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(1) Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to: **(A)** demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards; and (**B)** practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials. **(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:** **(A)** plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology; **(B)** design and implement comparative and experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology; **(C)** collect and record data using the International System of Units (SI) and	**Science Practices** **Standard SP.1: Scientific Questions and Predictions** **Asking scientific questions that can be tested empirically and structuring these questions in the form of testable predictions** **SP.1.1 Scientific Questions** Students recognize, formulate, justify and revise scientific questions that can be addressed by science in order to construct explanations. **SP.1.2 Predictions** Students make and justify predictions concerning natural phenomena. Predictions and justifications are based on observations of the world, on knowledge of the discipline and on empirical evidence. **Standard SP.2: Generation of Evidence: Collecting data to address scientific questions and to support predictions** **SP.2.1 Data Collection** Students select and use appropriate measurement methods and techniques for gathering data, and systematically record and organize	**I. Nature of Science: Scientific Ways of Learning and Thinking** **A. Cognitive skills in science** **1.** Utilize skepticism, logic, and professional ethics in science. **2.** Use creativity and insight to recognize and describe patterns in natural phenomena. **3.** Formulate appropriate questions to test understanding of natural phenomena. **4.** Rely on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes. **B. Scientific inquiry** **1.** Design and conduct scientific investigations In which hypotheses are formulated and tested. **C. Collaborative and safe working practices** **1.** Collaborate on joint projects. **2**. Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms. **3**. Demonstrate skill in the safe use of a wide variety of apparatuses, equipment, techniques, and procedures. **D. Current scientific technology** **1.** Demonstrate literacy in computer use. **2.** Use computer models, applications, and simulations.

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qualitative means such as labeled drawings, writing, and graphic organizers; **(D)** construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and **(E)** analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends. **(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:** **(A)** in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student; **(B)** use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature; **(C)** identify advantages and limitations of models such as size, scale, properties, and materials; and **(D)** relate the impact of research on scientific	observations and measurements. **SP.2.2 Evaluating Data for Evidence** Students determine which data from a specific investigation can be used as evidence to address a scientific question or to support a prediction or an explanation, and distinguish credible data from noncredible data in terms of quality. **Standard SP.3: Data Analysis** **Searching for regularities and patterns in observations and measurements (i.e., data analysis)** **SP.3.1 Analyzing Data for Patterns** Students analyze data to discover patterns. **Standard SP.4:Evidence-Based Explanations and Models :** **Using evidence and science knowledge to construct scientific explanations, models and representations** **SP.4.1 Constructing Explanations** Students construct explanations that are based on observations and measurements of the world, on empirical evidence and on reasoning grounded in the theories, principles and concepts of the discipline. **SP.4.2 Models and Representations** Students construct, use, re-express and	**3.** Demonstrate appropriate use of a wide variety of apparatuses, equipment, techniques, and procedures for collecting quantitative and qualitative data. **E. Effective communication of scientific information** **1.** Use several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic. **2.** Use essential vocabulary of the discipline being studied. **II. Foundation Skills: Scientific Applications of Mathematics** **A. Basic mathematics conventions** **1**. Understand the real number system and its properties. **2.** Use exponents and scientific notation. **3.** Understand ratios, proportions, percentages, and decimal fractions, and translate from any form to any other. **4.** Use proportional reasoning to solve problems. **5.** Simplify algebraic expressions. **6.** Estimate results to evaluate whether a calculated result is reasonable. **7**. Use calculators, spreadsheets, computers,

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thought and society, including the history of science and contributions of scientists as related to the content. **(4) Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:** **(A)** use appropriate tools to collect, record, and analyze information, including lab journals/notebooks, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectroscopes, timing devices, and other equipment as needed to teach the curriculum; and **(B)** use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher. **(5) Matter and energy. The student knows that matter is composed of atoms and has chemical and physical properties. The student is expected to:** **(A)** describe the structure of atoms, including the masses, electrical charges, and locations, of	revise models and representations of natural and designed objects, systems, phenomena and scientific ideas in the appropriate context and in formulating their explanation. **SP.4.3 Evaluating Explanations** Students evaluate, compare and contrast explanations that are based on observations of the world, on empirical evidence and on reasoning grounded in the theories, principles and concepts of the discipline. **Standard SP.5:Quantitative Applications** **Using mathematical reasoning and quantitative applications to interpret and analyze data to solve problems** **SP.5.1 Proportionality Between Variables** Students reason about relationships between variables (e.g., data, representations, uncertainty, samples) through the lens of ratios, rates, percentages, probability or proportional relationships when approaching or solving problems or when interpreting results or situations. **SP.5.2 Patterns of Bivariate Relationships** Students apply, analyze and create algebraic representations, relationships and patterns of linear functions, systems of linear	etc., in data analysis. **B. Mathematics as a symbolic language** **1**. Carry out formal operations using standard algebraic symbols and formulae. **2.** Represent natural events, processes, and relationships with algebraic expressions and algorithms. **C. Understand relationships among geometry, algebra, and trigonometry** **1.** Understand simple vectors, vector notations, and vector diagrams, and carry out simple calculations involving vectors. **2.** Understand that a curve drawn on a defined set of axes is fully equivalent to a set of algebraic equations. **3.** Understand basic trigonometric principles, Including definitions of terms, such as sine, cosine, tangent, cotangent, and their relationship to triangles. **4.** Understand basic geometric principles. **D. Scientific problem solving** **1.** Use dimensional analysis in problem solving. **E. Scientific application of probability and statistics** **1**. Understand descriptive statistics. **F. Scientific measurement** **1.** Select and use appropriate Standard International (SI) units and prefixes to express measurements for real world problems.

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protons and neutrons in the nucleus and electrons in the electron cloud; **(B)** identify that protons determine an element's identity and valence electrons determine its chemical properties, including reactivity; **(C)** interpret the arrangement of the Periodic Table, including groups and periods, to explain how properties are used to classify elements; **(D)** recognize that chemical formulas are used to identify substances and determine the number of atoms of each element in chemical formulas containing subscripts; **(E)** investigate how evidence of chemical reactions indicate that new substances with different properties are formed; and **(F)** recognize whether a chemical equation containing coefficients is balanced or not and how that relates to the law of conservation of mass. **(6) Force, motion, and energy. The student knows that there is a relationship between force, motion, and energy. The student is expected to:** **(A)** demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion; **(B)** differentiate between speed, velocity, and	inequalities, and one- or two-dimensional changes to solve problems, interpret situations and address scientific questions. **Science, Technology and Society** **Standard STS.1:Science, Technology and Society** **A critical interdependence exists among science, technology and society.** **STS.1.1 Interdependence of Science and Technology** Students explain the interdependence of science and technology: how the ongoing development of technology relies on the advancements of science while scientific research relies on technological progress. Students understand how the evolution of various technologies (e.g., biotechnology, seismology, computational software, lasers) radically alters the practice of many science disciplines by affecting the quality and quantity of available data. **STS.1.2 Advantages and Disadvantages to Society** Students understand how science and technology together can be used for the benefit of society as well as their own lives (e.g., weather predictions, development of	**2.** Use appropriate significant digits. **3**. Understand and use logarithmic notation (base 10). **III. Foundation Skills: Scientific Applications of Communication** **A. Scientific writing** **1.** Use correct applications of writing practices in scientific communication. **B. Scientific reading** **1.** Read technical and scientific articles to gain understanding of interpretations, apparatuses, techniques or procedures, and data. **2.** Set up apparatuses, carry out procedures, and collect specified data from a given set of appropriate instructions. **3.** Recognize scientific and technical vocabulary In the field of study and use this vocabulary to enhance clarity of communication. **4.** List, use, and give examples of specific strategies before, during, and after reading to improve comprehension. **C. Presentation of scientific/technical information** **1.** Prepare and present scientific/technical information in appropriate formats for various audiences. **D. Research skills/information literacy** **1.** Use search engines, databases, and other

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acceleration; and **(C)** investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches. **(7) Earth and space. The student knows the effects resulting from cyclical movements of the Sun, Earth, and Moon. The student is expected to:** **(A)** model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in seasons; **(B)** demonstrate and predict the sequence of events in the lunar cycle; and **(C)** relate the position of the Moon and Sun to their effect on ocean tides. **(8) Earth and space. The student knows characteristics of the universe. The student is expected to:** **(A)** describe components of the universe, including stars, nebulae, and galaxies, and use models such as the Herztsprung-Russell diagram for classification; **(B)** recognize that the Sun is a medium-sized	medications, creation of safety devices in cars), but that some technological capabilities (e.g., cloning, genetic recombination, nuclear energy studies, access to fossil fuels, chemical engineering) create ethical and economic dilemmas for society. **STS.1.3 Evaluating Online Information** Students recognize that the amount of information, as well as access to information, has exploded since the creation of the Internet. Online information should be judged using the same science practices and critical and skeptical views that reflect the way science is conducted and evaluated. Students also recognize the relationship between digital technology and the **fact** that social networking is a source of information generation and of the determination of "truths" in our current society. Students understand that this information presents a specific perspective that is not backed by research; therefore, the information and the perspective do not represent the empirical reality of science. **Earth Science** **Standard ES.1: Dynamic Earth Processes: Dynamic processes shape and order Earth.**	digital electronic tools effectively to locate information. **2.** Evaluate quality, accuracy, completeness, reliability, and currency of information from any sources. **IV. Science, Technology, and Society** **A. Interactions between innovations and science** **1.** Recognize how scientific discoveries are connected to technological innovations. **B. Social ethics** **1.** Understand how scientific research and technology have an impact on ethical and legal practices. **2.** Understand how commonly held ethical beliefs impact scientific research. **C. History of science** **1.** Understand the historical development of major theories in science. 2. Recognize the role of people in important contributions to scientific knowledge. **V. Cross-Disciplinary Themes** **A. Matter/states of matter** **1.** Know modern theories of atomic structure. **2.** Understand the typical states of matter (solid, liquid, gas) and phase changes among these.

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star near the edge of a disc-shaped galaxy of stars and that the Sun is many thousands of times closer to Earth than any other star; **(C)** explore how different wavelengths of the electromagnetic spectrum such as light and radio waves are used to gain information about distances and properties of components in the universe; **(D)** model and describe how light years are used to measure distances and sizes in the universe; and (**E**) research how scientific data are used as evidence to develop scientific theories to describe the origin of the universe. **(9) Earth and space. The student knows that natural events can impact Earth systems. The student is expected to:** **(A)** describe the historical development of evidence that supports plate tectonic theory; **(B)** relate plate tectonics to the formation of crustal features; and **(C)** interpret topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering. **(10) Earth and space. The student knows that climatic interactions exist among Earth, ocean,**	**ES.1.1 Earth's Surface** Students understand that physical and chemical changes in Earth's materials result from the interactions of Earth's surface with water, air, gravity, tectonic forces and biological activity. These changes create landscapes on Earth's surface. **ES.1.2 Energy Transfer** Students understand that the uneven distribution of thermal energy and materials in Earth's systems, combined with gravity, is the underlying cause of the movement of matter within the lithosphere (plate tectonics), hydrosphere (ocean currents) and atmosphere (winds). **ES.1.3 Tectonism** Students understand that tectonic plates interact along their boundaries, resulting in folding, faulting, earthquakes and volcanoes. **ES.1.4 Weather Processes** Students understand that weather is the result of short-term interactions (days) among the atmosphere, hydrosphere, lithosphere and biosphere. **ES.1.5 Rock-Forming Environment** Students understand that the physical and chemical properties of rocks and fossil fuels	**B. Energy (thermodynamics, kinetic, potential, energy transfers)** **1.** Understand the Laws of Thermodynamics. **2.** Know the processes of energy transfer. **C. Change over time/equilibrium** **1.** Recognize patterns of change. **D. Classification** **1.** Understand that scientists categorize things according to similarities and differences. **E. Measurements and models** **1.** Use models to make predictions. **2.** Use scale to relate models and structures. **3.** Demonstrate familiarity with length scales from sub-atomic particles through macroscopic objects.

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and weather systems. The student is expected to: **(A)** recognize that the Sun provides the energy that drives convection within the atmosphere and oceans, producing winds and ocean currents; **(B)** identify how global patterns of atmospheric movement influence local weather using weather maps that show high and low pressures and fronts; and **(C)** identify the role of the oceans in the formation of weather systems such as hurricanes. **(11) Organisms and environments. The student knows that interdependence occurs among living systems and the environment and that human activities can affect these systems. The student is expected to:** **(A)** describe producer/consumer, predator/prey, and parasite/host relationships as they occur in food webs within marine, freshwater, and terrestrial ecosystems; **(B)** investigate how organisms and populations in an ecosystem depend on and may compete for biotic and abiotic factors such as quantity of light, water, range of temperatures, or soil composition; **(C)** explore how short- and long-term	indicate the environment in which they were formed. **Standard ES.2: Independent and Interacting Systems** **Earth is composed of interdependent and interacting systems.** **ES.2.1** Atmosphere as a System Students understand that Earth's atmosphere acts as a system that absorbs and distributes matter and energy. **ES.2.2 Oceans as a System** Students understand that Earth's oceans act as a system that absorbs and distributes matter and energy. **ES.2.3 Lithosphere as a System** Students understand that the lithosphere is a system of large plates that move matter and energy in Earth's systems. **ES.2.4 Climate** Students understand that climate is the result of interactions among the atmosphere, hydrosphere, lithosphere and biosphere. **ES.2.5 Planetary Evolution** Students understand that Earth is part of a solar system and has unique characteristics that are based on its position and its stage of planetary evolution.	

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environmental changes affect organisms and traits in subsequent populations; and **(D)** recognize human dependence on ocean systems and explain how human activities such as runoff, artificial reefs, or use of resources have modified these systems.	**Standard ES.3: Earth's History** **Earth's history can be inferred from evidence left from past events.** **ES.3.1 Relative and Absolute Dating** Students understand that various dating methods — relative and absolute — have been used to determine the age of Earth. **ES.3.2 Rock and Fossil Records** Students understand that the rock and fossil records provide evidence of the evolution of Earth's environment and the associated changes in life over time. **Standard ES.4: Cycles of Matter and Energy** **Matter on Earth is finite and moves through various cycles that are driven by the transformation of energy.** **ES.4.1 Water Cycle** Students understand water cycles at various rates and at various scales within Earth's systems. **ES.4.2 Carbon Cycle** Students understand that the carbon cycle illustrates the transformation and pathways of carbon and carbon compounds through Earth's systems.	

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	Standard ES.5: Humans and the Environment **Humans and the environment impact each other.** **ES.5.1 Humans and Natural Resources** Students understand that human societies require natural resources derived from Earth. The amounts and types of resources required are a function of the size, growth and affluence of the human population. The value of a natural resource is dependent on its amount and its ease of extractability from Earth. **ES.5.2 Humans and Natural Hazards** Students understand that natural hazards impact human society. Societies try to reduce the impacts of natural hazards through disaster reduction, which entails early warning and engineering projects that seek risk reduction. **ES.5.3** Humans' Impact on the Environment Students understand that all human activities, including use of resources, have environmental consequences that occur over a range of spatial and temporal scales. Because of the complexity of Earth's systems and because of the occurrence of unintended consequences, a systems framework is commonly used to understand	

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	important environmental issues such as pollution, climate change or ecosystem disruption. A systems analysis guides scientific investigations, decision making and the identification of potential solutions to environmental issues. **Life Science** **Standard LS.1: Evolution** **The diversity and unity of life can be explained by the process of evolution.** **LS.1.1 Evidence of Common Ancestry and Divergence** Students understand that an analysis over time of both the anatomical structures and the DNA compositions of organisms can be used to infer lines of descent back to a common ancestor. **LS.1.2 Natural Selection** Students understand that when a trait is favorable to an organism, the number of organisms with that trait will increase over time; and that when a trait is unfavorable, the number of organisms with that trait will decrease over time. Students understand that as a result, there is an increase in the proportion of individuals with the advantageous trait in a population. Over time, the process of natural selection	

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	leads to both the extinction of existing species and the evolution of new species. **LS.1.3 Genetic Variation Within Populations** Students understand that genetic variation within a population is essential for natural selection. Mutations, as well as random assortment of existing genes, can produce genetic variation in a population. **Standard LS.2: Cells as a System:** **Cells are a fundamental structural and functional unit of life.** **LS.2.1 Cell Function** Students understand that cells perform the essential functions of life, such as energy transfer and transformation, exchange of gas, disposal of waste, growth, reproduction, and interaction with the environment. **LS.2.2 Cell Structure** Students understand that cells have internal structures that carry out specialized life functions, and that these internal structures vary depending on a cell's function. **LS.2.3 Cell Growth and Repair** Students understand that cells of multicellular organisms repeatedly divide to make more cells for growth and repair.	

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	LS.2.4 Cell Differentiation Students understand that in multicellular organisms, the single cell (zygote) ultimately divides and differentiates into specialized cells that form the various tissues and organs of the organism. **Standard LS.3: Interdependent Relationships** **Interdependent relationships characterize biological ecosystems.** **LS.3.1 Living Systems and the Physical Environment** Students understand that in all ecosystems, living organisms interact with and depend on the physical (abiotic) conditions of their environment for survival. **LS.3.2 Interactions of Living Systems** Students understand that organisms in all ecosystems interact with and depend on each other, and that organisms with similar needs compete for limited resources. **LS.3.3 Ecosystem Stability** Students understand that a complex set of interactions within an ecosystem can maintain the number and types of organisms in an ecosystem that is relatively constant over long periods of time.	

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	Standard LS.4: Matter and Energy **Biological systems utilize energy and molecular building blocks to carry out life's essential functions.** **LS.4.1 Matter Cycling** Students understand that matter is continuously recycled within the biological system and between the biological (biotic) and physical (abiotic) components of an ecosystem. **LS.4.2 Energy Transfer** Students understand that all of the processes that take place within organisms require energy. In most ecosystems, the energy is derived from the Sun and transferred into chemical energy in photosynthetic organisms of that ecosystem. **Standard LS.5: Information Transmission, Storage and Retrieval** **Living systems have multiple mechanisms that are used to store, retrieve and transmit information.** **LS.5.1 Changing Model of Inheritance** Students describe the historic ideas that led to the identification of DNA as the molecule that contains and transmits genetic information.	

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	LS.5.2 Genetic Information Transmission Students understand that during reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction the lone parent contributes DNA to the offspring, and in sexual reproduction both parents contribute DNA to the offspring. **LS.5.3 DNA to Trait** Students understand that genetic information (DNA) is used to produce proteins that largely determine the traits of an organism. These traits often result from the interactions and expression of many genes. **LS.5.4 Imperfect Transmission of Genetic Information** Students understand that there are various ways in which the transmission of genetic information can be imperfect, and that these imperfections may have positive, negative or no consequences to the organism. **LS.5.5 Nongenetic Information Transmission** Students understand that nongenetic transmission of information within and among organisms involves specialized molecules, cell structures and cell systems.	

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	Physical Science **Standard PS.1: Interactions, Forces and Motion** **Changes in the natural and designed world are caused by interactions. Interactions of an object with other objects can be described by forces that can cause a change in motion of one or both interacting objects.** **PS.1.1 Patterns of Straight-Line Motion** Students understand that there are different patterns of straight-line motion that can be represented using different models. **PS.1.2 Forces and Motion** Students understand that when the sum of the forces is equal to zero, either the object is not moving and it will continue to not move, or the object is moving and it will always continue to move at a constant speed in a straight line (Newton's first law). **PS.1.3 Interactions and Forces** Students understand that interactions can be described in terms of forces. These interactions occur when two objects in contact push or pull on each other, which can cause a change in motion of one or both objects. **PS.1.4 Gravitational Force** Students understand that gravity is an attractive interaction between any two	

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	objects with mass, which can cause a change in motion of the objects. **PS.1.5 Magnetic and Electric Charge Interactions** Students understand that magnetic and electric charge interactions occur between mutually attracting or repelling objects, which can cause a change in motion of one or both objects. Materials can be classified as magnetic or nonmagnetic, depending on how they interact with a magnet. **Standard PS.2: Physical and Chemical Properties of Matter** **Matter has mass and volume and can exist as a solid, liquid or gas. All pure substances have their own unique set of physical and chemical properties that can be used to identify them.** **PS.2.1 Properties of Matter** Students understand that pure substances are composed of matter that has definable properties. Through macroscopic observation and measurement of these properties, students can describe and identify these substances. **PS.2.2 States of Matter** Students understand through observation that matter can exist in three common	

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	states: solid, liquid or gas. Students understand that these macroscopic observations serve as evidence of the concept that matter can exist as elements, compounds or mixtures. **PS.2.3 Particulate Nature of Matter** Students understand that matter is composed of atoms that can interact in different ways to form molecules and crystals. The structure, behavior and properties of matter can be explained by using models that depict particles in constant motion as well as the strength of the interacting forces among the particles. **Standard PS.3: Conservation of Matter** **Matter can be transformed by a change of state or by undergoing chemical reactions, but it can never be created or destroyed.** **PS.3.1 Conservation of Matter** Students understand that matter can neither be created nor destroyed during any interaction, including change of state or a change that takes place as a result of a chemical reaction. **PS.3.2 Physical and Chemical Changes of Matter** Students understand that chemical reactions produce new substances with new	

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	properties, whereas changes of state alter the appearance of a substance, not the identity of a substance. **Standard PS.4: Conservation of Energy When any change occurs, energy is transferred and/or transformed, but it is never lost.** **PS.4.1 Mechanical Energy Transfer (Work) and Energy Changes** Students understand that interactions between objects can be described not only in terms of forces but also in terms of energy transfers between the objects. Energy can be transferred from one object to the other by means of pushes or pulls that result in changes in motion. **PS.4.2 Electric Circuit Interactions** Students understand that during electric circuit interactions, electrical energy is transferred from the source of electric current to the electrical device, or devices, in the circuit. **PS.4.3 Mechanical Wave Interactions** Students understand that during mechanical wave interactions, mechanical energy is transferred through a material without a transfer of matter.	

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	PS.4.4 Conservation of Energy Students understand that energy can be transferred from one object to another within a system or across a system boundary and/or transformed within a system from one form to another, but it never disappears. **PS.4.5 Thermal Energy** Students understand that thermal energy can be transferred and/or transformed by different mechanisms (i.e., conduction, convection and radiation).	