♦ Choose within a specified amount of time (e.g., 30 seconds) from an errorless array in an activity related to pure substances or mixtures, or models of molecular structure ♦ Respond to materials related to pure substances or mixtures, or models of molecular structure ♦ Attend visually, aurally, or tactilely to materials related to pure substances or mixtures, or models of molecular structure	

CONTENT Science and Technology/Engineering

STRAND Physical Sciences (Chemistry and Physics)

Learning Standards for:

- Elements, Compounds and Mixtures; Atomic Structure and Nuclear Chemistry
- Periodicity
- Chemical Bonding
- Reactions and Stoichiometry
- Solutions, Rates of Reaction, and Equilibrium

Science and Technology/ Engineering

Physical Science (Chemistry)

High School

Grade Level: High School

Topic		Learning Standards as written	Essence of the Standard(s)
Elements, Compounds and Mixtures; Atomic Structure and Nuclear Chemistry	**1.2**	Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.	♦ Identify and describe the difference between pure substances and mixtures ♦ Recognize the following discoveries leading to modern atomic theory • major components of atoms and their interaction • laws of conservation of mass, • constant composition, and multiple proportions ♦ Write electron configurations ♦ Identify types and explain properties and process of radioactive decay ♦ Compare nuclear fission and nuclear fusion
	2.1	Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom) and understand how these discoveries lead to the modern theory.	
	2.2	Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.	
	2.3	Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.	
	2.4	Write the electron configurations for the first twenty elements of the periodic table.	
	2.5	Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).	
	2.6	Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope, for example, C-14 is a powerful tool in determining the age of objects.	
	2.7	Compare and contrast nuclear fission and nuclear fusion.	
Periodicity	**3.1**	Explain the relationship of an element's position on the periodic table to its atomic number. Identify families (groups) and periods on the periodic table.	♦ Explain positions on the periodic table of elements and relevance of position to atomic number ♦ Use periodic table to identify three classes of elements
	3.2	Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.	

Periodicity (cont.)	**3.3**	Relate the position of an element on the periodic table to its electron configuration and compare its reactivity with other elements in the table.	♦ Compare and contrast position of an element on the periodic table to its electron configuration and reactivity ♦ Identify trends on the periodic table
	3.4	Identify trends on the periodic table (ionization energy, electronegativity, and relative size of atoms and ions).	
Chemical Bonding	**4.1**	Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.	♦ Explain how atoms combine to form compounds through ionic and covalent bonding ♦ Draw Lewis dot structures ♦ Explain the difference between polar and nonpolar covalent bonds ♦ Predict the electron geometry of simple molecules ♦ Identify the characteristics and effects of hydrogen bonding in water ♦ Name and write chemical formulas for simple ionic and molecular compounds
	4.2	Draw Lewis dot structures for simple molecules and ionic compounds.	
	4.3	Use electronegativity to explain the difference between polar and nonpolar covalent bonds.	
	4.4	Use valence-shell electron-pair repulsion theory (VSEPR) to predict the electron geometry (linear, trigonal planar, and tetrahedral) of simple molecules.	
	4.5	Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (such as, surface tension, capillary action, density, and boiling point).	
	4.6	Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.	
Reactions and Stoichiometry	**5.1**	Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).	♦ Balance chemical equations ♦ Classify chemical reactions ♦ Determine the number of particles ♦ and molar mass using the mole concept ♦ Determine percent compositions, empirical formulas, and molecular formulas ♦ Calculate the mass-to-mass stoichiometry and the percent yield for a chemical reaction ♦ Calculate a percent yield for a chemical reaction
	5.2	Classify chemical reactions as synthesis (combination), decomposition, single displacement, double displacement, and combustion.	
	5.3	Use the mole concept to determine the number of particles and the molar mass of elements and compounds.	
	5.4	Determine percent compositions, empirical formulas, and molecular formulas.	
	5.5	Calculate the mass-to-mass stoichiometry for a chemical reaction.	
	5.6	Calculate percent yield in a chemical reaction.	
Solutions, Rates of Reaction, and Equilibrium	**7.1**	Describe the process by which solutes dissolve in solvents.	♦ Describe how solutes dissolve in solvents ♦ Calculate concentration in terms of molarity ♦ Describe factors affecting the rate at which solutes dissolve ♦ Compare and contrast the properties of solutions and solvents
	7.2	Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.	
	7.3	Identify and explain the factors that affect the rate of dissolving, such as, temperature, concentration, surface area, pressure, and mixing.	

Solutions, Rates of Reaction, and Equilibrium (cont.)	**7.4**	Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).	♦ Identify factors that affect rate of a chemical reaction ♦ Predict shift in equilibrium as a result of stress and other factors
	7.5	Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, and catalyst).	
	7.6	Predict the shift in equilibrium when the system is subjected to a stress (LeChatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).	
Acids and Bases and Oxidation-Reduction	**8.1**	Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donor and acceptor.	♦ Give basic definitions of acids and bases ♦ Understand the differences between the Arrhenius and Bronsted-Lowry theories ♦ Apply the pH scale to measure, compare, and contrast strength for common acids and bases ♦ Explain how a buffer works ♦ Describe and give everyday examples of oxidation and reduction reactions
	8.2	Relate hydrogen ion concentrations to the pH scale, and to acidic, basic, and neutral solutions. Compare and contrast the strength of various common acids and bases such as vinegar, baking soda, soap, and citrus juice.	
	8.3	Explain how a buffer works.	
	8.4	Describe oxidation and reduction reactions and give some every day examples, such as, fuel burning, corrosion. Assign oxidation numbers in a reaction.	

ENTRY POINTS and ACCESS SKILLS to High School Chemistry

Less Complex ⟷ **More Complex**

	ACCESS SKILLS	ENTRY POINTS		
	The student will:	**The student will:**	**The student will:**	**The student will:**
Elements, Compounds, and Mixtures; Atomic Structure and Nuclear Chemistry	*Access skills for this topic can be found under the Grades: 6–8 Learning Standards*	♦ Label parts of the atom (protons, neutrons, and electrons) ♦ Label different atoms in a mixture ♦ Label the compound formed when two or more atoms bond ♦ Match electron configurations to one or more elements *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Classify familiar matter as a substance or mixture ♦ Classify mixtures as heterogeneous or homogeneous ♦ Describe the differences between protons, neutrons, and electrons ♦ Compare electron configurations of one or more elements	♦ Describe the function or purpose of protons, neutrons, and/or electrons ♦ Describe the difference between nuclear fission and nuclear fusion ♦ Explain radioactive decay ♦ Give examples of the three types of radioactive decay *Continue to address skills and concepts in this strand that approach grade-level expectations*
Periodicity	♦ Track materials related to the Periodic Table or chemical bonding ♦ Shift focus from materials to speaker in an activity related to the Periodic Table or chemical bonding ♦ Grasp materials related to the Periodic Table or chemical bonding	♦ Classify elements in the Periodic Table as metals, non-metals, or metalloids ♦ Match element to its atomic symbol and/or atomic number *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Identify the layout of the Periodic Table that allows recognition of features of a particular element ♦ Identify metals and nonmetals using the Periodic Table	♦ Describe characteristics of elements based on their placement in the Periodic Table ♦ Differentiate atoms that can bond with other atoms from those that cannot ♦ Identify or illustrate the atomic composition of elements *Continue to address skills and concepts in this strand that approach grade-level expectations*

Less Complex ← → **More Complex**

	ACCESS SKILLS The student will:	ENTRY POINTS The student will:
Periodicity (continued)	♦ Use two hands to hold materials related to the Periodic Table or chemical bonding ♦ Release materials related to the Periodic Table or chemical bonding ♦ Move materials related to the Periodic Table or chemical bonding ♦ Orient materials related to the Periodic Table or chemical bonding ♦ Manipulate objects related to the Periodic Table or chemical bonding ♦ Locate objects partially hidden or out of sight needed in an activity related to the Periodic Table or chemical bonding ♦ Use one object to act on another in an activity related to the Periodic Table or chemical bonding ♦ Turn on technology in an activity related to the Periodic Table or chemical bonding (e.g. activate a computer program to play a periodic table game) ♦ Imitate action in an activity related to the Periodic Table or chemical bonding ♦ Initiate cause-and-effect response during an activity related to the Periodic Table or chemical bonding ♦ Sustain through response in an activity related to the Periodic Table or chemical bonding ♦ Gain attention during activity related to the Periodic Table or chemical bonding ♦ Make a request during an activity (e.g., request a turn) related to the Periodic Table or chemical bonding ♦ Choose within a specified amount of time (e.g., 30 seconds) from an errorless array in an activity related to the Periodic Table or chemical bonding ♦ Respond to materials related to the Periodic Table or chemical bonding ♦ Attend visually, aurally, or tactilely to materials related to the Periodic Table or chemical bonding	

ENTRY POINTS to High School Chemistry

Less Complex → **More Complex**

	The student will:	The student will:	The student will:
Chemical Bonding	♦ Identify new materials (compounds) that are formed by combining two or more elements *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Describe properties of each substance in a compound (e.g., sodium + chloride → NaCl (salt) ♦ Describe how atoms bond in order to create compounds and molecules ♦ List properties of ionic and/or covalent compounds	♦ Differentiate between ionic and covalent bonding ♦ Illustrate how atoms seek stability by maximizing (completing) the outermost electron level ♦ Illustrate that different properties exist between reactants and end product (Na + Cl → NaCl) ♦ Describe the unique chemical and physical characteristics of water *Continue to address skills and concepts in this strand that approach grade-level expectations*
Reactions and Stoi-chiometry	♦ Illustrate the creation of various mixtures and compounds at the molecular level *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Describe the characteristics of chemical reactions ♦ Classify chemical reactions as either synthesis (combination) or decomposition ♦ Identify the mole as a way of counting the number of atoms	♦ Create chemical equations to represent a chemical reaction between reactants and product (result) ♦ Balance simple chemical equations ♦ Determine the number of moles in a chemical equation (e.g., $H_2 + O \rightarrow H_2O$ means that two moles of H and one mole of O combine to make one mole of water) *Continue to address skills and concepts in this strand that approach grade-level expectations*

ENTRY POINTS to High School Chemistry

Less Complex ⟷ **More Complex**

	The student will:	The student will:	The student will:
Solutions, Rates of Reactions, and Equil-ibrium	♦ Identify the combination of various substances in which the substances dissolve in a liquid as a solution ♦ Identify the combination of various substances in which the substances do not change characteristics as a mixture ♦ Identify the solute and the solvent in a solution ♦ Give examples of solutes that dissolve in solvents *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Identify factors affecting the rate at which solutes dissolve (e.g., temperature, mixing, concentration, surface area) ♦ Compare and contrast the properties of solutions and solvents ♦ Identify solutes that dissolve more easily than others	♦ Describe how various factors affect the rate at which solutes dissolve ♦ Determine the concentration of a solution in terms of molarity *Continue to address skills and concepts in this strand that approach grade-level expectations*
Acids and Bases and Oxidation-Reduction Reactions	♦ Identify the characteristics of acids and/or bases ♦ Give examples of acids ♦ Give examples of bases *Continue to address earlier standards in this topic at a level that challenges the student*	♦ Classify acids/bases by the way they react using litmus paper (i.e., acids turn the paper red, bases turn the paper blue) ♦ Explain the basic pH scale (i.e., 7 is neutral, >7 is basic, <7 is acidic)	♦ Use the pH scale to classify substances that are more/less acidic, more/less basic ♦ Provide real-life examples of simple oxidation and reduction reactions ♦ Provide examples of real-life situations in which a pH buffer would be used *Continue to address skills and concepts in this strand that approach grade-level expectations*