Physical Science

The Physical Science course develops understandings of the central concepts from chemistry and physics: Structure and Properties of Matter; Chemical Reactions; Energy; Forces and Interactions; Waves and Electromagnetic Radiation. The topics in Physical Science allow high school students to explain more in-depth phenomena central not only to the physical sciences but to life and earth and space sciences, as well. The standards blend the central ideas with the practices of scientists and engineers and science connecting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. There is a focus on multiple indicators, including developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations. Students are expected to use these practices to demonstrate understanding of the central ideas and demonstrate understanding of several engineering practices, including design and evaluation. Students will engage in active inquiries, investigations, and hands-on activities at least 50% of the instructional time as they develop and demonstrate conceptual understandings along with research and laboratory skills described in the standards and indicators for science. Safety instruction is integrated into all activities, and students will implement safe procedures and practices when manipulating equipment, materials, organisms, and models. Standards followed by an asterisk (*) denote the integration of traditional science content with an engineering practice.

Physical Science/Chemistry	
Topic	**Structure and Properties of Matter**
S.PS.1	Perform calculations involving equivalence statements for English and Metric conversions (e.g., Newtons/kg/lbs., km/mi., kg/g, km/m).
S.PS.2	Compare and contrast the properties of matter to classify as homogeneous or heterogeneous; pure substance or mixture; element or compound; metals, nonmetals, or metalloids; solution, colloid or suspension.
S.PS.3	Plan and conduct an investigation to distinguish chemical properties of matter from physical properties of matter including boiling point, freezing/melting point, density, solubility, viscosity, and conductivity.
S.PS.4	Compare the subatomic particles of an atom with regard to mass, location, and charge, then explain how these particles affect the properties of an atom including identity, mass, volume, and reactivity.
S.PS.5	Analyze data and interpret the Periodic Table to determine trends of the following: • number of valence electrons • types of ions formed by main group elements • location and properties of metals, nonmetals, metalloids • state phases at room temperature.
S.PS.6	Identify the names/formulas of ionic and molecular compounds and simple-chained hydrocarbons based on the bonding arrangement and structures of molecules.
S.PS.7	Investigate the properties of substances to classify them based on the relative strengths of ionic, covalent, and metallic bonds.
S.PS.8	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. *
Topic	**Chemical Reactions**
S.PS.9	Analyze experimental evidence to distinguish between chemical and physical reactions.

S.PS.10	Use mathematical representations to support the claim that atoms, mass, energy, and charge are conserved during a chemical reaction.
S.PS.11	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
S.PS.12	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. *
S.PS.13	Use models to identify chemical reactions as synthesis, decomposition, single-replacement, and double-replacement. Given the reactants, use these models to predict the products of those chemical reactions.
S.PS.14	Experimentally evaluate the characteristics and interactions of acids and bases.

Physical Science/Physics	
Topic	**Energy**
S.PS.15	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
S.PS.16	Evaluate the forces of a system to quantify the change in energy of a system as work and interpret the rate of energy changes as power.
S.PS.17	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. *
S.PS.18	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics).
S.PS.19	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
Topic	**Forces and Interactions**
S.PS.20	Experimentally generate graphical data of distance, speed/velocity, and acceleration to analyze the motion of an object and justify and/or derive kinematic equations.
S.PS.21	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
S.PS.22	Identify the pair of equal and opposite forces between two interacting bodies and relate their magnitudes and directions using Newton's 3rd Law.
S.PS.23	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when the system is closed.
S.PS.24	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. *
S.PS.25	Develop and use a model to describe the mathematical relationship between mass, distance, and force as expressed by Newton's Universal Law of Gravitation.
Topic	**Waves and Electromagnetic Radiation**
S.PS.26	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media while differentiating between longitudinal and transverse waves.

S.PS.27	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
S.PS.28	Qualitatively analyze the law of reflection, the law of refraction, and the relationship between the angle of incidence and angle of refraction.
S.PS.29	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy (e.g., broadband, Bluetooth, satellites, and WiFi). *

Engineering, Technology, and Application of Science	
Topic	**Engineering Design**
S.PS.30	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
S.PS.31	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
S.PS.32	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
S.PS.33	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.