New Mexico Science Content Standards, Benchmarks, and Performance Standards

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Strands and Benchmarks

Strand I: Scientific Thinking and Practice

Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

K-4 Benchmark I:	Use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.
5-8 Benchmark I:	Use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.
9-12 Benchmark I:	Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.
K-4 Benchmark II:	Use scientific thinking and knowledge and communicate findings.
5-8 Benchmark II:	Understand the processes of scientific investigation and how scientific inquiry results in scientific knowledge.
9-12 Benchmark II:	Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.
K-4 Benchmark III:	Use mathematical skills and vocabulary to analyze data, understand patterns and relationships, and communicate findings.
5-8 Benchmark III:	Use mathematical ideas, tools, and techniques to understand scientific knowledge.
9-12 Benchmark III:	Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.

Science Content Standards, Benchmarks, and Performance Standards

Strand II: Content of Science

Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

K-4 Benchmark I:	Recognize that matter has different forms and properties.
5-8 Benchmark I:	Know the forms and properties of matter and how matter interacts.
9-12 Benchmark I:	Understand the properties, underlying structure, and reactions of matter.
K-4 Benchmark II:	Know that energy is needed to get things done and that energy has different forms.
5-8 Benchmark II:	Explain the physical processes involved in the transfer, change, and conservation of energy.
9-12 Benchmark II:	Understand the transformation and transmission of energy and how energy and matter interact.
K-4 Benchmark III:	Identify forces and describe the motion of objects.
5-8 Benchmark III:	Describe and explain forces that produce motion in objects.
9-12 Benchmark III:	Understand the motion of objects and waves, and the forces that cause them.

Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

K-4 Benchmark I:	Know that living things have diverse forms, structures, functions, and habitats.
5-8 Benchmark I:	Explain the diverse structures and functions of living things and the complex relationships between living things and their environments.
9-12 Benchmark I:	Understand how the survival of species depends on biodiversity and on complex interactions, including the cycling of matter and the flow of energy.
K-4 Benchmark II:	Know that living things have similarities and differences and that living things change over time.
5-8 Benchmark II:	Understand how traits are passed from one generation to the next and how species evolve.
9-12 Benchmark II:	Understand the genetic basis for inheritance and the basic concepts of biological evolution.
K-4 Benchmark III:	Know the parts of the human body and their functions.
5-8 Benchmark III:	Understand the structure of organisms and the function of cells in living systems.

9-12 Benchmark III:	Understand the characteristics, structures, and functions of cells.

Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

K-4 Benchmark I:	Know the structure of the solar system and the objects in the universe.
5-8 Benchmark I:	Describe how the concepts of energy, matter, and force can be used to explain the observed behavior of the solar system, the universe, and their structures.
9-12 Benchmark I:	Examine the scientific theories of the origin, structure, contents, and evolution of the solar system and the universe, and their interconnections.
K-4 Benchmark II:	Know the structure and formation of Earth and its atmosphere and the processes that shape them.
5-8 Benchmark II:	Describe the structure of Earth and its atmosphere and explain how energy, matter, and forces shape Earth's systems.
9-12 Benchmark II:	Examine the scientific theories of the origin, structure, energy, and evolution of Earth and its atmosphere, and their interconnections.

Strand III: Science and Society

Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

K-4 Benchmark I:	Describe how science influences decisions made by individuals and societies.
5-8 Benchmark I:	Explain how scientific discoveries and inventions have changed individuals and societies.
9-12 Benchmark I:	Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.

Science Content Standards, Benchmarks, and Performance Standards

Kindergarten – 4th Grade

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

K-4 Benchmark I: Use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.

Grade	Performance Standards
K	1. Use observation and questioning skills in science inquiry (e.g., What happens when something is pushed or pulled?). 2. Ask and answer questions about surroundings and share findings with classmates. 3. Record observations and data with pictures, numbers, and/or symbols.
1	1. Make observations, develop simple questions, and make comparisons of familiar situations (e.g., What does the seed look like when it starts to grow?). 2. Describe relationships between objects (e.g., above, next to, below) and predict the results of changing the relationships (e.g., When that block moves, what will happen to the one next to it?).
2	1. Conduct simple investigations (e.g., measure the sizes of plants of the same kind that are grown in sunlight and in shade). 2. Use tools to provide information not directly available through only the senses (e.g., magnifiers, rulers, thermometers). 3. Make predictions based on observed patterns as opposed to random guessing. 4. Follow simple instructions for a scientific investigation.
3	1. Make new observations when discrepancies exist between two descriptions of the same object or phenomenon to improve accuracy. 2. Recognize the difference between data and opinion. 3. Use numerical data in describing and comparing objects, events, and measurements. 4. Collect data in an investigation and analyze those data. 5. Know that the same scientific laws govern investigations in different times and places (e.g., gravity, growing

	plants).
4	1. Use instruments to perform investigations (e.g., timers, balances) and communicate findings. 2. Differentiate observation from interpretation and understand that a scientific explanation comes in part from what is observed and in part from how the observation is interpreted. 3. Conduct multiple trials to test a prediction, draw logical conclusions, and construct and interpret graphs from measurements. 4. Collect data in an investigation using multiple techniques, including control groups, and analyze those data to determine what other investigations could be conducted to validate findings.

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

K-4 Benchmark II: Use scientific thinking and knowledge and communicate findings.

Grade	Performance Standards
K	1. Communicate observations and answer questions about surroundings.
1	1. Know that simple investigations do not always turn out as planned.
2	1. Understand that in doing science it is often helpful to work with a team and share findings. 2. Make accurate observations and communicate findings about investigations.
3	1. Use a variety of methods to display data and present findings. 2. Understand that predictions are based on observations, measurements, and cause-and-effect relationships.
4	1. Communicate ideas and present findings about scientific investigations that are open to critique from others. 2. Describe how scientific investigations may differ from one another (e.g., observations of nature, measurements of things changing over time). 3. Understand how data are used to explain how a simple system functions (e.g., a thermometer to measure heat loss as water cools).

Science Content Standards, Benchmarks, and Performance Standards

Strand I: **Scientific Thinking and Practice**
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

K-4 Benchmark III: Use mathematical skills and vocabulary to analyze data, understand patterns and relationships, and communicate findings.

Grade	Performance Standards
K	1. Observe and describe the relative sizes and characteristics of objects (e.g., bigger, brighter, louder, smellier).
1	1. Use numbers and mathematical language (e.g., "addition" instead of "add to," "subtraction" instead of "take away") to describe phenomena.
2	1. Record observations on simple charts or diagrams. 2. Measure length, weight, and temperature with appropriate tools and express those measurements in accurate mathematical language.
3	1. Use numerical data in describing and comparing objects, events, and measurements. 2. Pose a question of interest and present observations and measurements with accuracy. 3. Use various methods to display data and present findings and communicate results in accurate mathematical language.
4	1. Conduct multiple trials using simple mathematical techniques to make and test predictions. 2. Use mathematical equations to formulate and justify predictions based on cause-and-effect relationships. 3. Identify simple mathematical relationships in a scientific investigation (e.g., the relationship of the density of materials that will or will not float in water to the density of water).

Strand II: Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

Science Content Standards, Benchmarks, and Performance Standards

K-4 Benchmark I: Recognize that matter has different forms and properties.

Grade	Performance Standards
K	1. Observe that objects are made of different types of materials (e.g., metal, plastic, cloth, wood). 2. Observe that different materials have different properties (e.g., color, odor).
1	1. Observe that the three states of matter (i.e., solids, liquids, and gases) have different properties (e.g., water can be liquid, ice, or steam). 2. Describe simple properties of matter (e.g., hardness, flexibility, transparency).
2	1. Observe that properties of substances can change when they are mixed, cooled, or heated (e.g., salt dissolves in water, ice melts). 2. Describe the changes that occur when substances are heated or cooled and change from one state of matter to another (i.e., solid, liquid, and gas).
3	1. Identify and compare properties of pure substances and mixtures (e.g., sugar, fruit juice). 2. Separate mixtures based on properties (e.g., by size or by substance; rocks and sand, iron filings and sand, salt and sand).
4	1. Know that changes to matter may be chemical or physical and when two or more substances are combined, a new substance may be formed with properties that are different from those of the original substances (e.g., white glue and borax, cornstarch and water, vinegar and baking soda). 2. Know that materials are made up of small particles (atoms and molecules) that are too small to see with the naked eye. 3. Know that the mass of the same amount of material remains constant whether it is together, in parts, or in a different state.

Strand II: Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

K-4 Benchmark II: Know that energy is needed to get things done and that energy has different forms.

Science Content Standards, Benchmarks, and Performance Standards

Grade	Performance Standards
K	1. Observe how energy does things (e.g., batteries, the sun, wind, electricity).
1	1. Observe and describe how energy produces changes (e.g., heat melts ice, gas makes car go uphill, electricity makes TV work).
2	1. Describe how heat can be produced (e.g., burning, rubbing, mixing some substances). 2. Know that heat moves more rapidly in thermal conductors (e.g., metal pan) than in insulators (e.g., plastic handle). 3. Describe the usefulness of some forms of energy (e.g., electricity, sunlight, wind, sound) and how energy (e.g., heat, light,) can affect common objects (e.g., sunlight warms dark objects, heat melts candles). 4. Observe that sound is made by vibrating objects and describe it by its pitch and loudness. 5. Recognize that moving objects carry energy (kinetic energy).
3	1. Understand that light is a form of energy and can travel through a vacuum. 2. Know that light travels in a straight line until it strikes an object and then it is reflected, refracted, or absorbed. 3. Measure energy and energy changes (e.g., temperature changes). 4. Construct charts or diagrams that relate variables associated with energy changes (e.g., melting of ice over time).
4	1. Identify the characteristics of several different forms of energy and describe how energy can be converted from one form to another (e.g., light to heat, motion to heat, electricity to heat, light, or motion). 2. Recognize that energy can be stored in many ways (e.g., potential energy in gravity or springs, chemical energy in batteries). 3. Describe how some waves move through materials (e.g., water, sound) and how others can move through a vacuum (e.g., x-ray, television, radio). 4. Demonstrate how electricity flows through a simple circuit (e.g., by constructing one).

Strand II: Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

K-4 Benchmark III: Identify forces and describe the motion of objects.

Grade	Performance Standards
K	1. Observe that things move in many different ways (e.g., straight line, vibration, circular).

	2. Know that the position and motion of an object (direction or speed) are changed by pushing or pulling it.
1	1. Describe ways to make things move, what causes them to stop, and what causes a change of speed, or change of direction. 2. Observe that gravity makes things fall to the ground unless something holds them up.
2	1. Describe how the strength of a push or pull affects the change in an object's motion (e.g., how a big or small push affects how high a swing rises). 2. Observe that electrically charged materials and magnets attract and repel each other, and observe their effects on other kinds of materials.
3	1. Recognize that magnets can produce motion by attracting some materials (e.g., steel) and have no effect on others (e.g., plastics). 2. Describe how magnets have poles (N and S) and that like poles repel each other while unlike poles attract. 3. Observe that some forces produce motion without objects touching (e.g., magnetic force on nails). 4. Describe motion on different time scales (e.g., the slow motion of a plant toward light, the fast motion of a tuning fork).
4	1. Know that energy can be carried from one place to another by waves (e.g., water waves, sound waves), by electric currents, and by moving objects. 2. Describe the motion of an object by measuring its change of position over a period of time. 3. Describe that gravity exerts more force on objects with greater mass (e.g., it takes more force to hold up a heavy object than a lighter one). 4. Describe how some forces act on contact and other forces act at a distance (e.g., a person pushing a rock versus gravity acting on a rock).

Strand II: Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

K-4 Benchmark I: Know that living things have diverse forms, structures, functions, and habitats.

Grade	Performance Standards
K	1. Identify major structures of common living organisms (e.g., stems, leaves, and roots of plants; arms, wings, and

	legs of animals). 2. Observe that differences exist among individual living organisms (e.g., plants, animals) of the same kind.
1	1. Know that living organisms (e.g., plants, animals) have needs (e.g., water, air, food, sunlight). 2. Know that living organisms (e.g., plants, animals) inhabit various environments and have various external features to help them satisfy their needs (e.g., leaves, legs, claws). 3. Describe the differences and similarities among living organisms (e.g., plants, animals). 4. Observe that living organisms (e.g., plants, animals) have predictable but varied life cycles.
2	1. Observe that diversity exists among individuals within a population. 2. Observe and describe various shapes of fungi. 3. Know that bacteria and viruses are germs.
3	1. Know that an adaptation in physical structure or behavior can improve an organism's chance for survival (e.g., horned toads, chameleons, cacti, mushrooms). 2. Observe that plants and animals have structures that serve different functions (e.g., shape of animals' teeth). 3. Classify common animals according to their observable characteristics (e.g., body coverings, structure). 4. Classify plants according to their characteristics (e.g., tree leaves, flowers, seeds).
4	1. Explain that different living organisms have distinctive structures and body systems that serve specific functions (e.g., walking, flying, swimming). 2. Know that humans and other living things have senses to help them detect stimuli, and that sensations (e.g., hunger) and stimuli (e.g., changes in the environment) influence the behavior of organisms. 3. Describe how roots are associated with the intake of water and soil nutrients and green leaves are associated with making food from sunlight (photosynthesis). 4. Describe the components of and relationships among organisms in a food chain (e.g., plants are the primary source of energy for living systems). 5. Describe how all living things are made up of smaller units that are called cells.

Strand II: Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

K-4 Benchmark II: Know that living things have similarities and differences and that living things change over time.

Science Content Standards, Benchmarks, and Performance Standards

Grade	Performance Standards
K	1. Observe and describe similarities and differences in the appearance and behavior of living organisms (e.g., plants, animals). 2. Observe that living organisms (e.g., plants, animals) closely resemble their parents.
1	1. Identify differences between living and nonliving things. 2. Recognize the differences between mature and immature plants and animals (e.g., trees/seedlings, dogs/puppies, cats/kittens).
2	1. Explain that stages of the life cycle are different for different animals (e.g., mouse, cat, horse, butterfly, frog). 2. Observe that many characteristics of the offspring of living organisms (e.g., plants or animals) are inherited from their parents. 3. Observe how the environment influences some characteristics of living things (e.g., amount of sunlight required for plant growth).
3	1. Identify how living things cause changes to the environments in which they live, and that some of these changes are detrimental to the organism and some are beneficial. 2. Know that some kinds of organisms that once lived on Earth have become extinct (e.g., dinosaurs) and that others resemble those that are alive today (e.g., alligators, sharks).
4	1. Know that in any particular environment some kinds of plants and animals survive well, some survive less well, and others cannot survive at all. 2. Know that a change in physical structure or behavior can improve an organism's chance of survival (e.g., a chameleon changes color, a turtle pulls its head into its shell, a plant grows toward the light). 3. Describe how some living organisms have developed characteristics from generation to generation to improve chances of survival (e.g., spines on cacti, long beaks on hummingbirds, good eyesight on hawks).

Strand II: Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

K-4 Benchmark III: Know the parts of the human body and their functions.

Grade	Performance Standards
K	1. Use the senses (e.g., sight, hearing, smell, taste, touch) to observe surroundings, and describe the observations. 2. Identify the parts of the human body (e.g., legs, arms, head, hands) and the functions of these parts.

1	1. Describe simple body functions (e.g., breathing, eating). 2. Describe the basic food requirements for humans. 3. Describe how some parts of human bodies differ from similar parts of other animals (e.g., hands and feet/paws; ears).
2	1. Identify a variety of human organs (e.g., lungs, heart, stomach, brain). 2. Know that various nutrients are required for specific parts and functions of the body (e.g., milk for bones and teeth, protein for muscles, sugar for energy). 3. Identify the functions of human systems (e.g., respiratory, circulatory, digestive).
3	1. Know that bacteria and viruses are germs that affect the human body. 2. Describe the nutrients needed by the human body.
4	1. Know that the human body has many parts that interact to function as systems (e.g., skeletal, muscular) and describe the parts and their specific functions in selected systems (e.g., the nose, lungs, and diaphragm in the respiratory system). 2. Recognize that the human body is organized from cells, to tissues, to organs, to systems, to the organism.

Strand II: Content of Science
Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

K-4 Benchmark I: Know the structure of the solar system and the objects in the universe.

Grade	Performance Standards
K	1. Observe that there are many objects in the night sky and that some are brighter than others. 2. Describe the location and movements of objects in the sky (e.g., stars, sun, moon).
1	1. Observe the changes that occur in the sky as day changes into night and night into day. 2. Describe the basic patterns of objects as they move through the sky: • sun appears in the day

	• moon appears at night but can sometimes be seen during the day • sun and moon appear to move across the sky • moon appears to change shape over the course of a month. 3. Recognize that the sun, moon, and stars all appear to move slowly across the sky.
2	1. Observe that the phase of the moon appears a little different every day but looks the same again after about four weeks. 2. Observe that some objects in the night sky are brighter than others. 3. Know that the sun is a star.
3	1. Describe the objects in the solar system (e.g., sun, Earth and other planets, moon) and their features (e.g., size, temperature). 2. Describe the relationships among the objects in the solar system (e.g., relative distances, orbital motions). 3. Observe that the pattern of stars stays the same as they appear to move across the sky nightly. 4. Observe that different constellations can be seen in different seasons. 5. Know that telescopes enhance the appearance of some distant objects in the sky (e.g., the moon, planets).
4	1. Understand that the number of stars visible through a telescope is much greater than the number visible to the naked eye. 2. Know that there are various types of telescopes that use different forms of light to observe distant objects in the sky. 3. Know that the pattern of stars (e.g., constellations) stays the same although they appear to move across the sky nightly due to Earth's rotation.

Strand II: Content of Science
Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

K-4 Benchmark II: Know the structure and formation of Earth and its atmosphere and the processes that shape them.

Grade	Performance Standards
K	1. Observe that changes in weather occur from day to day and season to season. 2. Observe that the sun warms the land and water and they warm the air.
1	1. Know that simple tools can be used to measure weather conditions (e.g., thermometer, wind sock, hand held anemometer, rain gauge) and that measurements can be recorded from day to day and across seasons. 2. Know that there are different climates (e.g., desert, arctic, rainforest).

2	1. Know that rocks have different shapes and sizes (e.g., boulders, pebbles, sand) and that smaller rocks result from the breaking and weathering of larger rocks. 2. Understand that rocks are made of materials with distinct properties. 3. Know that soil is made up of weathered rock and organic materials, and that soils differ in their capacity to support the growth of plants. 4. Recognize the characteristics of the seasons.
3	1. Know that Earth's features are constantly changed by a combination of slow and rapid processes that include the action of volcanoes, earthquakes, mountain building, biological changes, erosion, and weathering. 2. Know that fossils are evidence of earlier life and provide data about plants and animals that lived long ago. 3. Know that air takes up space, is colorless, tasteless, and odorless, and exerts a force. 4. Identify how water exists in the air in different forms (e.g., in clouds and fog as tiny droplets; in rain, snow, and hail) and changes from one form to another through various processes (e.g., freezing/condensation, precipitation, evaporation).
4	1. Know that the properties of rocks and minerals reflect the processes that shaped them (i.e., igneous, metamorphic, and sedimentary rocks). 2. Describe how weather patterns generally move from west to east in the United States. 3. Know that local weather information describes patterns of change over a period of time (e.g., temperature, precipitation symbols, cloud conditions, wind speed/direction).

Strand III: Science and Society
Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

K-4 Benchmark I: Describe how science influences decisions made by individuals and societies.

Grade	Performance Standards
K	1. Recognize that germs exist and may cause disease. 2. Describe how science helps provide products we use every day (e.g., gasoline for cars; electricity for lights, refrigerators, TVs; gas or electricity for heating, cooking).
1	1. Know that germs can be transmitted by touching, breathing, and coughing, and that washing hands helps prevent the spread of germs.

	2. Describe how science has assisted in creating tools (e.g., plows, knives, telephones, cell phones, computers) to make life easier and more efficient. 3. Describe how tools and machines can be helpful, harmful, or both (e.g., bicycles, cars, scissors, stoves). 4. Know that men and women of all ethnic and social backgrounds practice science and technology.
2	1. Describe ways to prevent the spread of germs (e.g., soap, bleach, cooking). 2. Know that science has ways to help living things avoid sickness or recover from sickness (e.g., vaccinations, medicine) and adult supervision is needed to administer them. 3. Know that some materials are better than others for making particular things (e.g., paper, cardboard, plastic, metal, fiberglass, wood). 4. Understand that everybody can do science, invent things, and formulate ideas. 5. Know that science has discovered many things about objects, events, and nature and that there are many more questions to be answered.
3	1. Describe how food packaging (e.g., airtight containers, date) and preparation (heating, cooling, salting, smoking, drying) extend food life and the safety of foods (e.g., elimination of bacteria). 2. Know that science produces information for the manufacture and recycling of materials (e.g., materials that can be recycled [aluminum, paper, plastic] and others that cannot [gasoline]). 3. Know that naturally occurring materials (e.g., wood, clay, cotton, animal skins) may be processed or combined with other materials to change their properties. 4. Know that using poisons can reduce the damage to crops caused by rodents, weeds, and insects, but their use may harm other plants, animals, or the environment.
4	1. Know that science has identified substances called pollutants that get into the environment and can be harmful to living things. 2. Know that, through science and technology, a wide variety of materials not appearing in nature have become available (e.g., steel, plastic, nylon, fiber optics). 3. Know that science has created ways to store and retrieve information (e.g., paper and ink, printing press, computers, CD ROMs) but that these are not perfect (e.g., faulty programming, defective hardware). 4. Know that both men and women of all races and social backgrounds choose science as a career.

Science Content Standards, Benchmarks, and Performance Standards

5th – 8th Grade

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

5-8 Benchmark I: Use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.

Grade	Performance Standards
5	1. Plan and conduct investigations, including formulating testable questions, making systematic observations, developing logical conclusions, and communicating findings. 2. Use appropriate technologies (e.g., calculators, computers, balances, spring scales, microscopes) to perform scientific tests and to collect and display data. 3. Use graphic representations (e.g., charts, graphs, tables, labeled diagrams) to present data and produce explanations for investigations. 4. Describe how credible scientific investigations use reproducible elements including single variables, controls, and appropriate sample sizes to produce valid scientific results. 5. Communicate the steps and results of a scientific investigation.
6	1. Construct appropriate graphs from data and develop qualitative and quantitative statements about the relationships between variables being investigated. 2. Examine the reasonableness of data supporting a proposed scientific explanation. 3. Justify predictions and conclusions based on data.
7	1. Use a variety of print and web resources to collect information, inform investigations, and answer a scientific question or hypothesis. 2. Use models to explain the relationships between variables being investigated.
8	1. Evaluate the accuracy and reproducibility of data and observations. 2. Use a variety of technologies to gather, analyze and interpret scientific data. 3. Know how to recognize and explain anomalous data.

Science Content Standards, Benchmarks, and Performance Standards

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

5-8 Benchmark II: Understand the processes of scientific investigation and how scientific inquiry results in scientific knowledge.

Grade	Performance Standards
5	1. Understand that different kinds of investigations are used to answer different kinds of questions (e.g., observations, data collection, controlled experiments). 2. Understand that scientific conclusions are subject to peer and public review.
6	1. Understand that scientific knowledge is continually reviewed, critiqued, and revised as new data become available. 2. Understand that scientific investigations use common processes that include the collection of relevant data and observations, accurate measurements, the identification and control of variables, and logical reasoning to formulate hypotheses and explanations. 3. Understand that not all investigations result in defensible scientific explanations.
7	1. Describe how bias can affect scientific investigation and conclusions. 2. Critique procedures used to investigate a hypothesis. 3. Analyze and evaluate scientific explanations.
8	1. Examine alternative explanations for observations. 2. Describe ways in which science differs from other ways of knowing and from other bodies of knowledge (e.g., experimentation, logical arguments, skepticism). 3. Know that scientific knowledge is built on questions posed as testable hypotheses, which are tested until the results are accepted by peers.

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

5-8 Benchmark III: Use mathematical ideas, tools, and techniques to understand scientific knowledge.

Grade	Performance Standards

5	1. Use appropriate units to make precise and varied measurements. 2. Use mathematical skills to analyze data. 3. Make predictions based on analyses of data, observations, and explanations. 4. Understand the attributes to be measured in a scientific investigation and describe the units, systems, and processes for making the measurement.
6	1. Evaluate the usefulness and relevance of data to an investigation. 2. Use probabilities, patterns, and relationships to explain data and observations.
7	1. Understand that the number of data (sample size) influences the reliability of a prediction. 2. Use mathematical expressions to represent data and observations collected in scientific investigations. 3. Select and use an appropriate model to examine a phenomenon.
8	1. Use mathematical expressions and techniques to explain data and observations and to communicate findings (e.g., formulas and equations, significant figures, graphing, sampling, estimation, mean). 2. Create models to describe phenomena.

Strand II: Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

5-8 Benchmark I: Know the forms and properties of matter and how matter interacts.

Grade	Performance Standards
5	1. Describe properties (e.g., relative volume, ability to flow) of the three states of matter. 2. Describe how matter changes from one phase to another (e.g., condensation, evaporation). 3. Know that matter is made up of particles (atoms) that can combine to form molecules and that these particles are too small to see with the naked eye. 4. Know that the periodic table is a chart of the pure elements that make up all matter. 5. Describe the relative location and motion of the particles (atoms and molecules) in each state of matter. 6. Explain the relationship between temperature and the motion of particles in each state of matter.
6	1. Understand that substances have characteristic properties and identify the properties of various substances (e.g., density, boiling point, solubility, chemical reactivity). 2. Use properties to identify substances (e.g., for minerals: the hardness, streak, color, reactivity to acid, cleavage,

	fracture). 3. Know that there are about 100 known elements that combine to produce compounds in living organisms and nonliving substances. 4. Know the differences between chemical and physical properties and how these properties can influence the interactions of matter.
7	1. Explain how matter is transferred from one organism to another and between organisms and their environment (e.g., consumption, the water cycle, the carbon cycle, the nitrogen cycle). 2. Know that the total amount of matter (mass) remains constant although its form, location, and properties may change (e.g., matter in the food web). 3. Identify characteristics of radioactivity, including: • decay in time of some elements to others • release of energy • damage to cells. 4. Describe how substances react chemically in characteristic ways to form new substances (compounds) with different properties (e.g., carbon and oxygen combine to form carbon dioxide in respiration). 5. Know that chemical reactions are essential to life processes.
8	**Properties of Matter** 1. Know how to use density, boiling point, freezing point, conductivity, and color to identify various substances. 2. Distinguish between metals and non-metals. 3. Understand the differences among elements, compounds, and mixtures by: • classification of materials as elements, compounds, or mixtures • interpretation of chemical formulas • separation of mixtures into compounds by methods including evaporation, filtration, screening, magnetism. **Structure of Matter** 4. Identify the protons, neutrons, and electrons within an atom and describe their locations (i.e., in the nucleus or in motion outside the nucleus). 5. Explain that elements are organized in the periodic table according to their properties. 6. Know that compounds are made of two or more elements, but not all sets of elements can combine to form compounds. **Changes in Matter** 7. Know that phase changes are physical changes that can be reversed (e.g., evaporation, condensation, melting).

	8. Describe various familiar physical and chemical changes that occur naturally (e.g., snow melting, photosynthesis, rusting, burning). 9. Identify factors that influence the rate at which chemical reactions occur (e.g., temperature, concentration). 10. Know that chemical reactions can absorb energy (endothermic reactions) or release energy (exothermic reactions).

Strand II: Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

5-8 Benchmark II: Explain the physical processes involved in the transfer, change, and conservation of energy.

Grade	Performance Standards
5	1. Know that heat is transferred from hotter to cooler materials or regions until both reach the same temperature. 2. Know that heat is often produced as a by-product when one form of energy is converted to another form (e.g., when machines or organisms convert stored energy into motion). 3. Know that there are different forms of energy. 4. Describe how energy can be stored and converted to a different form of energy (e.g., springs, gravity) and know that machines and living things convert stored energy to motion and heat.
6	1. Identify various types of energy (e.g., heat, light, mechanical, electrical, chemical, nuclear). 2. Understand that heat energy can be transferred through conduction, radiation and convection. 3. Know that there are many forms of energy transfer but that the total amount of energy is conserved (i.e., that energy is neither created nor destroyed). 4. Understand that some energy travels as waves (e.g., seismic, light, sound), including: • the sun as source of energy for many processes on Earth • different wavelengths of sunlight (e.g., visible, ultraviolet, infrared) • vibrations of matter (e.g., sound, earthquakes) • different speeds through different materials.
7	1. Know how various forms of energy are transformed through organisms and ecosystems, including: • sunlight and photosynthesis • energy transformation in living systems (e.g., cellular processes changing chemical energy to heat and motion) • effect of mankind's use of energy and other activities on living systems (e.g., global warming, water quality).

8	**Energy Transformation** 1. Know that energy exists in many forms and that when energy is transformed some energy is usually converted to heat. 2. Know that kinetic energy is a measure of the energy of an object in motion and potential energy is a measure of an object's position or composition, including: • transformation of gravitational potential energy of position into kinetic energy of motion by a falling object. 3. Distinguish between renewable and nonrenewable sources of energy. 4. Know that electrical energy is the flow of electrons through electrical conductors that connect sources of electrical energy to points of use, including: • electrical current paths through parallel and series circuits • production of electricity by fossil-fueled and nuclear power plants, wind generators, geothermal plants, and solar cells • use of electricity by appliances and equipment (e.g., calculators, hair dryers, light bulbs, motors). **Waves** 5. Understand how light and radio waves carry energy through vacuum or matter by: • straight-line travel unless an object is encountered • reflection by a mirror, refraction by a lens, absorption by a dark object • separation of white light into different wavelengths by prisms • visibility of objects due to light emission or scattering. 6. Understand that vibrations of matter (e.g., sound, earthquakes, water waves) carry wave energy, including: • sound transmission through solids, liquids, and gases • relationship of pitch and loudness of sound to rate and distance (amplitude) of vibration • ripples made by objects dropped in water.

Strand II: Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

5-8 Benchmark III: Describe and explain forces that produce motion in objects.

Science Content Standards, Benchmarks, and Performance Standards

Grade	Performance Standards
5	1. Understand how the rate of change of position is the velocity of an object in motion. 2. Recognize that acceleration is the change in velocity with time. 3. Identify forces in nature (e.g., gravity, magnetism, electricity, friction). 4. Understand that when a force (e.g., gravity, friction) acts on an object, the object speeds up, slows down, or goes in a different direction. 5. Identify simple machines and describe how they give advantage to users (e.g., levers, pulleys, wheels and axles, inclined planes, screws, wedges).
6	1. Know that every object exerts gravitational force on every other object dependent on the masses and distance of separation (e.g., motions of celestial objects, tides). 2. Know that gravitational force is hard to detect unless one of the objects (e.g., Earth) has a lot of mass.
7	1. Know that forces cause motion in living systems, including: • the principle of a lever and how it gives mechanical advantage to a muscular/skeletal system to lift objects • forces in specific systems in the human body (e.g., how the heart generates blood pressure, how muscles contract and expand to produce motion).
8	**Forces** 1. Know that there are fundamental forces in nature (e.g., gravity, electromagnetic forces, nuclear forces). 2. Know that a force has both magnitude and direction. 3. Analyze the separate forces acting on an object at rest or in motion (e.g., gravity, elastic forces, friction), including how multiple forces reinforce or cancel one another to result in a net force that acts on an object. 4. Know that electric charge produces electrical fields and magnets produce magnetic fields. 5. Know how a moving magnetic field can produce an electric current (generator) and how an electric current can produce a magnetic field (electromagnet). 6. Know that Earth has a magnetic field. **Motion** 7. Know that an object's motion is always described relative to some other object or point (i.e., frame of reference). 8. Understand and apply Newton's Laws of Motion: • Objects in motion will continue in motion and objects at rest will remain at rest unless acted upon by an unbalanced force (inertia). • If a greater force is applied to an object a proportionally greater acceleration will occur. • If an object has more mass the effect of an applied force is proportionally less.

Science Content Standards, Benchmarks, and Performance Standards

Strand II: Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments.

Grade	Performance Standards
5	1. Identify the components of habitats and ecosystems (producers, consumers, decomposers, predators). 2. Understand how food webs depict relationships between different organisms. 3. Know that changes in the environment can have different effects on different organisms (e.g., some organisms move, some survive, some reproduce, some die). 4. Describe how human activity impacts the environment.
6	1. Understand how organisms interact with their physical environments to meet their needs (i.e., food, water, air) and how the water cycle is essential to most living systems. 2. Describe how weather and geologic events (e.g., volcanoes, earthquakes) affect the function of living systems. 3. Describe how organisms have adapted to various environmental conditions.
7	**Populations and Ecosystems** 1. Identify the living and nonliving parts of an ecosystem and describe the relationships among these components. 2. Explain biomes (i.e., aquatic, desert, rainforest, grasslands, tundra) and describe the New Mexico biome. 3. Explain how individuals of species that exist together interact with their environment to create an ecosystem (e.g., populations, communities, niches, habitats, food webs). 4. Explain the conditions and resources needed to sustain life in specific ecosystems. 5. Describe how the availability of resources and physical factors limit growth (e.g., quantity of light and water, range of temperature, composition of soil) and how the water, carbon, and nitrogen cycles contribute to the availability of those resources to support living systems. **Biodiversity** 6. Understand how diverse species fill all niches in an ecosystem. 7. Know how to classify organisms: domain, kingdom, phylum, class, order, family, genus, species.
8	1. Describe how matter moves through ecosystems (e.g., water cycle, carbon cycle).

	2. Describe how energy flows through ecosystems (e.g., sunlight, green plants, food for animals). 3. Explain how a change in the flow of energy can impact an ecosystem (e.g., the amount of sunlight available for plant growth, global climate change).

Strand II: Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

5-8 Benchmark II: Understand how traits are passed from one generation to the next and how species evolve.

Grade	Performance Standards
5	1. Know that plants and animals have life cycles that include birth, growth and development, reproduction, and death and that these cycles differ for different organisms. 2. Identify characteristics of an organism that are inherited from its parents (e.g., eye color in humans, flower color in plants) and other characteristics that are learned or result from interactions with the environment. 3. Understand that heredity is the process by which traits are passed from one generation to another.
6	1. Understand that the fossil record provides data for how living organisms have evolved. 2. Describe how species have responded to changing environmental conditions over time (e.g., extinction, adaptation).
7	**Reproduction** 1. Know that reproduction is a characteristic of all living things and is essential to the continuation of a species. 2. Identify the differences between sexual and asexual reproduction. 3. Know that, in sexual reproduction, an egg and sperm unite to begin the development of a new individual. 4. Know that organisms that sexually reproduce fertile offspring are members of the same species. **Heredity** 5. Understand that some characteristics are passed from parent to offspring as inherited traits and others are acquired from interactions with the environment. 6. Know that hereditary information is contained in genes that are located in chromosomes, including: • determination of traits by genes • traits determined by one or many genes • more than one trait sometimes influenced by a single gene.

	Biological Evolution 7. Describe how typical traits may change from generation to generation due to environmental influences (e.g., color of skin, shape of eyes, camouflage, shape of beak). 8. Explain that diversity within a species is developed by gradual changes over many generations. 9. Know that organisms can acquire unique characteristics through naturally occurring genetic variations. 10. Identify adaptations that favor the survival of organisms in their environments (e.g., camouflage, shape of beak). 11. Understand the process of natural selection. 12. Explain how species adapt to changes in the environment or become extinct and that extinction of species is common in the history of living things. 13. Know that the fossil record documents the appearance, diversification, and extinction of many life forms.
8	1. Understand that living organisms are made mostly of molecules consisting of a limited number of elements (e.g., carbon, hydrogen, nitrogen, oxygen). 2. Identify DNA as the chemical compound involved in heredity in living organisms. 3. Describe the widespread role of carbon in the chemistry of living systems.

Strand II: Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

5-8 Benchmark III: Understand the structure of organisms and the function of cells in living systems.

Grade	Performance Standards
5	1. Understand that all living organisms are composed of cells from one to many trillions, and that cells are usually only visible through a microscope. 2. Know that some organisms are made of a collection of similar cells that cooperate (e.g., algae) while other

	organisms are made of cells that are different in appearance and function (e.g., corn, birds). 3. Describe the relationships among cells, tissues, organs, organ systems, whole organisms, and ecosystems.
6	1. Explain how fossil fuels were formed from animal and plant cells. 2. Describe the differences between substances that were produced by living organisms (e.g., fossil fuels) and substances that result from nonliving processes (e.g., igneous rocks).
7	**Structure of Organisms** 1. Understand that organisms are composed of cells and identify unicellular and multicellular organisms. 2. Explain how organs are composed of tissues of different types of cells (e.g., skin, bone, muscle, heart, intestines). **Function of Cells** 3. Understand that many basic functions of organisms are carried out in cells, including: • growth and division to produce more cells (mitosis) • specialized functions of cells (e.g., reproduction, nerve-signal transmission, digestion, excretion, movement, transport of oxygen). 4. Compare the structure and processes of plant cells and animal cells. 5. Describe how some cells respond to stimuli (e.g., light, heat, pressure, gravity). 6. Describe how factors (radiation, UV light, drugs) can damage cellular structure or function.
8	1. Describe how cells use chemical energy obtained from food to conduct cellular functions (i.e., respiration). 2. Explain that photosynthesis in green plants captures the energy from the sun and stores it chemically. 3. Describe how chemical substances can influence cellular activity (e.g., pH).

Strand II: Content of Science
Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

5-8 Benchmark I: Describe how the concepts of energy, matter, and force can be used to explain the observed behavior of the solar system, the universe, and their structures.

Grade	Performance Standards
5	1. Know that many objects in the universe are huge and are separated from one another by vast distances (e.g., many stars are larger than the sun but so distant that they look like points of light). 2. Understand that Earth is part of a larger solar system, which is part of an even larger galaxy (Milky Way), which is

	one of many galaxies. 3. Know that there have been manned and unmanned journeys to space and to the moon.
6	**Universe** 1. Describe the objects in the universe, including: • billions of galaxies, each containing billions of stars • different sizes, temperatures, and colors of stars in the Milky Way galaxy. **Solar System** 2. Locate the solar system in the Milky Way galaxy. 3. Identify the components of the solar system, and describe their defining characteristics and motions in space, including: • sun as a medium sized star • sun's composition (i.e., hydrogen, helium) and energy production • nine planets, their moons, asteroids. 4. Know that the regular and predictable motions of the Earth-moon-sun system explain phenomena on Earth, including: • Earth's motion in relation to a year, a day, the seasons, the phases of the moon, eclipses, tides, and shadows • moon's orbit around Earth once in 28 days in relation to the phases of the moon.
7	1. Explain why Earth is unique in our solar system in its ability to support life. 2. Explain how energy from the sun supports life on Earth.
8	1. Understand how energy from the sun and other stars, in the form of light, travels long distances to reach Earth. 2. Explain how the properties of light (e.g., emission, reflection, refraction) emitted from the sun and stars are used to learn about the universe, including: • distances in the solar system and the universe • temperatures of different stars. 3. Understand how gravitational force acts on objects in the solar system and the universe, including: • similar action on masses on Earth and on other objects in the solar system • explanation of the orbits of the planets around the sun.

Strand II: Content of Science
Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

5-8 Benchmark II: Describe the structure of Earth and its atmosphere and explain how energy, matter, and forces shape Earth's systems.

Grade	Performance Standards
5	1. Understand that water and air relate to Earth's processes, including: • how the water cycle relates to weather • how clouds are made of tiny droplets of water, like fog or steam. 2. Know that air is a substance that surrounds Earth (atmosphere), takes up space, and moves, and that temperature fluctuations and other factors produce wind currents. 3. Know that most of Earth's surface is covered by water, that most of that water is salt water in oceans, and that fresh water is found in rivers, lakes, underground sources, and glaciers. 4. Recognize that the seasons are caused by Earth's motion around the sun and the tilt of Earth's axis of rotation.
6	**Structure of Earth** 1. Know that Earth is composed of layers that include a crust, mantle, and core. 2. Know that Earth's crust is divided into plates that move very slowly, in response to movements in the mantle. 3. Know that sedimentary, igneous, and metamorphic rocks contain evidence of the materials, temperatures, and forces that created them. **Weather and Climate** 4. Describe the composition (i.e., nitrogen, oxygen, water vapor) and strata of Earth's atmosphere, and differences between the atmosphere of Earth and those of other planets. 5. Understand factors that create and influence weather and climate, including: • heat, air movement, pressure, humidity, oceans • how clouds form by condensation of water vapor • how weather patterns are related to atmospheric pressure • global patterns of atmospheric movement (e.g., El Niño) • factors that can impact Earth's climate (e.g., volcanic eruptions, impacts of asteroids, glaciers). 6. Understand how to use weather maps and data (e.g., barometric pressure, wind speeds, humidity) to predict weather. **Changes to Earth** 7. Know that landforms are created and change through a combination of constructive and destructive forces, including:

	• weathering of rock and soil, transportation, deposition of sediment, and tectonic activity • similarities and differences between current and past processes on Earth's surface (e.g., erosion, plate tectonics, changes in atmospheric composition) • impact of volcanoes and faults on New Mexico geology. 8. Understand the history of Earth and how information about it comes from layers of sedimentary rock, including: • sediments and fossils as a record of a very slowly changing world • evidence of asteroid impact, volcanic and glacial activity.
7	1. Understand how the remains of living things give us information about the history of Earth, including: • layers of sedimentary rock, the fossil record, and radioactive dating showing that life has been present on Earth for more than 3.5 billion years. 2. Understand how living organisms have played many roles in changes of Earth's systems through time (e.g., atmospheric composition, creation of soil, impact on Earth's surface). 3. Know that changes to ecosystems sometimes decrease the capacity of the environment to support some life forms and are difficult and/or costly to remediate.
8	1. Describe the role of pressure (and heat) in the rock cycle. 2. Understand the unique role water plays on Earth, including: • ability to remain liquid at most Earth temperatures • properties of water related to processes in the water cycle: evaporation, condensation, precipitation, surface run-off, percolation • dissolving of minerals and gases and transport to the oceans • fresh and salt water in oceans, rivers, lakes, and glaciers • reactant in photosynthesis. 3. Understand the geologic conditions that have resulted in energy resources (e.g., oil, coal, natural gas) available in New Mexico.

Strand III: Science and Society
Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

5-8 Benchmark I: Explain how scientific discoveries and inventions have changed individuals and societies.

Science Content Standards, Benchmarks, and Performance Standards

Grade	Performance Standards
5	1. Describe the contributions of science to understanding local or current issues (e.g., watershed and community decisions regarding water use). 2. Describe how various technologies have affected the lives of individuals (e.g., transportation, entertainment, health).
6	1. Examine the role of scientific knowledge in decisions (e.g., space exploration, what to eat, preventive medicine and medical treatment). 2. Describe the technologies responsible for revolutionizing information processing and communications (e.g., computers, cellular phones, Internet).
7	1. Analyze the contributions of science to health as they relate to personal decisions about smoking, drugs, alcohol, and sexual activity. 2. Analyze how technologies have been responsible for advances in medicine (e.g., vaccines, antibiotics, microscopes, DNA technologies). 3. Describe how scientific information can help individuals and communities respond to health emergencies (e.g., CPR, epidemics, HIV, bio-terrorism).
8	1. Analyze the interrelationship between science and technology (e.g., germ theory, vaccines). 2. Describe how scientific information can help to explain environmental phenomena (e.g., floods, earthquakes, volcanoes, fire, extreme weather). 3. Describe how technological revolutions have significantly influenced societies (e.g., energy production, warfare, space exploration). 4. Critically analyze risks and benefits associated with technologies related to energy production.

9th – 12th Grade

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

9-12 Benchmark I: Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.

Grade	Performance Standards
9-12	1. Describe the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions. 2. Design and conduct scientific investigations that include: • testable hypotheses • controls and variables • methods to collect, analyze, and interpret data • results that address hypotheses being investigated • predictions based on results • re-evaluation of hypotheses and additional experimentation as necessary • error analysis. 3. Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes). 4. Convey results of investigations using scientific concepts, methodologies, and expressions, including: • scientific language and symbols • diagrams, charts, and other data displays • mathematical expressions and processes (e.g., mean, median, slope, proportionality) • clear, logical, and concise communication • reasoned arguments. 5. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom).

Science Content Standards, Benchmarks, and Performance Standards

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

9-12 Benchmark II: Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.

Grade	Performance Standards
9-12	1. Understand how scientific processes produce valid, reliable results, including: • consistency of explanations with data and observations • openness to peer review • full disclosure and examination of assumptions • testability of hypotheses • repeatability of experiments and reproducibility of results. 2. Use scientific reasoning and valid logic to recognize: • faulty logic • cause and effect • the difference between observation and unsubstantiated inferences and conclusions • potential bias. 3. Understand how new data and observations can result in new scientific knowledge. 4. Critically analyze an accepted explanation by reviewing current scientific knowledge. 5. Examine investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe). 6. Examine the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently.

Science Content Standards, Benchmarks, and Performance Standards

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

9-12 Benchmark III: Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.

Grade	Performance Standards
9-12	1. Create multiple displays of data to analyze and explain the relationships in scientific investigations. 2. Use mathematical models to describe, explain, and predict natural phenomena. 3. Use technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling). 4. Identify and apply measurement techniques and consider possible effects of measurement errors. 5. Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis).

Strand II: The Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

9-12 Benchmark I: Understand the properties, underlying structure, and reactions of matter.

Grade	Performance Standards
9-12	**Properties of Matter** 1. Classify matter in a variety of ways (e.g., element, compound, mixture; solid, liquid, gas; acidic, basic, neutral). 2. Identify, measure, and use a variety of physical and chemical properties (e.g., electrical conductivity, density, viscosity, chemical reactivity, pH, melting point). 3. Know how to use properties to separate mixtures into pure substances (e.g., distillation, chromatography, solubility). 4. Describe trends in properties (e.g., ionization energy or reactivity as a function of location on the periodic table, boiling point of organic liquids as a function of molecular weight).

	Structure of Matter 5. Understand that matter is made of atoms and that atoms are made of subatomic particles. 6. Understand atomic structure, including: • most space occupied by electrons • nucleus made of protons and neutrons • isotopes of an element • masses of proton and neutron 2000 times greater than mass of electron • atom held together by proton-electron electrical forces. 7. Explain how electrons determine the properties of substances by: • interactions between atoms through transferring or sharing valence electrons • ionic and covalent bonds • the ability of carbon to form a diverse array of organic structures. 8. Make predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements). 9. Understand how the type and arrangement of atoms and their bonds determine macroscopic properties (e.g., boiling point, electrical conductivity, hardness of minerals). 10. Know that states of matter (i.e., solid, liquid, gas) depend on the arrangement of atoms and molecules and on their freedom of motion. 11. Know that some atomic nuclei can change, including: • spontaneous decay • half-life of isotopes • fission • fusion (e.g., the sun) • alpha, beta, and gamma radiation. **Chemical Reactions** 12. Know that chemical reactions involve the rearrangement of atoms, and that they occur on many timescales (e.g., picoseconds to millennia). 13. Understand types of chemical reactions (e.g., synthesis, decomposition, combustion, redox, neutralization) and identify them as exothermic or endothermic. 14. Know how to express chemical reactions with balanced equations that show: • conservation of mass

	• products of common reactions. 15. Describe how the rate of chemical reactions depends on many factors that include temperature, concentration, and the presence of catalysts.

Strand II: The Content of Science
Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

9-12 Benchmark II: Understand the transformation and transmission of energy and how energy and matter interact.

Grade	Performance Standards
9-12	**Energy Transformation and Transfer** 1. Identify different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic. 2. Explain how thermal energy (heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature. 3. Understand that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and know that energy is conserved in these changes. 4. Understand how heat can be transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators. 5. Explain how heat flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions. 6. Understand that the ability of energy to do something useful (work) tends to decrease (and never increases) as energy is converted from one form to another. **Interactions of Energy and Matter** 7. Understand that electromagnetic waves carry energy that can be transferred when they interact with matter. 8. Describe the characteristics of electromagnetic waves (e.g., visible light, radio, microwave, X-ray, ultraviolet, gamma) and other waves (e.g., sound, seismic waves, water waves), including: • origin and potential hazards of various forms of electromagnetic radiation

	• energy of electromagnetic waves carried in discrete energy packets (photons) whose energy is inversely proportional to wavelength. 9. Know that each kind of atom or molecule can gain or lose energy only in discrete amounts. 10. Explain how wavelengths of electromagnetic radiation can be used to identify atoms, molecules, and the composition of stars. 11. Understand the concept of equilibrium (i.e., thermal, mechanical, and chemical).

Strand II: The Content of Science
Standard I: (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

9-12 Benchmark III: Understand the motion of objects and waves, and the forces that cause them.

Grade	Performance Standards
9-12	**Forces** 1. Know that there are four fundamental forces in nature: gravitation, electromagnetism, weak nuclear force, and strong nuclear force. 2. Know that every object exerts gravitational force on every other object, and how this force depends on the masses of the objects and the distance between them. 3. Know that materials containing equal amounts of positive and negative charges are electrically neutral, but that a small excess or deficit of negative charges produces significant electrical forces. 4. Understand the relationship between force and pressure, and how the pressure of a volume of gas depends on the temperature and the amount of gas. 5. Explain how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators). 6. Represent the magnitude and direction of forces by vector diagrams. 7. Know that when one object exerts a force on a second object, the second object exerts a force of equal magnitude and in the opposite direction on the first object (i.e., Newton's Third Law). **Motion** 8. Apply Newton's Laws to describe and analyze the behavior of moving objects, including:

	• displacement, velocity, and acceleration of a moving object • Newton's Second Law, $F = ma$ (e.g., momentum and its conservation, the motion of an object falling under gravity, the independence of a falling object's motion on mass) • circular motion and centripetal force. 9. Describe relative motion using frames of reference. 10. Describe wave propagation using amplitude, wavelength, frequency, and speed. 11. Explain how the interactions of waves can result in interference, reflection, and refraction. 12. Describe how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect).

Strand II: The Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

9-12 Benchmark I: Understand how the survival of species depends on biodiversity and on complex interactions, including the cycling of matter and the flow of energy.

Grade	Performance Standards
9-12	**Ecosystems** 1. Know that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time. 2. Describe how organisms cooperate and compete in ecosystems (e.g., producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism). 3. Understand and describe how available resources limit the amount of life an ecosystem can support (e.g., energy, water, oxygen, nutrients). 4. Critically analyze how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology). **Energy Flow in the Environment** 5. Explain how matter and energy flow through biological systems (e.g., organisms, communities, ecosystems), and how the total amount of matter and energy is conserved but some energy is always released as heat to the environment. 6. Describe how energy flows from the sun through plants to herbivores to carnivores and decomposers. 7. Understand and explain the principles of photosynthesis (i.e., chloroplasts in plants convert light energy, carbon dioxide, and water into chemical energy).

	Biodiversity 8. Understand and explain the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including: • classification of an organism into a category • similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities • similarities of organisms reflecting evolutionary relationships. 9. Understand variation within and among species, including: • mutations and genetic drift • factors affecting the survival of an organism • natural selection.

Strand II: The Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

9-12 Benchmark II: Understand the genetic basis for inheritance and the basic concepts of biological evolution.

Grade	Performance Standards
9-12	**Genetics** 1. Know how DNA carries all genetic information in the units of heredity called genes, including: • the structure of DNA (e.g., subunits A, G, C, T) • information-preserving replication of DNA • alteration of genes by inserting, deleting, or substituting parts of DNA. 2. Use appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype). 3. Explain the concepts of segregation, independent assortment, and dominant/recessive alleles. 4. Identify traits that can and cannot be inherited. 5. Know how genetic variability results from the recombination and mutation of genes, including: • sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring

	• radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA. 6. Understand the principles of sexual and asexual reproduction, including meiosis and mitosis. 7. Know that most cells in the human body contain 23 pairs of chromosomes including one pair that determines sex, and that human females have two X chromosomes and human males have an X and a Y chromosome. **Biological Evolution** 8. Describe the evidence for the first appearance of life on Earth as one-celled organisms, over 3.5 billion years ago, and for the later appearance of a diversity of multicellular organisms over millions of years. 9. Critically analyze the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms. 10. Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms. 11. Understand that evolution is a consequence of many factors, including the ability of organisms to reproduce, genetic variability, the effect of limited resources, and natural selection. 12. Explain how natural selection favors individuals who are better able to survive, reproduce, and leave offspring. 13. Analyze how evolution by natural selection and other mechanisms explains many phenomena including the fossil record of ancient life forms and similarities (both physical and molecular) among different species.

Strand II: The Content of Science
Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

9-12 Benchmark III: Understand the characteristics, structures, and functions of cells.

Grade	Performance Standards
9-12	**Structure and Function** 1. Know that cells are made of proteins composed of combinations of amino acids.

	2. Know that specialized structures inside cells in most organisms carry out different functions, including: • parts of a cell and their functions (e.g., nucleus, chromosomes, plasma, and mitochondria) • storage of genetic material in DNA • similarities and differences between plant and animal cells • prokaryotic and eukaryotic cells. 3. Describe the mechanisms for cellular processes (e.g., energy production and storage, transport of molecules, waste disposal, synthesis of new molecules). 4. Know how the cell membrane controls which ions and molecules enter and leave the cell based on membrane permeability and transport (i.e., osmosis, diffusion, active transport, passive transport). 5. Explain how cells differentiate and specialize during the growth of an organism, including: • differentiation, regulated through the selected expression of different genes • specialized cells, response to stimuli (e.g., nerve cells, sense organs). 6. Know that DNA directs protein building (e.g., role of RNA). **Biochemical Mechanisms** 7. Describe how most cell functions involve chemical reactions, including: • promotion or inhibition of biochemical reactions by enzymes • processes of respiration (e.g., energy production, ATP) • communication from cell to cell by secretion of a variety of chemicals (e.g., hormones).

Strand II: The Content of Science
Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

9-12 Benchmark I: Examine the scientific theories of the origin, structure, contents, and evolution of the solar system and the universe, and their interconnections.

Grade	Performance Standards
9-12	1. Understand the scale and contents of the universe, including: • range of structures from atoms through astronomical objects to the universe

	• objects in the universe such as planets, stars, galaxies, and nebulae. 2. Predict changes in the positions and appearances of objects in the sky (e.g., moon, sun) based on knowledge of current positions and patterns of movements (e.g., lunar cycles, seasons). 3. Understand how knowledge about the universe comes from evidence collected from advanced technology (e.g., telescopes, satellites, images, computer models). 4. Describe the key observations that led to the acceptance of the Big Bang theory and that the age of the universe is over 10 billion years. 5. Explain how objects in the universe emit different electromagnetic radiation and how this information is used. 6. Describe how stars are powered by nuclear fusion, how luminosity and temperature indicate their age, and how stellar processes create heavier and stable elements that are found throughout the universe. 7. Examine the role that New Mexico research facilities play in current space exploration (e.g., Very Large Array, Goddard Space Center).

Strand II: The Content of Science
Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

9-12 Benchmark II: Examine the scientific theories of the origin, structure, energy, and evolution of Earth and its atmosphere, and their interconnections.

Grade	Performance Standards
9-12	**Characteristics and Evolution of Earth** 1. Describe the characteristics and the evolution of Earth in terms of the geosphere, the hydrosphere, the atmosphere, and the biosphere. 2. Recognize that radiometric data indicate that Earth is at least 4 billion years old and that Earth has changed during that period. 3. Describe the internal structure of Earth (e.g., core, mantle, crust) and the structure of Earth's plates. 4. Understand the changes in Earth's past and the investigative methods used to determine geologic time, including: • rock sequences, relative dating, fossil correlation, and radiometric dating • geologic time scales, historic changes in life forms, and the evidence for absolute ages (e.g., radiometric methods, tree rings, paleomagnetism).

	5. Explain plate tectonic theory and understand the evidence that supports it. **Energy in Earth's System** 6. Know that Earth's systems are driven by internal (i.e., radioactive decay and gravitational energy) and external (i.e., the sun) sources of energy. 7. Describe convection as the mechanism for moving heat energy from deep within Earth to the surface and discuss how this process results in plate tectonics, including: • geological manifestations (e.g., earthquakes, volcanoes, mountain building) that occur at plate boundaries • impact of plate motions on societies and the environment (e.g., earthquakes, volcanoes). 8. Describe the patterns and relationships in the circulation of air and water driven by the sun's radiant energy, including: • patterns in weather systems related to the transfer of energy • differences between climate and weather • global climate, global warming, and the greenhouse effect • El Niño, La Niña, and other climatic trends. **Geochemical Cycles** 9. Know that Earth's system contains a fixed amount of natural resources that cycle among land, water, the atmosphere, and living things (e.g., carbon and nitrogen cycles, rock cycle, water cycle, ground water, aquifers). 10. Describe the composition and structure of Earth's materials, including: • the major rock types (i.e., sedimentary, igneous, metamorphic) and their formation • natural resources (e.g., minerals, petroleum) and their formation. 11. Explain how layers of the atmosphere (e.g., ozone, ionosphere) change naturally and artificially. 12. Explain how the availability of ground water through aquifers can fluctuate based on multiple factors (i.e., rate of use, rate of replenishment, surface changes, and changes in temperature).

Strand III: Science and Society
Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

9-12 Benchmark I: Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.

Grade	Performance Standards
9-12	**Science and Technology** 1. Know how science enables technology but also constrains it, and recognize the difference between real technology and science fiction (e.g., rockets vs. antigravity machines; nuclear reactors vs. perpetual-motion machines; medical X-rays vs. Star-Trek tricorders). 2. Understand how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe). 3. Evaluate the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod). 4. Understand the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment). 5. Understand that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning). 6. Analyze the impact of digital technologies on the availability, creation, and dissemination of information. 7. Describe how human activities have affected ozone in the upper atmosphere and how it affects health and the environment. 8. Describe uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating). **Science and Society** 9. Describe how scientific knowledge helps decision makers with local, national, and global challenges (e.g., Waste Isolation Pilot Project [WIPP], mining, drought, population growth, alternative energy, climate change). 10. Describe major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them. 11. Know that societal factors can promote or constrain scientific discovery (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research). 12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible. 13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico. 14. Describe New Mexico's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories). **Science and Individuals**

	15. Identify how science has produced knowledge that is relevant to individual health and material prosperity. 16. Understand that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on Earth, the cause of the Big Bang, the future of Earth). 17. Identify important questions that science cannot answer (e.g., questions that are beyond today's science, decisions that science can only help to make, questions that are inherently outside of the realm of science). 18. Understand that scientists have characteristics in common with other individuals (e.g., employment and career needs, curiosity, desire to perform public service, greed, preconceptions and biases, temptation to be unethical, core values including honesty and openness). 19. Know that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers).