SOUTH DAKOTA SCIENCE STANDARDS
9-12

Core High School Nature of Science
Standards, Supporting Skills, and Examples

Indicator 1: Understand the nature and origin of scientific knowledge.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Evaluation)	**9-12.N.1.1. Students are able to evaluate a scientific discovery to determine and describe how societal, cultural, and personal beliefs influence scientific investigations and interpretations.** **Examples**: telescope, birth control pill, penicillin, electricity • Recognize scientific knowledge is not merely a set of static facts but is dynamic and affords the best current explanations. Examples: spontaneous generation, relativity, geologic time • Discuss how progress in science can be affected by social issues.
(Synthesis)	**9-12.N.1.2. Students are able to describe the role of observation and evidence in the development and modification of hypotheses, theories, and laws.** • Research, communicate, and support a scientific argument. • Recognize and analyze alternative explanations and models. • Evaluate the scientific accuracy of information relevant to a specific issue (pseudo-science).

Indicator 2: Apply the skills necessary to conduct scientific investigations.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.N.2.1. Students are able to apply science process skills to design and conduct student investigations.** • Identify the questions and concepts to guide the development of hypotheses. • Analyze primary sources of information to guide the development of the procedure. • Select and use appropriate instruments to extend observations and measurements. • Revise explanations and models based on evidence and logic. • Use technology and mathematic skills to enhance investigations, communicate results, and defend conclusions. Examples: Computer-based data collection Graphical analysis and representation Use appropriate technology to display data (i.e. spreadsheets, PowerPoint, web).
(Application)	**9-12.N.2.2. Students are able to practice safe and effective laboratory techniques.** • Handle hazardous materials properly. • Use safety equipment correctly. • Practice emergency procedure. • Wear appropriate attire. • Practice safe behaviors.

Core High School Nature of Science
Performance Descriptors

Advanced	**High school students performing at the advanced level:** • given a scientific discovery, evaluate how different societal, cultural, and personal beliefs influenced the investigation and its interpretation; • design and conduct an investigation using an alternative student- developed hypothesis.
Proficient	**High school students performing at the proficient level:** • given a scientific discovery narrative, determine and describe how societal, cultural, and personal beliefs influenced the investigation and its interpretation; • describe the role of observation and evidence in the development and modification of hypotheses, theories, and laws; then apply science process skills to design and conduct student investigations.
Basic	**High school students performing at the basic level:** • describe the role of observation in the development of hypotheses, theories, and laws and conduct student investigations; • given a scientific discovery narrative, identify the cultural and personal beliefs that influenced the investigation.

Core High School Nature of Science
ELL Performance Descriptors

Proficient	**High school ELL students performing at the proficient level**: • describe the role of observation in the development of hypotheses; • conduct student investigations.
Intermediate	**High school ELL students performing at the intermediate level:** • identify the role of observation in the development of hypotheses; • participate in student investigations with peers.
Basic	**High school ELL students performing at the basic level:** • use observations to collect data; • observe student investigations with peers; • respond correctly to yes or no questions on topics presented in class.
Emergent	**High school ELL students performing at the emergent level:** • use correct pronunciation of science words; • use non-verbal communication to express scientific ideas.

Pre-emergent	**High school ELL students performing at the pre-emergent level**: • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

Core High School Physical Science
Standards, Supporting Skills, and Examples

Indicator 1: Describe structures and properties of, and changes in, matter

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Analysis)	**9-12.P.1.1. Students are able to use the Periodic Table to determine the atomic structure of elements, valence number, family relationships, and regions (metals, nonmetals, and metalloids).** • Determine protons, neutrons, electrons, mass number, and atomic number from the Periodic Table. • Determine the number of valence electrons for elements in the main (s&p) blocks of the Periodic Table. • Identify the relative metallic character of an element based on its location on the Periodic Table.
(Comprehension)	**9-12.P.1.2. Students are able to describe ways that atoms combine.** • Name and write formulas for binary ionic and covalent compounds. Example: sodium chloride (NaCl), carbon dioxide (CO_2) • Compare the roles of electrons in covalent, ionic, and metallic bonding. • Discuss the special nature of carbon covalent bonds.
(Application)	**9-12.P.1.3. Students are able to predict whether reactions will speed up or slow down as conditions change.** **Examples**: temperature, concentration, surface area, and catalysts
(Application)	**9-12.P.1.4. Students are able to balance chemical equations by applying the Law of Conservation of Matter.** • Trace number of particles in diagrams and pictures of balanced equations. Example: Write out an equation with symbols: $Mg + 2HCL \rightarrow MgCl_2 + 2H_2$

(Comprehension)	**9-12.P.1.5. Students are able to distinguish among chemical, physical, and nuclear changes.** • Differentiate between physical and chemical properties used to describe matter. • Identify key indicators of chemical and physical changes. • Describe the effects of changing pressure, volume, or temperature upon gases. • Identify characteristics of a solution and factors that affect the rate of solution formation. • Explain the differences among nuclear, chemical, and physical changes at the atomic level. Examples: solute, solvent, concentrated, dilute, saturated, unsaturated, supersaturated Factors affecting rate: agitation, heating, particle size, pictures of particles

Indicator 2: Analyze forces, their forms, and their effects on motions.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Analysis)	**9-12.P.2.1. Students are able to apply concepts of distance and time to the quantitative relationships of motion using appropriate mathematical formulas, equations, and units.** • Evaluate speed, velocity, and acceleration both qualitatively and quantitatively. Examples: Identify the sign (+,-, 0) of an object's acceleration based on velocity information. Predict whether an object speeds up, slows down, or maintains a constant speed based on the forces acting upon it. Calculate acceleration using the equation $A_{avg}=\Delta V/\Delta t$. • Given distance and time, calculate the velocity or speed of an object. • Create and interpret graphs of linear motion. Example: Given a velocity-time or a distance-time graph with

	different slopes, determine the motion of an object. • Distinguish between velocity and acceleration as related to force.
(Application)	**9-12.P.2.2. Students are able to predict motion of an object using Newton's Laws.** • Describe how inertia is related to Newton's First Law. • Explain the effect of balanced and unbalanced forces. • Identify the forces at work on action/reaction pairs as distinguished from balanced forces. Examples: Draw a linear force diagram for the forces acting on an object in contact with another. Identify action/reaction pairs. • Explain how force, mass, and acceleration are related.
(Application)	**9-12.P.2.3. Students are able to relate concepts of force, distance, and time to the quantitative relationships of work, energy, and power.** • Apply appropriate mathematical formulas and equations to concepts using appropriate units. Examples: Calculate power given force, distance and time. Calculate work done on an object given force and distance.

Indicator 3: Analyze interactions of energy and matter.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Application)	**9-12.P.3.1. Students are able to describe the relationships among potential energy, kinetic energy, and work as applied to the Law of Conservation of Energy.** • Describe how energy can be transferred and transformed to produce useful work. Examples: Diagram simple energy transfers, describing the objects and the forms of energy gained and lost. Use simple machines as an example of the transmission

	of energy. • Given the formulas, calculate the mechanical advantage and efficiency of selected systems. • Explain methods of heat transfer. Examples: conduction, radiation, and convection
(Comprehension)	**9-12.P.3.2. Students are able to describe how characteristics of waves are related to one another.** • Relate wavelength, speed, and frequency ($v = \lambda f$). • Distinguish between transverse and longitudinal waves. Examples: Discuss changes in frequency of waves using the Doppler Effect. Compare the energy of different frequency ranges of waves with in the electromagnetic spectrum. Describe how different colors of light waves have different amounts of energy.
(Application)	**9-12.P.3.3. Students are able to describe electrical effects in terms of motion and concentrations of charged particles.** • Relate potential difference to current. • Describe how static electricity is different from current electricity. • Interpret and apply Ohm's Law. • Describe electrical attractions and repulsions. • Describe how magnetism originates from motion of charged particles.

Core High School Physical Science
Performance Descriptors

Advanced	**High school students performing at the advanced level:** • predict the type of bonds formed as elements combine; • balance chemical equations involving polyatomic ions; • analyze and solve a problem involving velocity, acceleration, force, work, energy, or power; • construct or design a model that illustrates the Law of Conservation of Energy to show energy changes from potential to kinetic in doing work; • describe electrical effects in terms of motion and concentrations of charged particles.
Proficient	**High school students performing at the proficient level:** • use the Periodic Table to determine the properties of elements and the ways they combine; • given a variable, predict whether reactions will speed up or slow down as conditions change; • balance simple chemical equations; • describe chemical, physical, and nuclear changes at the atomic and macroscopic levels; • calculate velocity, acceleration, force, work, energy, and power given the formulas; • given the forces acting on an object, predict its motion using Newton's Laws; • apply the Law of Conservation of energy to show energy changes from potential to kinetic in doing work; • describe how characteristics of waves are related to one another; • describe electrical effects in terms of motion and concentrations of charged particles.
Basic	**High school students performing at the basic level:** • use the Periodic Table to determine the properties of the 1st 18 elements; • provide the coefficients for an unbalanced synthesis or decomposition equation; • identify chemical and physical changes at the macroscopic level; • calculate velocity and force given the formulas; • given an example, identify which of Newton's Laws is illustrated; • identify the characteristics of waves; • identify electricity as movement of charged particles.

Core High School Physical Science
ELL Performance Descriptors

Proficient	**High school ELL students performing at the proficient level:** • read the Periodic Table to gather information about elements; • describe basic chemical and physical changes; • describe what a force is; • define the parts of waves; • recognize that electricity is movement of charged particles.
Intermediate	**High school ELL students performing at the intermediate level:** • read the Periodic Table; • recognize basic chemical and physical changes; • identify what a force is; • label parts of a wave; • turn a circuit on and off.
Basic	**High school ELL students performing at the basic level:** • know what the Periodic Table is; • observe physical changes in matter; • demonstrate a force; • recognize a wave; • identify usage of electricity in daily life.
Emergent	**High school ELL students performing at the emergent level:** • use correct pronunciation of science words; • use non-verbal communication to express scientific ideas.
Pre-emergent	**High school ELL students performing at the pre-emergent level**: • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

Core High School Life Science
Standards, Supporting Skills, and Examples

Indicator 1: Understand the fundamental structures, functions, classifications, and mechanisms found in living things.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Analysis)	**9-12.L.1.1. Students are able to relate cellular functions and processes to specialized structures within cells.** • Transport Examples: cell membrane, homeostasis • Photosynthesis and respiration Examples: ATP-ADP energy cycle Role of enzymes Mitochondria Chloroplasts • Storage and transfer of genetic information Examples: replication, transcription, and translation • Cell life cycles Examples: somatic cells (mitosis), germ cells (meiosis)
(Application)	**9-12.L.1.2. Students are able to classify organisms using characteristics and evolutionary relationship of major taxa.** • Kingdoms Examples: animals, plants, fungi, protista, monera • Phyla Examples: invertebrates, vertebrates, divisions of plants Note: There is an ongoing scientific debate about the number of groupings and which organisms should be included in each.
(Analysis)	**9-12.L.1.3. Students are able to identify structures and function relationships within major taxa.** **Examples**: Relate how the layers in a leaf support leaf function. Interaction of agonist and antagonist muscles to support bone movement

Indicator 2: Analyze various patterns and products of natural and induced biological change.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Application)	**9-12.L.2.1. Students are able to predict inheritance patterns using a single allele.** • Solve problems involving simple dominance, co-dominance, and sex-linked traits using Punnett squares for F1 and F2 generations. Examples: color blindness, wavy hair • Discuss disorders resulting from alteration of a single gene. Example: hemophilia, cystic fibrosis
(Synthesis)	**9-12.L.2.2. Students are able to describe how genetic recombination, mutations, and natural selection lead to adaptations, evolution, extinction, or the emergence of new species.** **Examples**: behavioral adaptations, environmental pressures, allele variations, bio-diversity • Use comparative anatomy to support evolutionary relationships.

Indicator 3: Analyze how organisms are linked to one another and the environment.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Comprehension)	**9-12.L.3.1. Students are able to identify factors that can cause changes in stability of populations, communities, and ecosystems.** • Define populations, communities, ecosystems, niches and symbiotic relationships. • Predict the results of biotic and abiotic interactions. Examples: Responses to changing of the seasons Tolerances (temperature, weather, climate) Dormancy and migration Fluctuation in available resources (water, food, shelter) Human activity Biogeochemical cycles

	Energy flow Cooperation and competition in ecosystems Response to external stimuli

Core High School Life Science
Performance Descriptors

Advanced	**High school students performing at the advanced level:** • explain the steps of photophosphorylation and the Calvin Cycle; • analyze chemical reaction and chemical processes involved in the Calvin Cycle and Krebs Cycle; • predict the function of a given structure; • predict the outcome of changes in the cell cycle; • explain how protein production is regulated; • predict how homeostasis is maintained within living systems; • predict how traits are transmitted from parents to offspring; • construct an original dichotomous key.
Proficient	**High school students performing at the proficient level:** • describe and give examples of chemical reactions required to sustain life (hydrolysis, dehydration synthesis, photosynthesis, cellular respiration, ADP/ATP, role of enzymes); • describe the relationship between structure and function (cells, tissues, organs, organ systems, and organisms); • compare and contrast the cell cycles in somatic and germ cells; • tell how DNA determines protein formation; • explain how homeostasis is maintained within living systems; • explain how traits are transmitted from parents to offspring; • predict the impact of genetic changes in populations (mutation, natural selection and artificial selection, adaptation/extinction); • predict how life systems respond to changes in the environment; • classify organisms using a dichotomous key.
Basic	**High school students performing at the basic level:** • name chemical reactions required to sustain life (hydrolysis, dehydration synthesis, photosynthesis, cellular respiration, ADP/ATP, role of enzymes); • recognize that different structures perform different functions;

	• describe the life cycle of somatic cells; • identify DNA as the structure that carries the genetic code; • define homeostasis; • identify that genetic traits can be transmitted from parents to offspring; • know the purpose of a dichotomous key.

Core High School Life Science
ELL Performance Descriptors

Proficient	**High school ELL students performing at the proficient level:** • name chemical reactions involved in photosynthesis and cellular respiration; • recognize the structure and function of the cell membrane, nucleus, mitochondria, and chloroplasts; • describe the phases of mitosis and meiosis; • identify DNA as the structure that carries the genetic code; • recognize that homeostasis occurs in cells; • identify that genetic traits can be transmitted from parents to offspring; • know the purpose of a dichotomous key.
Intermediate	**High school ELL students performing at the intermediate level:** • label chemical reactions involved in photosynthesis and cellular respiration; • label the cell membrane, nucleus, mitochondria, and chloroplasts in a cell diagram; • label the phases of mitosis and meiosis in a diagram; • recognize that materials are transported across the cell membrane; • recognize that genetic traits can be transmitted from parents to offspring; • sort collections of animal/plant photos into appropriate groups.
Basic	**High school ELL students performing at the basic level:** • recognize chemical reactions involved in photosynthesis and cellular respiration; • identify the cell membrane, nucleus, mitochondria, and chloroplasts in a cell diagram; • identify the phases of mitosis and meiosis in a diagram; • know the function of a cell membrane; • identify genetic traits (eye color, hair color); • recognize that animal/plants are sorted into groups.

Emergent	**High school ELL students performing at the emergent level:** • use correct pronunciation of science words; • use non-verbal communication to express scientific ideas.
Pre-emergent	**High school ELL students performing at the pre-emergent level**: • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

Core High School Earth/Space Science
Standards, Supporting Skills, and Examples

Indicator 1: Analyze the various structures and processes of the Earth system.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Comprehension)	**9-12.E.1.1. Students are able to explain how elements and compounds cycle between living and non-living systems.** • Diagram and describe the N, C, O and H_2O cycles. • Describe the importance of the N, C, O and H_2O cycles to life on this planet. Examples: water cycle including evaporation, cloud formation, condensation.
(Application)	**9-12.E.1.2. Students are able to describe how atmospheric chemistry may affect global climate.** **Examples**: Greenhouse Effect, ozone depletion, ocean's effects on weather
(Analysis)	**9-12.E.1.3. Students are able to assess how human activity has changed the land, ocean, and atmosphere of Earth.** **Examples**: forest cover, chemical usage, farming, urban sprawl, grazing

Indicator 2: Analyze essential principles and ideas about the composition and structure of the universe.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Comprehension)	**9-12.E.2.1. Students are able to recognize how Newtonian mechanics can be applied to the study of the motions of the solar system.** • Given a set of possible explanations of orbital motion (revolution), identify those that make use of gravitational forces and inertia.

Core High School Earth/Space Science
Performance Descriptors

Advanced	**High school students performing at the advanced level:** • predict the effect of an interruption in a given cycles; • predict how human activity may change the land, ocean, and atmosphere of Earth.
Proficient	**High school students performing at the proficient level:** • explain how H_20, N, C, and O cycle between living and non-living systems; • recognize how Newtonian mechanics can be applied to the study of the motions of the solar system; • describe how various factors may affect global climate; • explain how human activity changes the land, ocean, and atmosphere of Earth.
Basic	**High school students performing at the basic level:** • given pictorial representations of the H_20 and C cycles, explain how elements and compounds move between living and nonliving systems; • identify the forces that cause motion in the solar system; • describe one factor that may affect global climate; • give an example of human activity that changes the land, ocean, or atmosphere of Earth.

Core High School Earth/Space Science
ELL Performance Descriptors

Proficient	**High school ELL students performing at the proficient level:** • given a pictorial representation of the H2O and C cycle, explain how elements and compounds move between living and nonliving systems; • describe why the Earth rotates around the sun, the Moon rotates around the Earth, and why the Earth has tides; • describe one factor that may affect global climate; • give an example of human activity that changes the land, ocean, or atmosphere of Earth.
Intermediate	**High school ELL students performing at the intermediate level:** • given a pictorial representation of the H2O cycle, label transpiration, condensation, evaporation, run-off, and ground water; • identify the force of gravity; • identify factors that may affect global climate; • give an example of human activity that changes the land and ocean.

Basic	**High school ELL students performing at the basic level:** • recognize a pictorial representation of the H2O cycle; • demonstrate how objects fall to the ground (ball, feather); • recognize factors that may affect global climate; • give an example of human activity that changes the land.
Emergent	**High school ELL students performing at the emergent level:** • use correct pronunciation of science words; • use non-verbal communication to express scientific ideas.
Pre-emergent	**High school ELL students performing at the pre-emergent level:** • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

Core High School Science, Technology, Environment, and Society
Standards, Supporting Skills, and Examples

Indicator 1: Analyze various implications/effects of scientific advancement within the environment and society.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Application)	**9-12.S.1.1. Students are able to explain ethical roles and responsibilities of scientists and scientific research.** **Examples:** Sharing of data Accuracy of data Acknowledgement of sources Following laws Animal research Human research Managing hazardous materials and wastes
(Evaluation)	**9-12.S.1.2. Students are able to evaluate and describe the impact of scientific discoveries on historical events and social, economic, and ethical issues.** **Examples**: cloning, stem cells, gene splicing, nuclear power, patenting new life forms, emerging diseases, AIDS, resistant forms of bacteria, biological and chemical weapons, global warming, and alternative fuels

Indicator 2: Analyze the relationships/interactions among science, technology, environment, and society.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Evaluation)	**9-12.S.2.1. Students are able to describe immediate and long-term consequences of potential solutions for technological issues.** **Examples**: environmental, communication, internet, entertainment, construction, manufacturing, power and transportation, energy sources, health technology, and biotechnology issues • Describe how the pertinent technological system operates. Example: waste management facility

(Analysis)	**9-12.S.2.2. Students are able to analyze factors that could limit technological design**. **Examples**: ethics, environmental impact, manufacturing processes, operation, maintenance, replacement, disposal, and liability
(Synthesis)	**9-12.S.2.3. Students are able to analyze and describe the benefits, limitations, cost, and consequences involved in using, conserving, or recycling resources.** **Examples**: mining, agriculture, medicine, school science labs, forestry, energy, disposable diapers, computers, tires

Core High School Science Technology, Environment, and Society
Performance Descriptors

Advanced	**High school students performing at the advanced level:** • modify a technology taking into consideration limiting factors of design; • given a narrative of a scientific discovery, defend a position on the impact of the ethical issues.
Proficient	**High school students performing at the proficient level:** • given a narrative of a scientific discovery, identify and evaluate the immediate and long-term consequences of scientific issues; • identify and explain ethical roles and responsibilities of scientists conducting a given research project.; • evaluate factors that could limit technological design; • given a narrative description of a resource, analyze and describe the benefits, limitations, cost, and consequences involved in its use, conservation, or recycling.
Basic	**High school students performing at the basic level:** • given a narrative of a scientific discovery, identify the immediate consequences of scientific issues; • identify ethical roles and responsibilities concerning a given research project; • identify factors that could limit technological design; • given a narrative description of a resource, describe a benefit and limitation involved in its use, conservation, or recycling.

Core High School Science Technology, Environment, and Society
ELL Performance Descriptors

Proficient	**High school ELL students performing at the proficient level:** • identify the immediate consequences of scientific issues; • identify ethical roles and responsibilities concerning a given research project; • identify factors that could limit technological design; • given a narrative description of a resource, describe a benefit and limitation involved in its use, conservation, or recycling.
Intermediate	**High school ELL students performing at the intermediate level:** • identify the consequences of scientific issues; • identify ethical roles and responsibilities in scientific investigations; • identify a factor that could limit technological design; • given a narrative description of a resource, describe a benefit and limitation involved in its use.
Basic	**High school ELL students performing at the basic level:** • identify scientific issues; • identify that ethical issues exist in scientific research; • identify technological design; • define conservation and recycling.
Emergent	**High school ELL students performing at the emergent level:** • use correct pronunciation of science words; • use non-verbal communication to express scientific ideas.
Pre-emergent	**High school ELL students performing at the pre-emergent level:** • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

Advanced High School Nature of Science
Standards, Supporting Skills, and Examples

Indicator 1: Understand the nature and origin of scientific knowledge.

Note: These skills are initially mastered in the high school core standards. Teachers and students should continue to apply them in advanced standards to the study of science content.

Indicator 2: Apply the skills necessary to conduct scientific investigations.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** • Use a control and change one variable at a time. Examples: gas laws, seed germination and plant growth, Newton's Second Law
(Evaluation)	**9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results.** • Use correlation coefficient with graphs. Examples: chi-squared value in genetics, determination of absolute zero, verify concentration of an unknown solution
(Analysis)	**9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** • Use significant digits to illustrate precision in measurement. • Factor label conversion, scientific notation.

Advanced High School Physical Science
Standards, Supporting Skills, and Examples

Indicator 1: Describe structures and properties of, and changes in, matter.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Analysis)	**9-12.P.1.1A. Students are able to distinguish between the changing models of the atom using the historical experimental evidence.** **Examples**: Dalton, Thompson, Rutherford, Bohr, wave-mechanical models
(Synthesis)	**9-12.P.1.2A. Students are able to predict electron configuration, ion formation, reactivity, compound formation, periodic trends, and types of compounds formed based on location on the Periodic Table.** **Examples**: periodic trends including ionization, energy, electronegativity, atomic and ionic size, and shielding effect.
(Synthesis)	**9-12.P.1.3A. Students are able to identify five basic types of chemical reactions and predict the products.** • Single replacement, double replacement, synthesis, decomposition, and combustion reactions • Describe the properties and interactions of acids, bases, and salts. • Calculate pH, pOH, $[H_3O^+]$, $[OH^-]$. • Distinguish between Arrhenius, Bronsted-Lowry, and Lewis definitions of acids and bases.
(Synthesis)	**9-12.P.1.4A. Students are able to describe factors that affect solution interactions.** • Calculate concentration of solutions. • "Like dissolves like" • Vander Waal's forces

(Application)	**9-12.P.1.5A. Students are able to examine energy transfer as matter changes.** **Examples**: Determine ΔH, ΔG, ΔS for thermo-chemical equations. Calculate energy involved in phase changes. Compare the specific heats of various substances. • Describe physical and chemical processes that result in endothermic and exothermic changes. • Describe energy transfer as matter changes from one phase to another.
(Application)	**9-12.P.1.6A. Students are able to perform stoichiometric calculations.** • Convert between moles, mass, particles, volume. • Calculate empirical and molecular formulas from mass percents. • Determine limiting and excess reactants and percent yield in chemical reactions.
(Application)	**9-12.P.1.7A. Students are able to apply the kinetic molecular theory to solve quantitative problems involving pressure, volume, temperature, and number of moles of gas.** • Apply Boyle's Law, Charles' Law, Gay-Lussac's Law, Combined Gas Law, and Ideal Gas Law.
(Synthesis)	**9-12.P.1.8A. Students are able to use models to make predictions about molecular structure, chemical bonds, chemical reactivity, and polarity of molecules.** • Create Lewis structures for molecules and polyatomic ions. • Determine molecular shape using VSEPR theory. • Determine the polarity of a molecule.
(Analysis)	**9-12.P.1.9A. Students are able to describe the characteristics of equilibria.** • Apply LeChatelier's principle to equilibrium reactions. • Identify factors that drive reactions toward completion. • Calculate K_{eq} values for equilibrium reactions.

Indicator 2: Analyze forces, their forms, and their effects on motions.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.P.2.1A. Students are able to solve vector problems graphically and analytically.** • Define and manipulate vectors and scalars. • Determine if an object is in equilibrium and distinguish among stable, neutral, and unstable equilibria. Examples: center of mass, torque
(Analysis)	**9-12.P.2.2A. Students are able to relate gravitational or centripetal force to projectile or uniform circular motion.** • Analyze and graph projectile motion.

Indicator 3: Analyze interactions of energy and matter.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.P.3.1A. Students are able to explain wave behavior in the fundamental processes of reflection, refraction, diffraction, interference, resonance, and image formation.** • Construct ray diagrams to show the relationship between image and focal point. • Compare properties of images (real vs virtual). • Identify situations when diffraction occurs. • Identify conditions necessary for refraction to occur.
(Application)	**9-12.P.3.2A. Students are able to describe the relationship between charged particles, static electricity, and electric fields.** • Use Coulomb's Law to calculate forces. • Explain methods of transferring charge. Examples: induction, conduction, friction, electron guns • Describe the direction and general shape of electric fields.

(Analysis)	**9-12.P.3.3A. Students are able to describe the relationship between changing magnetic and electric fields.** • Explain the properties of magnetic fields. • Describe how electric and magnetic fields can induce each other.

Advanced High School Life Science
Standards, Supporting Skills, and Examples

Indicator 1: Understand the fundamental structures, functions, classifications, and mechanisms found in living things.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.L.1.1A. Students are able to explain the physical and chemical processes of photosynthesis and cell respiration and their importance to plant and animal life.** **Examples**: photosystems, photophosphorylation, Calvin Cycle and Krebs Cycle
(Synthesis)	**9-12.L.1.2A. Students are able to describe how living systems use biofeedback mechanisms to maintain homeostasis.** **Examples**: endocrine, nervous, immune
(Synthesis)	**9-12.L.1.3A. Students are able to explain how gene expression regulates cell growth and differentiation.** **Examples:** Tissue formation Development of new cells from original stem cells
(Application)	**9-12.L.1.4A. Students are able to identify factors that change the rates of enzyme catalyzed reactions.** **Examples**: inhibitors, co-enzymes, ph balance, environment
(Analysis)	**9-12.L.1.5A. Students are able to classify organisms using characteristics and evolutionary relationships of domains.** **Examples:** eubacteria, archaebacteria, and eukaryotes

Indicator 2: Analyze various patterns and products of natural and induced biological change.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.L.2.1A. Students are able to predict the results of complex inheritance patterns involving multiple alleles and genes.** **Examples**: human skin color, polygenic inheritance • Relate crossing over to genetic variation. • Evaluate changes in gene frequencies in populations to

	see if Hardy-Weinberg equilibrium exists or evolution has occurred.

Indicator 3: Analyze how organisms are linked to one another and the environment.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Synthesis)	**9-12.L.3.1A. Students are able to relate genetic, instinct, and behavior patterns to biodiversity and survival of species.** • Compare and contrast learned behavior vs instinct. Example: nature vs nurture • Relate the introduction of non-native species to the disruption of an ecosystem. Examples: Asian lady beetle, Asian carp, zebra mussels, Eurasian watermilfoil, salt cedar

Advanced High School Earth/Space Science
Standards, Supporting Skills, and Examples

Indicator 1: Analyze the various structures and processes of the Earth system.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Application)	**9-12.E.1.1A. Students are able to explain how elements and compounds cycle between living and non-living systems.** • Diagram and describe the P, S, and Ca cycles.
(Analysis)	**9-12.E.1.2A. Students are able to compare, quantitatively and qualitatively, methods used to determine geological time.** **Examples**: fossil record, radioactive decay, tree rings, geologic stratification, South Dakota geology • Construct a geologic time scale over the past 4.8 billion years.

Indicator 2: Analyze essential principles and ideas about the composition and structure of the universe.

Bloom's Taxonomy Level	Standard, Supporting Skills, and Examples
(Analysis)	**9-12.E.2.1A. Students are able to describe the evidence supporting the Big Bang theory.** • Describe the four fundamental forces. • Describe the organization of the solar system, the Milky Way galaxy, and the universe of galaxies. • Examine the changing model of the universe using historical experimental evidence.
(Analysis)	**9-12.E.2.2A. Students are able to describe the physical and nuclear dynamics involved in the formation, evolution, and death of a star.** • Use the H-R diagram to determine the life stage of a star. • Discuss how gravitational forces and the products of nuclear fusion reactions affect the dynamics of a star.

(Application)	**9-12.E.2.3A. Students are able to describe various ways data about the universe is collected.** • Describe how information is collected from star light. Examples: star's mass, chemistry, intrinsic brightness, distance, speed, direction, and eventual fate • Describe the use of instruments to collect data. Examples: optical, radio, and x-ray telescopes, spectrometers, space probes, gamma ray detectors, remote sensing • Describe methods of measuring astronomical distance. Examples: parallax, light years, astronomical units

Advanced High School Science, Technology, Environment, and Society
Standards, Supporting Skills, and Examples

Note: All high school students are expected to master the indicators for this goal stated in the Core Standards above. Students will continue to apply them in advanced and elective coursework described for Physical, Life, and Earth/Space Science.

Indicator 1: Analyze various implications/effects of scientific advancement within the environment and society.

See note above.

Indicator 2: Analyze the relationships/interactions among science, technology, environment, and society.

See note above.

NATURE OF SCIENCE STANDARDS
9-12

Indicator 1: Understand the nature and origin of scientific knowledge.

Core HS Standards
9-12.N.1.1. (Evaluation) Evaluate a scientific discovery to determine and describe how societal, cultural, and personal beliefs influence scientific investigations and interpretations.
9-12.N.1.2. (Synthesis) Describe the role of observation and evidence in the development and modification of hypotheses, theories, and laws.

Indicator 2: Apply the skills necessary to conduct scientific investigations.

Note: These skills should be taught and practiced in grade-level study of Physical, Life, and Earth/Space Science although mastery is not expected at these grade levels.

Core HS Standards
9-12.N.2.1. (Synthesis) Apply science process skills to design and conduct student investigations**.**
9-12.N.2.2. (Application) Practice safe and effective laboratory techniques.
Advanced HS Standards
9-12.N.2.1A. (Synthesis) Manipulate multiple variables with repeated trials.
9-12.N.2.2A. (Evaluation) Use statistical analysis of data to evaluate the validity of results.
9-12.N.2.3A. (Analysis) Demonstrate correct precision in measurements and calculations.

PHYSICAL SCIENCE STANDARDS
9-12

Indicator 1: Describe structures and properties of, and changes in, matter.

Core HS Standards
9-12.P.1.1. (Analysis) Use the Periodic Table to determine the atomic structure of elements, valence number, family relationships, and regions (metals, nonmetals, and metalloids).
9-12.P.1.2. (Comprehension) Describe ways that atoms combine.
9-12.P.1.3. (Application) Predict whether reactions will speed up or slow down as conditions change.
9-12.P.1.4. (Application) Balance chemical equations by applying the Law of Conservation of Matter.
9-12.P.1.5. (Comprehension) Distinguish among chemical, physical, and nuclear changes.
Advanced HS Standards
9-12.P.1.1A. (Analysis) Distinguish between the changing models of the atom using the historical experimental evidence.
9-12.P.1.2A. (Synthesis) Predict electron configuration, ion formation, reactivity, compound formation, periodic trends, and types of compounds formed based on location on the Periodic Table.
9-12.P.1.3A. (Synthesis) Identify five basic types of chemical reactions and predict the products.
9-12.P.1.4A. (Synthesis) Describe factors that affect solution interactions.
9-12.P.1.5A. (Application) Examine energy transfer as matter changes.
9-12.P.1.6A. (Application) Perform stoichiometric calculations.
9-12.P.1.7A. (Application) Apply the kinetic molecular theory to solve quantitative problems involving pressure, volume, temperature, and number of

moles of gas.
9-12.P.1.8A. (Synthesis) Use models to make predictions about molecular structure, chemical bonds, chemical reactivity, and polarity of molecules.
9-12.P.1.9A. (Analysis) Describe the characteristics of equilibria.

Indicator 2: Analyze forces, their forms, and their effects on motions.

Core HS Standards
9-12.P.2.1. (Analysis) Apply concepts of distance and time to the quantitative relationships of motion using appropriate mathematical formulas, equations, and units.
9-12.P.2.2. (Application) Predict motion of an object using Newton's Laws.
9-12.P.2.3. (Application) Relate concepts of force, distance, and time to the quantitative relationships of work, energy, and power.
Advanced HS Standards
9-12.P.2.1A. (Synthesis) Solve vector problems graphically and analytically.
9-12.P.2.2A. (Analysis) Relate gravitational or centripetal force to projectile or uniform circular motion.

Indicator 3: Analyze interactions of energy and matter.

Core HS Standards
9-12.P.3.1. (Application) Describe the relationships among potential energy, kinetic energy, and work as applied to the Law of Conservation of Energy.
9-12.P.3.2. (Comprehension) Describe how characteristics of waves are related to one another.
9-12.P.3.3. (Application) Describe electrical effects in terms of motion and concentrations of charged particles.

Advanced HS Standards
9-12.P.3.1A. (Synthesis) Explain wave behavior in the fundamental processes of reflection, refraction, diffraction, interference, resonance, and image formation.
9-12.P.3.2A. (Application) Describe the relationship between charged particles, static electricity, and electric fields.
9-12.P.3.3A. (Analysis) Describe the relationship between changing magnetic and electric fields.

LIFE SCIENCE STANDARDS
9-12

Indicator 1: Understand the fundamental structures, functions, classifications, and mechanisms found in living things.

Core HS Standards
9-12.L.1.1. (Analysis) Relate cellular functions and processes to specialized structures within cells.
9-12.L.1.2. (Application) Classify organisms using characteristics and evolutionary relationship of major taxa.
9-12.L.1.3. (Analysis) Identify structures and function relationships within major taxa.
Advanced HS Standards
9-12.L.1.1A. (Synthesis) Explain the physical and chemical processes of photosynthesis and cell respiration and their importance to plant and animal life.
9-12.L.1.2A. (Synthesis) Describe how living systems use biofeedback mechanisms to maintain homeostasis.
9-12.L.1.3A. (Synthesis) Explain how gene expression regulates cell growth and differentiation.
9-12.L.1.4A. (Application) Identify factors that change the rates of enzyme catalyzed reactions.
9-12.L.1.5A. (Analysis) Classify organisms using characteristics and evolutionary relationships of domains.

Indicator 2: Analyze various patterns and products of natural and induced biological change.

Core HS Standards
9-12.L.2.1. (Application) Predict inheritance patterns using a single allele.

9-12.L.2.2. (Synthesis) Describe how genetic recombination, mutations, and natural selection lead to adaptations, evolution, extinction, or the emergence of new species.
Advanced HS Standards
9-12.L.2.1A. (Synthesis) Predict the results of complex inheritance patterns involving multiple alleles and genes.

Indicator 3: Analyze how organisms are linked to one another and the environment.

Core HS Standards
9-12.L.3.1. (Comprehension) Identify factors that can cause changes in stability of populations, communities, and ecosystems.
Advanced HS Standards
9-12.L.3.1. (Synthesis) Relate genetic, instinct, and behavior patterns to biodiversity and survival of species.

EARTH/SPACE SCIENCE STANDARDS
9-12

Indicator 1: Analyze the various structures and processes of the Earth system.

Core HS Standards
9-12.E.1.1. (Comprehension) Explain how elements and compounds cycle between living and non-living systems.
9-12.E.1.2. (Application) Describe how atmospheric chemistry may affect global climate.
9-12.E.1.3. (Analysis) Assess how human activity has changed the land, ocean, and atmosphere of Earth.
Advanced HS Standards
9-12.E.1.1A (Application) Explain how elements and compounds cycle between living and non-living systems.
9-12.E.1.2A. (Analysis) Compare, quantitatively and qualitatively, methods used to determine geological time.

Indicator 2: Analyze essential principles and ideas about the composition and structure of the universe.

Core HS Standards
9-12.E.2.1. (Comprehension) Recognize how Newtonian mechanics can be applied to the study of the motions of the solar system.
Advanced HS Standards
9-12.E.2.1A. (Analysis) Describe the evidence supporting the Big Bang theory.
9-12.E.2.2A. (Analysis) Describe the physical and nuclear dynamics involved in the formation, evolution, and death of a star.
9-12.E.2.3A. (Application) Describe various ways data about the universe is collected.

SCIENCE, TECHNOLOGY, ENVIRONMENT, AND SOCIETY STANDARDS 9-12

Indicator 1: Analyze various implications/effects of scientific advancement within the environment and society.

Core HS Standards
9-12.S.1.1. (Application) Explain ethical roles and responsibilities of scientists and scientific research.
9-12.S.1.2. (Evaluation) Evaluate and describe the impact of scientific discoveries on historical events and social, economic, and ethical issues.
Advanced HS Standards
See note below.

Indicator 2: Analyze the relationships/interactions among science, technology, environment, and society.

Core HS Standards
9-12.S.2.1. (Evaluation) Describe immediate and long-term consequences of potential solutions for technological issues.
9-12.S.2.2. (Analysis) Analyze factors that could limit technological design.
9-12.S.2.3. (Synthesis) Analyze and describe the benefits, limitations, cost, and consequences involved in using, conserving, or recycling resources.
Advanced HS Standards
See note below.

Note: All high school students are expected to master the indicators for this goal stated in the Core Standards above. Students will continue to apply them in advanced and elective coursework described for Physical, Life, and Earth/Space Science.