Scientific Process Standards

B.1 Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices.

B.2 Scientific processes. The student uses scientific practices and equipment during laboratory and field investigations.

STAAR	Tools to Know	
≥ 40% of items will be dual coded	B.1(A)	demonstrate safe practices during laboratory and field investigations
	B.1(B)	demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials
	B.2(A)	know the definition of science and understand that it has limitations, as specified in chapter 112.34, subsection (b)(2) of 19 TAC
	B.2(B)	know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories
	B.2(C)	know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed
	B.2(D)	distinguish between scientific hypotheses and scientific theories
	B.2(E)	plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology
	B.2(F)	collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as data-collecting probes, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, balances, gel electrophoresis apparatuses, micropipettes, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures

Cell Structure and Function

B.4 Science concepts. The student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

STAAR	Readiness Standards		Supporting Standards	
5-6 items	B.4(B)	investigate and explain cellular processes, including homeostasis and transport of molecules	B.4(A)	compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity
	B.4(C)	compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza		

Organism Growth and Cell Differentiation

B.5 Science concepts. The student knows how an organism grows and the importance of cell differentiation.

3-4 items	B.5(A)	describe the stages of the cell cycle, including deoxyribonucleic acid (DNA) replication and mitosis, and the importance of the cell cycle to the growth of organisms	B.5(B)	describe the roles of DNA, ribonucleic acid (RNA), and environmental factors in cell differentiation
			B.5(C)	recognize that disruptions of the cell cycle lead to diseases such as cancer

Mechanisms of Genetics

B.6 Science concepts. The student knows the mechanisms of genetics such as the role of nucleic acids and the principles of Mendelian and non-Mendelian genetics.

10-11 items	B.6(A)	identify components of DNA, identify how information for specifying the traits of an organism is carried in the DNA, and examine scientific explanations for the origin of DNA	B.6(B)	recognize that components that make up the genetic code are common to all organisms
	B.6(E)	identify and illustrate changes in DNA and evaluate the significance of these changes	B.6(C)	explain the purpose and process of transcription and translation using models of DNA and RNA
	B.6(F)	predict possible outcomes of various genetic combinations such as monohybrid crosses, dihybrid crosses, and non-Mendelian inheritance	B.6(D)	recognize that gene expression is a regulated process
			B.6(G)	recognize the significance of meiosis to sexual reproduction

Evolutionary Theory

B.7 Science concepts. The student knows evolutionary theory is a scientific explanation for the unity and diversity of life.

STAAR	Readiness Standards		Supporting Standards	
6-7 items	B.7(A)	analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental	B.7(B)	examine scientific explanations of abrupt appearance and stasis in the fossil record
	B.7(E)	analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species	B.7(C)	analyze and evaluate how natural selection produces change in populations, not individuals
			B.7(D)	analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success
			B.7(F)	analyze other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination

Taxonomy of Organisms

B.8 Science concepts. The student knows that taxonomy is a branching classification based on the shared characteristics of organisms and can change as new discoveries are made.

3-4 items	B.8(B)	categorize organisms using a hierarchical classification system based on similarities and differences shared among groups	B.8(A)	define taxonomy and recognize the importance of a standardized taxonomic system to the scientific community
			B.8(C)	compare characteristics of taxonomic groups, including archaea, bacteria, protists, fungi, plants, and animals

Molecules

B.9 Science concepts. The student knows the significance of various molecules involved in metabolic processes and energy conversions that occur in living organisms.

4-5 items	B.9(A)	compare the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids	B.9(B)	compare the reactants and products of photosynthesis and cellular respiration in terms of energy, energy conversions, and matter
			B.9(C)	identify and investigate the role of enzymes

Levels of Biological Systems

B.10 Science concepts. The student knows that biological systems are composed of multiple levels.

6-8 items	B.10(A)	describe the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals	B.10(C)	analyze the levels of organization in biological systems and relate the levels to each other and to the whole system
	B.10(B)	describe the interactions that occur among systems that perform the functions of transport, reproduction, and response in plants		

Ecological Succession

B.11 Science concepts. The student knows that biological systems work to achieve and maintain balance.

2-3 items	B.11(B)	describe how events and processes that occur during ecological succession can change populations and species diversity	B.11(A)	summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems

Organism Behavior

B.12 Science concepts. The student knows that interdependence and interactions occur within an environmental system.

STAAR	Readiness Standards	Supporting Standards
7-8 items	B.12(A) interpret relationships, including predation, parasitism, commensalism, mutualism, and competition, among organisms B.12(C) analyze the flow of matter and energy through trophic levels using various models, including food chains, food webs, and ecological pyramids B.12(E) describe how environmental change can impact ecosystem stability	B.12(B) compare variations and adaptations of organisms in different ecosystems B.12(D) describe the flow of matter through the carbon and nitrogen cycles and explain the consequences of disrupting these cycles

Scientific Process Standards

B.2 Scientific processes. The student uses scientific practices and equipment during laboratory and field investigations.

B.3 Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom.

STAAR	Ways to Show
≥ 40% of items will be dual coded	B.2(G) analyze, evaluate, make inferences, and predict trends from data B.2(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports B.3(A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student B.3(B) communicate and apply scientific information extracted from various sources such as current events, published journal articles, and marketing materials B.3(C) draw inferences based on data related to promotional materials for products and services B.3(D) evaluate the impact of scientific research on society and the environment B.3(E) evaluate models according to their limitations in representing biological objects or events B.3(F) research and describe the history of biology and contributions of scientists

50 items	30-32 questions from Readiness Standards	18-20 questions from Supporting Standards

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Snapshot – Chemistry

Scientific Process Standards

C.1 **Scientific processes.** The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices.

C.2 **Scientific processes.** The student uses scientific practices to solve investigative questions.

Tools to Know

C.1(A)	demonstrate safe practices during laboratory and field investigations, including the appropriate use of safety showers, eyewash fountains, safety goggles or chemical splash goggles, as appropriate, and fire extinguishers
C.1(B)	know specific hazards of chemical substances such as flammability, corrosiveness, and radioactivity as summarized on the Safety Data Sheets (SDS)
C.1(C)	demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials
C.2(A)	know the definition of science and understand that it has limitations, as specified in chapter 112.35, subsection (b)(2) of 19 TAC
C.2(B)	know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories
C.2(C)	know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but may be subject to change as new areas of science and new technologies are developed
C.2(D)	distinguish between scientific hypotheses and scientific theories
C.2(E)	plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology, including graphing calculators, computers and probes, electronic balances, an adequate supply of consumable chemicals, and sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, and burettes
C.2(F)	collect data and make measurements with accuracy and precision
C.2(G)	express and manipulate chemical quantities using scientific conventions and mathematical procedures, including dimensional analysis, scientific notation, and significant figures

Properties of Matter

C.4 **Science concepts.** The student knows the characteristics of matter and can analyze the relationships between chemical and physical changes and properties.

Readiness Standards		Supporting Standards	
C.4(A)	differentiate between physical and chemical changes and properties	C.4(B)	identify extensive properties such as mass and volume and intensive properties such as density and melting point
C.4(D)	classify matter as pure substances or mixtures through investigation of their properties	C.4(C)	compare solids, liquids, and gases in terms of compressibility, structure, shape, and volume

Periodic Table

C.5 **Science concepts.** The student understands the historical development of the Periodic Table and can apply its predictive power.

C.5(B)	identify and explain the properties of chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals using the Periodic Table	C.5(A)	explain the use of chemical and physical properties in the historical development of the Periodic Table
C.5(C)	interpret periodic trends, including atomic radius, electronegativity, and ionization energy using the Periodic Table		

Atomic Theory

C.6 **Science concepts.** The student knows and understands the historical development of atomic theory.

C.6(D)	express the arrangement of electrons in atoms of representative elements using electron configurations and Lewis valence electron dot structures	C.6(A)	describe the experimental design and conclusions used in the development of modern atomic theory, including Dalton's Postulates, Thomson's discovery of electron properties, Rutherford's nuclear atom, and Bohr's nuclear atom
		C.6(B)	describe the mathematical relationships between energy, frequency, and wavelength of light using the electromagnetic spectrum
		C.6(C)	calculate average atomic mass of an element using isotopic composition

Ionic, Covalent, and Metallic Bonds

C.7 Science concepts. The student knows how atoms form ionic, covalent, and metallic bonds.

Readiness Standards		Supporting Standards	
C.7(A)	name ionic compounds containing main group or transition metals, covalent compounds, acids, and bases, using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules	C.7(D)	describe metallic bonding and explain metallic properties such as thermal and electrical conductivity, malleability, and ductility
C.7(B)	write the chemical formulas of ionic compounds containing representative elements, transition metals and common polyatomic ions, covalent compounds, and acids and bases	C.7(E)	classify molecular structure for molecules with linear, trigonal planar, and tetrahedral electron pair geometries as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory
C.7(C)	construct electron dot formulas to illustrate ionic and covalent bonds		

Changes in Chemical Reactions

C.8 Science concepts. The student can quantify the changes that occur during chemical reactions.

C.8(B)	calculate the number of atoms or molecules in a sample of material using Avogadro's number	C.8(A)	define and use the concept of a mole
C.8(E)	write and balance chemical equations using the law of conservation of mass	C.8(C)	calculate percent composition of compounds
		C.8(D)	differentiate between empirical and molecular formulas
		C.8(F)	differentiate among double replacement reactions, including acid-base reactions, and precipitation reactions, and oxidation-reduction reactions such as synthesis, decomposition, single replacement, and combustion reactions
		C.8(G)	perform stoichiometric calculations, including determination of mass and gas volume relationships between reactants and products and percent yield
		C.8(H)	describe the concept of limiting reactants in a balanced chemical equation

Principles of Gases

C.9 Science concepts. The student understands the principles of ideal gas behavior, kinetic molecular theory, and the conditions that influence the behavior of gases.

C.9(A)	describe and calculate the relations between volume, pressure, number of moles, and temperature for an ideal gas as described by Boyle's law, Charles' law, Avogadro's law, Dalton's law of partial pressure, and the ideal gas law	C.9(B)	describe the postulates of kinetic molecular theory

Behaviors of Solutions

C.10 Science concepts. The student understands and can apply the factors that influence the behavior of solutions.

C.10(B)	apply the general rules regarding solubility through investigations with aqueous solutions	C.10(A)	describe the unique role of water in solutions in terms of polarity
C.10(E)	distinguish among types of solutions such as electrolytes and nonelectrolytes; unsaturated, saturated, and supersaturated solutions; and strong and weak acids and bases	C.10(C)	calculate the concentration of solutions in units of molarity
		C.10(D)	calculate the dilutions of solutions using molarity
C.10(F)	investigate factors that influence solid and gas solubilities and rates of dissolution such as temperature, agitation, and surface area	C.10(G)	define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid-base reactions that form water
		C.10(H)	define pH and calculate the pH of a solution using the hydrogen ion concentration

Energy Changes in Chemical Reactions

C.11 Science concepts. The student understands the energy changes that occur in chemical reactions.

Readiness Standards		Supporting Standards	
C.11(C)	classify reactions as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis	C.11(A) C.11(B) C.11(D)	describe energy and its forms, including kinetic, potential, chemical, and thermal energies describe the law of conservation of energy and the processes of heat transfer in terms of calorimetry perform calculations involving heat, mass, temperature change, and specific heat

Nuclear Chemistry

C.12 Science concepts. The student understands the basic processes of nuclear chemistry.

		C.12(A) C.12(B)	describe the characteristics of alpha, beta, and gamma radioactive decay processes in terms of balanced nuclear equations compare fission and fusion reactions

Scientific Process Standards

C.2 Scientific processes. The student uses scientific practices to solve investigative questions.

C.3 Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom.

Ways to Show

C.2(H)	organize, analyze, evaluate, make inferences, and predict trends from data
C.2(I)	communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphs, journals, summaries, oral reports, and technology-based reports
C.3(A)	analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing
C.3(B)	communicate and apply scientific information extracted from various sources such as current events, published journal articles, and marketing materials
C.3(C)	draw inferences based on data related to promotional materials for products and services
C.3(D)	evaluate the impact of research on scientific thought, society, and the environment
C.3(E)	describe the connection between chemistry and future careers
C.3(F)	describe the history of chemistry and contributions of scientists

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Snapshot – Integrated Physics and Chemistry

Scientific Process Standards

I.1 **Scientific processes.** The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices.

I.2 **Scientific processes.** The student uses scientific practices during laboratory and field investigations.

Tools to Know

I.1(A)	demonstrate safe practices during laboratory and field investigations, including the appropriate use of safety showers, eyewash fountains, safety goggles or chemical splash goggles, as appropriate, and fire extinguishers
I.1(B)	know specific hazards of chemical substances such as flammability, corrosiveness, and radioactivity as summarized on the Safety Data Sheets (SDS)
I.1(C)	demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials
I.2(A)	know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section
I.2(B)	plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology
I.2(C)	collect data and make measurements with accuracy and precision

Force and Motion

I.4 **Science concepts.** The student knows concepts of force and motion evident in everyday life.

Readiness Standards

I.4(A)	describe and calculate an object's motion in terms of position, displacement, speed, and acceleration
I.4(C)	investigate how an object's motion changes only when a net force is applied, including activities and equipment such as toy cars, vehicle restraints, sports activities, and classroom objects
I.4(D)	describe and calculate the relationship between force, mass, and acceleration using equipment such as dynamic carts, moving toys, vehicles, and falling objects

Supporting Standards

I.4(B)	measure and graph distance and speed as a function of time
I.4(E)	explain the concept of conservation of momentum using action and reaction forces
I.4(F)	describe the gravitational attraction between objects of different masses at different distances
I.4(G)	examine electrical force as a universal force between any two charged objects

Energy Forms and Transfer

I.5 **Science concepts.** The student recognizes multiple forms of energy and knows the impact of energy transfer and energy conservation in everyday life.

I.5(B)	recognize and demonstrate common forms of potential energy, including gravitational, elastic, and chemical, such as a ball on an inclined plane, springs, and batteries
I.5(D)	investigate the law of conservation of energy
I.5(E)	investigate and demonstrate the movement of thermal energy through solids, liquids, and gases by convection, conduction, and radiation such as in weather, living, and mechanical systems
I.5(G)	explore the characteristics and behaviors of energy transferred by waves, including acoustic, seismic, light, and waves on water as they reflect, refract, diffract, interfere with one another, and are absorbed by materials
I.5(A)	recognize and demonstrate that objects and substances in motion have kinetic energy such as vibration of atoms, water flowing down a stream moving pebbles, and bowling balls knocking down pins
I.5(C)	demonstrate that moving electric charges produce magnetic forces and moving magnets produce electric forces
I.5(F)	evaluate the transfer of electrical energy in series and parallel circuits and conductive materials
I.5(H)	analyze energy transformations of renewable and nonrenewable resources
I.5(I)	critique the advantages and disadvantages of various energy sources and their impact on society and the environment

Structure and Properties of Matter

I.6 **Science concepts.** The student knows that relationships exist between the structure and properties of matter.

I.6(A)	examine differences in physical properties of solids, liquids, and gases as explained by the arrangement and motion of atoms or molecules
I.6(C)	analyze physical and chemical properties of elements and compounds such as color, density, viscosity, buoyancy, boiling point, freezing point, conductivity, and reactivity
I.6(B)	relate chemical properties of substances to the arrangement of their atoms
I.6(D)	relate the placement of an element on the Periodic Table to its physical and chemical behavior, including bonding and classification
I.6(E)	relate the structure of water to its function as a solvent
I.6(F)	investigate the properties of water solutions and factors affecting solid solubility, including nature of solute, temperature, and concentration

Matter in Everyday Life

I.7 **Science concepts.** The student knows that changes in matter affect everyday life.

Readiness Standards		Supporting Standards	
I.7(A)	investigate changes of state as it relates to the arrangement of particles of matter and energy transfer	I.7(B)	recognize that chemical changes can occur when substances react to form different substances and that these interactions are largely determined by the valence electrons
I.7(C)	demonstrate that mass is conserved when substances undergo chemical change and that the number and kind of atoms are the same in the reactants and products	I.7(D)	classify energy changes that accompany chemical reactions such as those occurring in heat packs, cold packs, and glow sticks as exothermic or endothermic reactions
		I.7(E)	describe types of nuclear reactions such as fission and fusion and their roles in applications such as medicine and energy production
		I.7(F)	research and describe the environmental and economic impact of the end-products of chemical reactions such as those that may result in acid rain, degradation of water and air quality, and ozone depletion

Scientific Process Standards

I.2 **Scientific processes.** The student uses scientific practices during laboratory and field investigations.

I.3 **Scientific processes.** The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions.

Ways to Show	
I.2(D)	organize, analyze, evaluate, make inferences, and predict trends from data
I.2(E)	communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphs, journals, summaries, oral reports, and technology-based reports
I.3(A)	analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student
I.3(B)	communicate and apply scientific information extracted from various sources such as current events, published journal articles, and marketing materials
I.3(C)	draw inferences based on data related to promotional materials for products and services
I.3(D)	evaluate the impact of research on scientific thought, society, and the environment
I.3(E)	describe the connection between physics and chemistry and future careers
I.3(F)	research and describe the history of physics and chemistry and contributions of scientists

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Scientific Process Standards

P.1 **Scientific processes.** The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom.

P.2 **Scientific processes.** The student uses a systematic approach to answer scientific laboratory and field investigative questions.

Tools to Know

P.1(A)	demonstrate safe practices during laboratory and field investigations
P.1(B)	demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials
P.2(A)	know the definition of science as specified in chapter 112.39, subsection (b)(2) of 19 TAC
P.2(B)	know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence
P.2(C)	know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but may be subject to change
P.2(D)	design and implement investigative procedures, including making observations, asking well defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, evaluating numerical answers for reasonableness, and identifying causes and effects of uncertainties in measured data
P.2(E)	demonstrate the use of course apparatus, equipment, techniques, and procedures, including multimeters (current, voltage, resistance), balances, batteries, dynamics demonstration equipment, collision apparatus, lab masses, magnets, plane mirrors, convex lenses, stopwatches, trajectory apparatus, graph paper, magnetic compasses, protractors, metric rulers, spring scales, thermometers, slinky springs, and/or other equipment and materials that will produce the same results
P.2(F)	use a wide variety of additional course apparatus, equipment, techniques, materials, and procedures as appropriate such as ripple tank with wave generator, wave motion rope, tuning forks, hand-held visual spectroscopes, discharge tubes with power supply (H, He, Ne, Ar), electromagnetic spectrum charts, laser pointers, micrometer, caliper, computer, data acquisition probes, scientific calculators, graphing technology, electrostatics kits, electroscope, inclined plane, optics bench, optics kit, polarized film, prisms, pulley with table clamp, motion detectors, photogates, friction blocks, ballistic carts or equivalent, resonance tube, stroboscope, resistors, copper wire, switches, iron filings, and/or other equipment and materials that will produce the same results
P.2(G)	make measurements with accuracy and precision and record data using scientific notation and International System (SI) units

Laws of Motion

P.4 **Science concepts.** The student knows and applies the laws governing motion in a variety of situations.

Readiness Standards

P.4(A)	generate and interpret graphs and charts describing different types of motion, including investigations using real-time technology such as motion detectors or photogates
P.4(B)	describe and analyze motion in one dimension using equations and graphical vector addition with the concepts of distance, displacement, speed, average velocity, instantaneous velocity, frames of reference, and acceleration
P.4(D)	calculate the effect of forces on objects, including the law of inertia, the relationship between force and acceleration, and the nature of force pairs between objects using methods, including free-body force diagrams

Supporting Standards

P.4(C)	analyze and describe accelerated motion in two dimensions, including using equations, graphical vector addition, and projectile and circular examples

Natural Forces in the Physical World

P.5 **Science concepts.** The student knows the nature of forces in the physical world.

P.5(B)	describe and calculate how the magnitude of the gravitational force between two objects depends on their masses and the distance between their centers
P.5(F)	investigate and calculate current through, potential difference across, resistance of, and power used by electric circuit elements connected in both series and parallel combinations

P.5(A)	describe the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces
P.5(C)	describe and calculate how the magnitude of the electric force between two objects depends on their charges and the distance between their centers
P.5(D)	identify and describe examples of electric and magnetic forces and fields in everyday life such as generators, motors, and transformers
P.5(E)	characterize materials as conductors or insulators based on their electric properties

Laws of Conservation of Energy and Momentum

P.6 **Science concepts.** The student knows that changes occur within a physical system and applies the laws of conservation of energy and momentum.

Readiness Standards		Supporting Standards	
P.6(A)	investigate and calculate quantities using the work-energy theorem in various situations	P.6(E)	explain everyday examples that illustrate the four laws of thermodynamics and the processes of thermal energy transfer
P.6(B)	investigate examples of kinetic and potential energy and their transformations		
P.6(C)	calculate the mechanical energy of, power generated within, impulse applied to, and momentum of a physical system		
P.6(D)	demonstrate and apply the laws of conservation of energy and conservation of momentum in one dimension		

Characteristics and Behaviors of Waves

P.7 **Science concepts.** The student knows the characteristics and behavior of waves.

P.7(B)	investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationship between wavespeed, frequency, and wavelength	P.7(A)	examine and describe oscillatory motion and wave propagation in various types of media
P.7(D)	investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect	P.7(C)	compare characteristics and behaviors of transverse waves, including electromagnetic waves and the electromagnetic spectrum, and characteristics and behaviors of longitudinal waves, including sound waves
		P.7(E)	describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens

Atomic, Nuclear, and Quantum Phenomena

P.8 **Science concepts.** The student knows simple examples of atomic, nuclear, and quantum phenomena.

P.8(A)	describe the photoelectric effect and the dual nature of light	P.8(B)	compare and explain the emission spectra produced by various atoms
		P.8(C)	calculate and describe the applications of mass-energy equivalence
		P.8(D)	give examples of applications of atomic and nuclear phenomena using the standard model such as nuclear stability, fission and fusion, radiation therapy, diagnostic imaging, semiconductors, superconductors, solar cells, and nuclear power and examples of applications of quantum phenomena

Scientific Process Standards

P.2 **Scientific processes.** The student uses a systematic approach to answer scientific laboratory and field investigative questions.

P.3 **Scientific processes.** The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom.

Ways to Show	
P.2(H)	organize, evaluate, and make inferences from data, including the use of tables, charts, and graphs
P.2(I)	communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports
P.2(J)	express relationships among physical variables quantitatively, including the use of graphs, charts, and equations
P.3(A)	analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student
P.3(B)	communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials
P.3(C)	explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society
P.3(D)	research and describe the connections between physics and future careers
P.3(E)	express, manipulate, and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically

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