

**TExES**  
**Texas Examinations of Educator Standards**

**Field 114: Mathematics\Science 4–8**  
**Test Framework**

<b>Domain</b>	<b>Range of Competencies</b>
I. Number Concepts	001–003
II. Patterns and Algebra	004–007
III. Geometry and Measurement	008–011
IV. Probability and Statistics	012–014
V. Mathematical Processes and Perspectives	015–016
VI. Mathematical Learning, Instruction, and Assessment	017–019
VII. Scientific Inquiry and Processes	020–024
VIII. Physical Science	025–029
IX. Life Science	030–034
X. Earth and Space Science	035–039
XI. Science Learning, Instruction, and Assessment	040–042

# TEST FRAMEWORK FOR FIELD 114: MATHEMATICS\SCIENCE 4–8

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**Domain I Number Concepts (approximately 8% of the test)**

**Standards Assessed:**

**Mathematics Standard I:**

Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

**Domain II Patterns and Algebra (approximately 11% of the test)**

**Standards Assessed:**

**Mathematics Standard II:**

Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

**Domain III Geometry and Measurement (approximately 11% of the test)**

**Standards Assessed:**

**Mathematics Standard III:**

Geometry and Measurement: The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

**Domain IV Probability and Statistics (approximately 8% of the test)**

**Standards Assessed:**

**Mathematics Standard IV:**

Probability and Statistics: The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

**Domain V Mathematical Processes and Perspectives (approximately 5% of the test)**

**Standards Assessed:**

**Mathematics Standards V and VI:**

Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.

Mathematical Perspectives: The mathematics teacher understands the historical development of mathematical ideas, the interrelationship between society and mathematics, the structure of mathematics, and the evolving nature of mathematics and mathematical knowledge.

**Domain VI Mathematical Learning, Instruction, and Assessment (approximately 8% of the test)**

**Standards Assessed:**

**Mathematics Standards VII and VIII:**

**Mathematical Learning and Instruction:** The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.

**Mathematical Assessment:** The mathematics teacher understands assessment and uses a variety of formal and informal assessment techniques appropriate to the learner on an ongoing basis to monitor and guide instruction and to evaluate and report student progress.

**Domain VII Scientific Inquiry and Processes (approximately 11% of the test)**

**Standards Assessed:**

**Science Standards I, II, III, VI, VII, and XI:**

The science teacher manages classroom, field, and laboratory activities to ensure the safety of all students and the ethical care and treatment of organisms and specimens.

The science teacher understands the correct use of tools, materials, equipment, and technologies.

The science teacher understands the process of scientific inquiry and its role in science instruction.

The science teacher understands the history and nature of science.

The science teacher understands how science affects the daily lives of students and how science interacts with and influences personal and societal decisions.

The science teacher knows unifying concepts and processes that are common to all sciences.

**Domain VIII Physical Science (approximately 11% of the test)**

**Standards Assessed:**

**Science Standard VIII:**

The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.

**Domain IX Life Science (approximately 11% of the test)**

**Standards Assessed:**

**Science Standard IX:**

The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in life science.

**Domain X Earth and Space Science (approximately 11% of the test)**

**Standards Assessed:**

**Science Standard X:**

The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in Earth and space science.

**Domain XI Science Learning, Instruction, and Assessment (approximately 6% of the test)**

**Standards Assessed:**

**Science Standards III, IV, and V:**

The science teacher understands the process of scientific inquiry and its role in science instruction.

The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.

The science teacher knows the varied and appropriate assessments and assessment practices to monitor science learning.

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**Texas Examinations of Educator Standards**

**Field 114: Mathematics\Science 4–8**  
**Test Framework**

**DOMAIN I—NUMBER CONCEPTS**

**Competency 001**

**The teacher understands the structure of number systems, the development of a sense of quantity, and the relationship between quantity and symbolic representations.**

The beginning teacher:

- Analyzes the structure of numeration systems and the roles of place value and zero in the base ten system.
- Understands the relative magnitude of whole numbers, integers, rational numbers, and real numbers.
- Demonstrates an understanding of a variety of models for representing numbers (e.g., fraction strips, diagrams, patterns, shaded regions, number lines).
- Demonstrates an understanding of equivalency among different representations of rational numbers.
- Selects appropriate representations of real numbers (e.g., fractions, decimals, percents, roots, exponents, scientific notation) for particular situations.
- Understands the characteristics of the set of whole numbers, integers, rational numbers, real numbers, and complex numbers (e.g., commutativity, order, closure, identity elements, inverse elements, density).
- Demonstrates an understanding of how some situations that have no solution in one number system (e.g., whole numbers, integers, rational numbers) have solutions in another number system (e.g., real numbers, complex numbers).

**Competency 002**

**The teacher understands number operations and computational algorithms.**

The beginning teacher:

- Works proficiently with real and complex numbers and their operations.
- Analyzes and describes relationships between number properties, operations, and algorithms for the four basic operations involving integers, rational numbers, and real numbers.
- Uses a variety of concrete and visual representations to demonstrate the connections between operations and algorithms.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Justifies procedures used in algorithms for the four basic operations with integers, rational numbers, and real numbers, and analyzes error patterns that may occur in their application.
- Relates operations and algorithms involving numbers to algebraic procedures (e.g., adding fractions to adding rational expressions, division of integers to division of polynomials).
- Extends and generalizes the operations on rationals and integers to include exponents, their properties, and their applications to the real numbers.

**Competency 003**

**The teacher understands ideas of number theory and uses numbers to model and solve problems within and outside of mathematics.**

The beginning teacher:

- Demonstrates an understanding of ideas from number theory (e.g., prime factorization, greatest common divisor) as they apply to whole numbers, integers, and rational numbers, and uses these ideas in problem situations.
- Uses integers, rational numbers, and real numbers to describe and quantify phenomena such as money, length, area, volume, and density.
- Applies knowledge of place value and other number properties to develop techniques of mental mathematics and computational estimation.
- Applies knowledge of counting techniques such as permutations and combinations to quantify situations and solve problems.
- Applies properties of the real numbers to solve a variety of theoretical and applied problems.

**DOMAIN II—PATTERNS AND ALGEBRA**

**Competency 004**

**The teacher understands and uses mathematical reasoning to identify, extend, and analyze patterns and understands the relationships among variables, expressions, equations, inequalities, relations, and functions.**

The beginning teacher:

- Uses inductive reasoning to identify, extend, and create patterns using concrete models, figures, numbers, and algebraic expressions.
- Formulates implicit and explicit rules to describe and construct sequences verbally, numerically, graphically, and symbolically.
- Makes, tests, validates, and uses conjectures about patterns and relationships in data presented in tables, sequences, or graphs.
- Gives appropriate justification of the manipulation of algebraic expressions.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Illustrates the concept of a function using concrete models, tables, graphs, and symbolic and verbal representations.
- Uses transformations to illustrate properties of functions and relations and to solve problems.

**Competency 005**

**The teacher understands and uses linear functions to model and solve problems.**

The beginning teacher:

- Demonstrates an understanding of the concept of linear function using concrete models, tables, graphs, and symbolic and verbal representations.
- Demonstrates an understanding of the connections among linear functions, proportions, and direct variation.
- Determines the linear function that best models a set of data.
- Analyzes the relationship between a linear equation and its graph.
- Uses linear functions, inequalities, and systems to model problems.
- Uses a variety of representations and methods (e.g., numerical methods, tables, graphs, algebraic techniques) to solve systems of linear equations and inequalities.
- Demonstrates an understanding of the characteristics of linear models and the advantages and disadvantages of using a linear model in a given situation.

**Competency 006**

**The teacher understands and uses nonlinear functions and relations to model and solve problems.**

The beginning teacher:

- Uses a variety of methods to investigate the roots (real and complex), vertex, and symmetry of a quadratic function or relation.
- Demonstrates an understanding of the connections among geometric, graphic, numeric, and symbolic representations of quadratic functions.
- Analyzes data and represents and solves problems involving exponential growth and decay.
- Demonstrates an understanding of the connections among proportions, inverse variation, and rational functions.
- Understands the effects of transformations such as  $f(x \pm c)$  on the graph of a nonlinear function  $f(x)$ .
- Applies properties, graphs, and applications of nonlinear functions to analyze, model, and solve problems.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Uses a variety of representations and methods (e.g., numerical methods, tables, graphs, algebraic techniques) to solve systems of quadratic equations and inequalities.
- Understands how to use properties, graphs, and applications of non-linear relations including polynomial, rational, radical, absolute value, exponential, logarithmic, trigonometric, and piecewise functions and relations to analyze, model, and solve problems.

**Competency 007**

**The teacher uses and understands the conceptual foundations of calculus related to topics in middle school mathematics.**

The beginning teacher:

- Relates topics in middle school mathematics to the concept of limit in sequences and series.
- Relates the concept of average rate of change to the slope of the secant line and instantaneous rate of change to the slope of the tangent line.
- Relates topics in middle school mathematics to the area under a curve.
- Demonstrates an understanding of the use of calculus concepts to answer questions about rates of change, areas, volumes, and properties of functions and their graphs.

**DOMAIN III—GEOMETRY AND MEASUREMENT**

**Competency 008**

**The teacher understands measurement as a process.**

The beginning teacher:

- Selects and uses appropriate units of measurement (e.g., temperature, money, mass, weight, area, capacity, density, percents, speed, acceleration) to quantify, compare, and communicate information.
- Develops, justifies, and uses conversions within measurement systems.
- Applies dimensional analysis to derive units and formulas in a variety of situations (e.g., rates of change of one variable with respect to another) and to find and evaluate solutions to problems.
- Describes the precision of measurement and the effects of error on measurement.
- Applies the Pythagorean theorem, proportional reasoning, and right triangle trigonometry to solve measurement problems.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**Competency 009**

**The teacher understands the geometric relationships and axiomatic structure of Euclidean geometry.**

The beginning teacher:

- Understands concepts and properties of points, lines, planes, angles, lengths, and distances.
- Analyzes and applies the properties of parallel and perpendicular lines.
- Uses the properties of congruent triangles to explore geometric relationships and prove theorems.
- Describes and justifies geometric constructions made using a compass and straight edge and other appropriate technologies.
- Applies knowledge of the axiomatic structure of Euclidean geometry to justify and prove theorems.

**Competency 010**

**The teacher analyzes the properties of two- and three-dimensional figures.**

The beginning teacher:

- Uses and understands the development of formulas to find lengths, perimeters, areas, and volumes of basic geometric figures.
- Applies relationships among similar figures, scale, and proportion and analyzes how changes in scale affect area and volume measurements.
- Uses a variety of representations (e.g., numeric, verbal, graphic, symbolic) to analyze and solve problems involving two- and three-dimensional figures such as circles, triangles, polygons, cylinders, prisms, and spheres.
- Analyzes the relationship among three-dimensional figures and related two-dimensional representations (e.g., projections, cross-sections, nets) and uses these representations to solve problems.

**Competency 011**

**The teacher understands transformational geometry and relates algebra to geometry and trigonometry using the Cartesian coordinate system.**

The beginning teacher:

- Describes and justifies geometric constructions made using a reflection device and other appropriate technologies.
- Uses translations, reflections, glide-reflections, and rotations to demonstrate congruence and to explore the symmetries of figures.
- Uses dilations (expansions and contractions) to illustrate similar figures and proportionality.
- Uses symmetry to describe tessellations and shows how they can be used to illustrate geometric concepts, properties, and relationships.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Applies concepts and properties of slope, midpoint, parallelism, and distance in the coordinate plane to explore properties of geometric figures and solve problems.
- Applies transformations in the coordinate plane.
- Uses the unit circle in the coordinate plane to explore properties of trigonometric functions.

**DOMAIN IV—PROBABILITY AND STATISTICS**

**Competency 012**

**The teacher understands how to use graphical and numerical techniques to explore data, characterize patterns, and describe departures from patterns.**

The beginning teacher:

- Organizes and displays data in a variety of formats (e.g., tables, frequency distributions, stem-and-leaf plots, box-and-whisker plots, histograms, pie charts).
- Applies concepts of center, spread, shape, and skewness to describe a data distribution.
- Supports arguments, makes predictions, and draws conclusions using summary statistics and graphs to analyze and interpret one-variable data.
- Demonstrates an understanding of measures of central tendency (e.g., mean, median, mode) and dispersion (e.g., range, interquartile range, variance, standard deviation).
- Analyzes connections among concepts of center and spread, data clusters and gaps, data outliers, and measures of central tendency and dispersion.
- Calculates and interprets percentiles and quartiles.

**Competency 013**

**The teacher understands the theory of probability.**

The beginning teacher:

- Explores concepts of probability through data collection, experiments, and simulations.
- Uses the concepts and principles of probability to describe the outcome of simple and compound events.
- Generates, simulates, and uses probability models to represent a situation.
- Determines probabilities by constructing sample spaces to model situations.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Solves a variety of probability problems using combinations, permutations, and geometric probability (i.e., probability as the ratio of two areas).
- Uses the binomial, geometric, and normal distributions to solve problems.

**Competency 014**

**The teacher understands the relationship among probability theory, sampling and statistical inference, and how statistical inference is used in making and evaluating predictions.**

The beginning teacher:

- Applies knowledge of designing, conducting, analyzing, and interpreting statistical experiments to investigate real-world problems.
- Demonstrates an understanding of random samples, sample statistics, and the relationship between sample size and confidence intervals.
- Applies knowledge of the use of probability to make observations and draw conclusions from single variable data and to describe the level of confidence in the conclusion.
- Makes inferences about a population using binomial, normal, and geometric distributions.
- Demonstrates an understanding of the use of techniques such as scatter plots, regression lines, correlation coefficients, and residual analysis to explore bivariate data and to make and evaluate predictions.

**DOMAIN V—MATHEMATICAL PROCESSES AND PERSPECTIVES**

**Competency 015**

**The teacher understands mathematical reasoning and problem solving.**

The beginning teacher:

- Demonstrates an understanding of proof, including indirect proof, in mathematics.
- Applies correct mathematical reasoning to derive valid conclusions from a set of premises.
- Demonstrates an understanding of the use of inductive reasoning to make conjectures and deductive methods to evaluate the validity of conjectures.
- Applies knowledge of the use of formal and informal reasoning to explore, investigate, and justify mathematical ideas.
- Recognizes that a mathematical problem can be solved in a variety of ways and selects an appropriate strategy for a given problem.
- Evaluates the reasonableness of a solution to a given problem.

**FIELD 114: MATHEMATICS\SCIENCE 4–8  
TEST FRAMEWORK**

- Applies content knowledge to develop a mathematical model of a real-world situation and analyzes and evaluates how well the model represents the situation.
- Demonstrates an understanding of estimation and evaluates its appropriate uses.

**Competency 016**

**The teacher understands mathematical connections within and outside of mathematics and how to communicate mathematical ideas and concepts.**

The beginning teacher:

- Recognizes and uses multiple representations of a mathematical concept (e.g., a point and its coordinates, the area of circle as a quadratic function in  $r$ , probability as the ratio of two areas).
- Uses mathematics to model and solve problems in other disciplines, such as art, music, science, social science, and business.
- Expresses mathematical statements using developmentally appropriate language, standard English, mathematical language, and symbolic mathematics.
- Communicates mathematical ideas using a variety of representations (e.g., numeric, verbal, graphic, pictorial, symbolic, concrete).
- Demonstrates an understanding of the use of visual media such as graphs, tables, diagrams, and animations to communicate mathematical information.
- Uses the language of mathematics as a precise means of expressing mathematical ideas.
- Understands the structural properties common to the mathematical disciplines.

**DOMAIN VI—MATHEMATICAL LEARNING, INSTRUCTION, AND ASSESSMENT**

**Competency 017**

**The teacher understands how children learn and develop mathematical skills, procedures, and concepts.**

The beginning teacher:

- Applies theories and principles of learning mathematics to plan appropriate instructional activities for all students.
- Understands how students differ in their approaches to learning mathematics with regards to diversity.
- Uses students' prior mathematical knowledge to build conceptual links to new knowledge and plans instruction that builds on students' strengths and addresses students' needs.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Understands how learning may be assisted through the use of mathematics manipulatives and technological tools.
- Understands how to motivate students and actively engage them in the learning process by using a variety of interesting, challenging, and worthwhile mathematical tasks in individual, small-group, and large-group settings.
- Understands how to provide instruction along a continuum from concrete to abstract.
- Recognizes the implications of current trends and research in mathematics and mathematics education.

**Competency 018**

**The teacher understands how to plan, organize, and implement instruction using knowledge of students, subject matter, and statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) to teach all students to use mathematics.**

The beginning teacher:

- Demonstrates an understanding of a variety of instructional methods, tools, and tasks that promote students' ability to do mathematics described in the TEKS.
- Understands planning strategies for developing mathematical instruction as a discipline of interconnected concepts and procedures.
- Develops clear learning goals to plan, deliver, assess, and reevaluate instruction based on the TEKS.
- Understands procedures for developing instruction that establishes transitions between concrete, symbolic, and abstract representations of mathematical knowledge.
- Applies knowledge of a variety of instructional delivery methods, such as individual, structured small-group, and large-group formats.
- Understands how to create a learning environment that provides all students, including English Language Learners, with opportunities to develop and improve mathematical skills and procedures.
- Demonstrates an understanding of a variety of questioning strategies to encourage mathematical discourse and to help students analyze and evaluate their mathematical thinking.
- Understands how technological tools and manipulatives can be used appropriately to assist students in developing, comprehending, and applying mathematical concepts.
- Understands how to relate mathematics to students' lives and a variety of careers and professions.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**Competency 019**

**The teacher understands assessment and uses a variety of formal and informal assessment techniques to monitor and guide mathematics instruction and to evaluate student progress.**

The beginning teacher:

- Demonstrates an understanding of the purpose, characteristics, and uses of various assessments in mathematics, including formative and summative assessments.
- Understands how to select and develop assessments that are consistent with what is taught and how it is taught.
- Demonstrates an understanding of how to develop a variety of assessments and scoring procedures consisting of worthwhile tasks that assess mathematical understanding, common misconceptions, and error patterns.
- Understands how to evaluate a variety of assessment methods and materials for reliability, validity, absence of bias, clarity of language, and appropriateness of mathematical level.
- Understands the relationship between assessment and instruction and knows how to evaluate assessment results to design, monitor, and modify instruction to improve mathematical learning for all students, including English Language Learners.

**DOMAIN VII—SCIENTIFIC INQUIRY AND PROCESSES**

**Competency 020**

**The teacher understands how to manage learning activities to ensure the safety of all students.**

The beginning teacher:

- Understands safety regulations and guidelines for science facilities and science instruction.
- Knows procedures for and sources of information regarding the appropriate handling, use, disposal, care, and maintenance of chemicals, materials, specimens, and equipment.
- Knows procedures for the safe handling and ethical care and treatment of organisms and specimens.

**Competency 021**

**The teacher understands the correct use of tools, materials, equipment, and technologies.**

The beginning teacher:

- Selects and safely uses appropriate tools, technologies, materials, and equipment needed for instructional activities.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Understands concepts of precision, accuracy, and error with regard to reading and recording numerical data from a scientific instrument.
- Understands how to gather, organize, display, and communicate data in a variety of ways (e.g., charts, tables, graphs, diagrams, written reports, oral presentations).
- Understands the international system of measurement (i.e., metric system) and performs unit conversions within measurement systems.

**Competency 022**

**The teacher understands the process of scientific inquiry and the history and nature of science.**

The beginning teacher:

- Understands the characteristics of various types of scientific investigations (e.g., descriptive studies, controlled experiments, comparative data analysis).
- Understands how to design, conduct, and communicate the results of a variety of scientific investigations.
- Understands the historical development of science and the contributions that diverse cultures and individuals of both genders have made to scientific knowledge.
- Understands the roles that logical reasoning, verifiable evidence, prediction, and peer review play in the process of generating and evaluating scientific knowledge.
- Understands principles of scientific ethics.
- Develops, analyzes, and evaluates different explanations for a given scientific result.
- Demonstrates an understanding of potential sources of error in inquiry-based investigation.
- Demonstrates an understanding of how to communicate and defend the results of an inquiry-based investigation.

**Competency 023**

**The teacher understands how science impacts the daily lives of students and interacts with and influences personal and societal decisions.**

The beginning teacher:

- Understands that decisions about the use of science are based on factors such as ethical standards, economics, and personal and societal needs.
- Applies scientific principles and the theory of probability to analyze the advantages of, disadvantages of, or alternatives to a given decision or course of action.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Applies scientific principles and processes to analyze factors that influence personal choices concerning fitness and health, including physiological and psychological effects and risks associated with the use of substances and substance abuse.
- Understands concepts, characteristics, and issues related to changes in populations and human population growth.
- Understands the types and uses of natural resources and the effects of human consumption on the renewal and depletion of resources.
- Understands the role science can play in helping resolve personal, societal, and global challenges.

**Competency 024**

**The teacher knows and understands the unifying concepts and processes that are common to all sciences.**

The beginning teacher:

- Understands how the following concepts and processes provide a unifying explanatory framework across the science disciplines: systems, order, and organization; evidence, models, and explanation; change, constancy, and measurements; evolution and equilibrium; and form and function.
- Demonstrates an understanding of how patterns in observations and data can be used to make explanations and predictions.
- Analyzes interactions and interrelationships between systems and subsystems.
- Applies unifying concepts to explore similarities in a variety of natural phenomena.
- Understands how properties and patterns of systems can be described in terms of space, time, energy, and matter.
- Understands how change and constancy occur in systems.
- Understands the complementary nature of form and function in a given system.
- Understands how models are used to represent the natural world and how to evaluate the strengths and limitations of a variety of scientific models (e.g., physical, conceptual, mathematical).

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**DOMAIN VIII—PHYSICAL SCIENCE**

**Competency 025**

**The teacher understands forces and motion and their relationships.**

The beginning teacher:

- Demonstrates an understanding of properties of universal forces (e.g., gravitational, electrical, magnetic).
- Understands how to measure, graph, and describe changes in motion using concepts of displacement, velocity, and acceleration.
- Understands the vector nature of force.
- Identifies the forces acting on an object and applies Newton's laws to describe the motion of an object.
- Analyzes the relationship between force and motion in a variety of situations (e.g., simple machines, blood flow, geologic processes).

**Competency 026**

**The teacher understands physical properties of and changes in matter.**

The beginning teacher:

- Describes the physical properties of substances (e.g., density, boiling point, solubility, thermal and electrical conductivity).
- Describes the physical properties and molecular structure of solids, liquids, and gases.
- Describes the relationship between the molecular structure of materials (e.g., metals, crystals, polymers) and their physical properties.
- Relates the physical properties of an element to its placement in the periodic table.
- Distinguishes between physical and chemical changes in matter.
- Applies knowledge of physical properties of and changes in matter to processes and situations that occur in life and earth/space science.

**Competency 027**

**The teacher understands chemical properties of and changes in matter.**

The beginning teacher:

- Describes the structure and components of the atom.
- Distinguishes among elements, mixtures, and compounds and describes their properties.
- Relates the chemical properties of an element to its placement in the periodic table.
- Describes chemical bonds and chemical formulas.
- Analyzes chemical reactions and their associated chemical equations.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Explains the importance of a variety of chemical reactions that occur in daily life (e.g., rusting, burning of fossil fuels, photosynthesis, cell respiration, chemical batteries, digestion of food).
- Understands applications of chemical properties of matter in physical, life, and earth/space science and technology (e.g., materials science, biochemistry, transportation, medicine, telecommunications).

**Competency 028**

**The teacher understands energy and interactions between matter and energy.**

The beginning teacher:

- Describes concepts of work, power, and potential and kinetic energy.
- Understands the concept of heat energy and the difference between heat and temperature.
- Understands the principles of electricity and magnetism and their applications (e.g., electric circuits, motors, audio speakers, nerve impulses, lightning).
- Applies knowledge of properties of light (e.g., reflection, refraction, dispersion) to describe the function of optical systems and phenomena (e.g., camera, microscope, rainbow, eye).
- Demonstrates an understanding of the properties, production, and transmission of sound.
- Applies knowledge of properties and characteristics of waves (e.g., wavelength, frequency, interference) to describe a variety of waves (e.g., water, electromagnetic, sound).

**Competency 029**

**The teacher understands energy transformations and the conservation of matter and energy.**

The beginning teacher:

- Describes the processes that generate energy in the sun and other stars.
- Applies the law of conservation of matter to analyze a variety of situations (e.g., the water cycle, food chains, decomposition, balancing chemical equations).
- Describes sources of electrical energy and processes of energy transformation for human uses (e.g., fossil fuels, solar panels, hydroelectric plants).
- Understands exothermic and endothermic chemical reactions and their applications (e.g., hot and cold packs, energy content of food).
- Applies knowledge of the transfer of energy in a variety of situations (e.g., the production of heat, light, sound, and magnetic effects by electrical energy; the process of photosynthesis; weather processes; food webs; food/energy pyramids).

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Applies the law of conservation of energy to analyze a variety of physical phenomena (e.g., specific heat, nuclear reactions, efficiency of simple machines, collisions).
- Understands applications of energy transformations and the conservation of matter and energy in life and earth/space science.

**DOMAIN IX—LIFE SCIENCE**

**Competency 030**

**The teacher understands the structure and function of living things.**

The beginning teacher:

- Describes characteristics of organisms from the major taxonomic groups.
- Analyzes how structure complements function in cells.
- Analyzes how structure complements function in tissues, organs, organ systems, and organisms.
- Identifies human body systems and describes their functions.
- Describes how organisms obtain and use energy and matter.
- Applies chemical principles to describe the structure and function of the basic chemical components (e.g., proteins, carbohydrates, lipids, nucleic acids) of living things.

**Competency 031**

**The teacher understands reproduction and the mechanisms of heredity.**

The beginning teacher:

- Compares and contrasts sexual and asexual reproduction.
- Understands the organization of hereditary material (e.g., DNA, genes, chromosomes).
- Describes how an inherited trait can be determined by one or many genes and how more than one trait can be influenced by a single gene.
- Distinguishes between dominant and recessive traits and predicts the probable outcomes of genetic combinations.
- Evaluates the influence of environmental and genetic factors on the traits of an organism.
- Describes current applications of genetic research (e.g., related to cloning, reproduction, health, industry, agriculture).

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**Competency 032**

**The teacher understands adaptations of organisms and the theory of evolution.**

The beginning teacher:

- Describes similarities and differences among various types of organisms and methods of classifying organisms.
- Describes traits in a population or species that enhance its survival and reproductive success.
- Describes how populations and species change through time.
- Applies knowledge of the mechanisms and processes of biological evolution (e.g., variation, mutation, environmental factors, natural selection).
- Describes evidence that supports the theory of evolution of life on Earth.

**Competency 033**

**The teacher understands regulatory mechanisms and behavior.**

The beginning teacher:

- Describes how organisms respond to internal and external stimuli.
- Applies knowledge of structures and physiological processes that maintain stable internal conditions.
- Demonstrates an understanding of feedback mechanisms that allow organisms to maintain stable internal conditions.
- Understands how evolutionary history affects behavior.

**Competency 034**

**The teacher understands the relationships between organisms and the environment.**

The beginning teacher:

- Identifies the abiotic and biotic components of an ecosystem.
- Analyzes the interrelationships among producers, consumers, and decomposers in an ecosystem.
- Identifies factors that influence the size and growth of populations in an ecosystem.
- Analyzes adaptive characteristics that result in a population's or species's unique niche in an ecosystem.
- Describes and analyzes energy flow through various types of ecosystems.
- Knows how populations and species modify and affect ecosystems.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**DOMAIN X—EARTH AND SPACE SCIENCE**

**Competency 035**

**The teacher understands the structure and function of earth systems.**

The beginning teacher:

- Understands the structure of Earth and analyzes constructive and destructive processes that produce geologic change.
- Understands the form and function of surface and subsurface water.
- Applies knowledge of the composition and structure of the atmosphere and its properties.
- Demonstrates an understanding of the interactions that occur among the biosphere, geosphere, hydrosphere, and atmosphere.
- Applies knowledge of how human activity and natural processes, both gradual and catastrophic, can alter earth systems.
- Identifies the sources of energy (e.g., solar, geothermal) in earth systems and describes mechanisms of energy transfer (e.g., convection, radiation).

**Competency 036**

**The teacher understands cycles in earth systems.**

The beginning teacher:

- Understands the rock cycle and how rocks, minerals, and soils are formed.
- Understands the water cycle and its relationship to weather processes.
- Understands the nutrient (e.g., carbon, nitrogen) cycle and its relationship to earth systems.
- Applies knowledge of how human and natural processes affect earth systems.
- Understands the dynamic interactions that occur among the various cycles in the biosphere, geosphere, hydrosphere, and atmosphere.

**Competency 037**

**The teacher understands the role of energy in weather and climate.**

The beginning teacher:

- Understands the elements of weather (e.g., humidity, wind speed, pressure, temperature) and how they are measured.
- Compares and contrasts weather and climate.
- Analyzes weather charts and data to make weather predictions.
- Applies knowledge of how transfers of energy among earth systems affect weather and climate.
- Analyzes how Earth's position, orientation, and surface features affect weather and climate.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**Competency 038**

**The teacher understands the characteristics of the solar system and the universe.**

The beginning teacher:

- Understands the properties and characteristics of celestial objects.
- Applies knowledge of the earth-moon-sun system and the interactions among them (e.g., seasons, lunar phases, eclipses).
- Identifies properties of the components of the solar system.
- Recognizes characteristics of stars and galaxies and their distribution in the universe.
- Demonstrates an understanding of scientific theories of the origin of the universe.

**Competency 039**

**The teacher understands the history of the earth system.**

The beginning teacher:

- Understands the scope of the geologic time scale and its relationship to geologic processes.
- Demonstrates an understanding of theories about the earth's origin and geologic history.
- Demonstrates an understanding of how tectonic forces have shaped landforms over time.
- Understands the formation of fossils and the importance of the fossil record in explaining the earth's history.

**DOMAIN XI—SCIENCE LEARNING, INSTRUCTION, AND ASSESSMENT**

**Competency 040**

**The teacher has theoretical and practical knowledge about teaching science and about how students learn science.**

The beginning teacher:

- Understands how the developmental characteristics, prior knowledge and experience, and attitudes of students influence science learning.
- Selects and adapts science curricula, content, instructional materials, and activities to meet the interests, knowledge, understanding, abilities, experiences, and needs of all students, including English Language Learners.
- Understands how to use situations from students' daily lives to develop instructional materials that investigate how science can be used to make informed decisions.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

- Understands common misconceptions in science and effective ways to address these misconceptions.
- Understands the rationale for the use of active learning and inquiry processes for students.
- Understands questioning strategies designed to elicit higher-level thinking and how to use them to move students from concrete to more abstract understanding.
- Understands the importance of planning activities that are inclusive and accommodate the needs of all students.
- Understands how to sequence learning activities in a way that allows students to build upon their prior knowledge and challenges them to expand their understanding of science.

**Competency 041**

**The teacher understands the process of scientific inquiry and its role in science instruction.**

The beginning teacher:

- Plans and implements instruction that provides opportunities for all students to engage in nonexperimental and experimental inquiry investigations.
- Focuses inquiry-based instruction on questions and issues relevant to students and uses strategies to assist students with generating, refining, and focusing scientific questions and hypotheses.
- Instructs students in the safe and proper use of a variety of grade-appropriate tools, equipment, resources, technology, and techniques to access, gather, store, retrieve, organize, and analyze data.
- Knows how to guide students in making systematic observations and measurements.
- Knows how to promote the use of critical-thinking skills, logical reasoning, and scientific problem solving to reach conclusions based on evidence.
- Knows how to teach students to develop, analyze, and evaluate different explanations for a given scientific result.
- Knows how to teach students to demonstrate an understanding of potential sources of error in inquiry-based investigation.
- Knows how to teach students to demonstrate an understanding of how to communicate and defend the results of an inquiry-based investigation.

**FIELD 114: MATHEMATICS/SCIENCE 4–8  
TEST FRAMEWORK**

**Competency 042**

**The teacher knows the varied and appropriate assessments and assessment practices to monitor science learning in laboratory, field, and classroom settings.**

The beginning teacher:

- Understands the relationships among science curriculum, assessment, and instruction and bases instruction on information gathered through assessment of students' strengths and needs.
- Understands the importance of monitoring and assessing students' understanding of science concepts and skills on an ongoing basis.
- Understands the importance of carefully selecting or designing formative and summative assessments for the specific decisions they are intended to inform.
- Selects or designs and administers a variety of appropriate assessment methods (e.g., performance assessment, self-assessment, formal/informal, formative/summative) to monitor student understanding and progress.
- Uses formal and informal assessments of student performance and products (e.g., projects, lab journals, rubrics, portfolios, student profiles, checklists) to evaluate student participation in and understanding of the inquiry process.
- Understands the importance of sharing evaluation criteria and assessment results with students.