

TEXES
Texas Examinations of Educator Standards

Field 136: Science 8–12
Test Framework

Domain	Range of Competencies
I. Scientific Inquiry and Processes	001–003
II. Physics	004–011
III. Chemistry	012–020
IV. Cell Structure and Processes	021–024
V. Heredity and Evolution of Life	025–028
VI. Diversity of Life	029–032
VII. Interdependence of Life and Environmental Systems	033–035
VIII. Earth’s History and the Structure and Function of Earth Systems	036–041
IX. Components and Properties of the Solar System and the Universe	042–045
X. Science Learning, Instruction, and Assessment	046–047

TEST FRAMEWORK FOR FIELD 136: SCIENCE 8–12

Domain I Scientific Inquiry and Processes
(approximately 10% of the test)

Standards Assessed:

Science Standards I–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 II Physics
(approximately 20% 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 III Chemistry
(approximately 20% 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 IV Cell Structure and Processes
(approximately 8% 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 V Heredity and Evolution of Life
(approximately 8% 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 VI Diversity of Life
(approximately 8% 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 VII Interdependence of Life and Environmental Systems
(approximately 6% 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 VIII Earth's History and the Structure and Function of Earth Systems
(approximately 9% 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 IX Components and Properties of the Solar System and the Universe
(approximately 6% 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 X Science Learning, Instruction, and Assessment
(approximately 5% of the test)**

Standards Assessed:

Science Standards IV and V:

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.

TEExES
Texas Examinations of Educator Standards

Field 136: Science 8–12
Test Framework

DOMAIN I—SCIENTIFIC INQUIRY AND PROCESSES

Competency 001

The teacher understands how to select and manage learning activities to ensure the safety of all students and the correct use and care of organisms, natural resources, materials, equipment, and technologies.

The beginning teacher:

- Uses current sources of information about laboratory safety, including safety regulations and guidelines for the use of science facilities.
- Recognizes potential safety hazards in the laboratory and in the field and knows how to apply procedures, including basic first aid, for responding to accidents.
- Employs safe practices in planning and implementing all instructional activities and designs, and implements rules and procedures to maintain a safe learning environment.
- Understands procedures for selecting, maintaining, and safely using chemicals, tools, technologies, materials, specimens, and equipment, including procedures for the recycling, reuse, and conservation of laboratory resources and for the safe handling and ethical treatment of organisms.
- Knows how to use appropriate equipment and technology (e.g., Internet, spreadsheet, Calculator Based Laboratory) for gathering, organizing, displaying, and communicating data in a variety of ways (e.g., charts, tables, graphs, diagrams, written reports, oral presentations).
- Understands how to use a variety of tools, techniques, and technology to gather, organize, and analyze data and how to apply appropriate methods of statistical measures and analysis.
- Knows how to apply techniques to calibrate measuring devices and understands concepts of precision, accuracy, and error with regard to reading and recording numerical data from scientific instruments.
- Uses the International System of Units (i.e., metric system) and performs unit conversions within and across measurement systems.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 002

The teacher understands the nature of science, the process of scientific inquiry, and the unifying concepts that are common to all sciences.

The beginning teacher:

- Understands the nature of science, the relationship between science and technology, the predictive power of science, and limitations to the scope of science (i.e., the types of questions that science can and cannot answer).
- Knows the characteristics of various types of scientific investigations (e.g., descriptive studies, controlled experiments, comparative data analysis) and how and why scientists use different types of scientific investigations.
- Understands principles and procedures for designing and conducting a variety of scientific investigations, with emphasis on inquiry-based investigations, and how to communicate and defend scientific results.
- Understands how logical reasoning, verifiable observational and experimental evidence, and peer review are used in the process of generating and evaluating scientific knowledge.
- Understands how to identify potential sources of error in an investigation, evaluate the validity of scientific data, and develop and analyze different explanations for a given scientific result.
- Knows the characteristics and general features of systems; how properties and patterns of systems can be described in terms of space, time, energy, and matter; and how system components and different systems interact.
- Knows how to apply and analyze the systems model (e.g., interacting parts, boundaries, input, output, feedback, subsystems) across the science disciplines.
- Understands how shared themes and concepts (e.g., systems, order, and organization; evidence, models, and explanation; change, constancy, and measurements; evolution and equilibrium; and form and function) provide a unifying framework in science.
- 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 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 003

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

The beginning teacher:

- Understands the historical development of science, key events in the history of science, and the contributions that diverse cultures and individuals of both genders have made to scientific knowledge.
- Knows how to use examples from the history of science to demonstrate the changing nature of scientific theories and knowledge (i.e., that scientific theories and knowledge are always subject to revision in light of new evidence).
- Knows that science is a human endeavor influenced by societal, cultural, and personal views of the world, and that decisions about the use and direction of science are based on factors such as ethical standards, economics, and personal and societal biases and needs.
- Understands the application of scientific ethics to the conducting, analyzing, and publishing of scientific investigations.
- Applies scientific principles to analyze factors (e.g., diet, exercise, personal behavior) that influence personal and societal choices concerning fitness and health (e.g., physiological and psychological effects and risks associated with the use of substances and substance abuse).
- Applies scientific principles, the theory of probability, and risk/benefit analysis to analyze the advantages of, disadvantages of, or alternatives to a given decision or course of action.
- Understands the role science can play in helping resolve personal, societal, and global issues (e.g., population growth, disease prevention, resource use).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN II—PHYSICS

Competency 004

The teacher understands the description of motion in one and two dimensions.

The beginning teacher:

- Analyzes and interprets graphs describing the motion of a particle.
- Applies vector concepts to displacement, velocity, and acceleration in order to analyze and describe the motion of a particle.
- Solves problems involving uniform and accelerated motion using scalar and vector quantities.
- Analyzes and solves problems involving projectile motion.
- Analyzes and solves problems involving uniform circular and rotary motion.
- Understands motion of fluids.
- Understands motion in terms of frames of reference and relativity concepts.

Competency 005

The teacher understands the laws of motion.

The beginning teacher:

- Identifies and analyzes the forces acting in a given situation and constructs a free-body diagram.
- Solves problems involving the vector nature of force (e.g., resolving forces into components, analyzing static or dynamic equilibrium of a particle).
- Identifies and applies Newton's laws to analyze and solve a variety of practical problems (e.g., properties of frictional forces, acceleration of a particle on an inclined plane, displacement of a mass on a spring, forces on a pendulum).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 006

The teacher understands the concepts of gravitational and electromagnetic forces in nature.

The beginning teacher:

- Applies the Law of Universal Gravitation to solve a variety of problems (e.g., determining the gravitational fields of the planets, analyzing properties of satellite orbits).
- Calculates electrostatic forces, fields, and potentials.
- Understands the properties of magnetic materials and the molecular theory of magnetism.
- Identifies the source of the magnetic field and calculates the magnetic field for various simple current distributions.
- Analyzes the magnetic force on charged particles and current-carrying conductors.
- Understands induced electric and magnetic fields and analyzes the relationship between electricity and magnetism.
- Understands the electromagnetic spectrum and the production of electromagnetic waves.

Competency 007

The teacher understands applications of electricity and magnetism.

The beginning teacher:

- Analyzes common examples of electrostatics (e.g., a charged balloon attached to a wall, behavior of an electroscope, charging by induction).
- Understands electric current, resistance and resistivity, potential difference, capacitance, and electromotive force in conductors and circuits.
- Analyzes series and parallel DC circuits in terms of current, resistance, voltage, and power.
- Identifies basic components and characteristics of AC circuits.
- Understands the operation of an electromagnet.
- Understands the operation of electric meters, motors, generators, and transformers.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 008

The teacher understands the conservation of energy and momentum.

The beginning teacher:

- Understands the concept of work.
- Understands the relationships among work, energy, and power.
- Solves problems using the conservation of mechanical energy in a physical system (e.g., determining potential energy for conservative forces, analyzing the motion of a pendulum).
- Applies the work-energy theorem to analyze and solve a variety of practical problems (e.g., finding the speed of an object given its potential energy, determining the work done by frictional forces on a decelerating car).
- Understands linear and angular momentum.
- Solves a variety of problems (e.g., collisions) using the conservation of linear and angular momentum.

Competency 009

The teacher understands the laws of thermodynamics.

The beginning teacher:

- Understands methods of heat transfer (i.e., convection, conduction, radiation).
- Understands the molecular interpretation of temperature and heat.
- Solves problems involving thermal expansion, heat capacity, and the relationship between heat and other forms of energy.
- Applies the first law of thermodynamics to analyze energy transformations in a variety of everyday situations (e.g., electric light bulb, power generating plant).
- Understands the concept of entropy and its relationship to the second law of thermodynamics.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 010

The teacher understands the characteristics and behavior of waves.

The beginning teacher:

- Understands interrelationships among wave characteristics such as velocity, frequency, wavelength, and amplitude and relates them to properties of sound and light (e.g., pitch, color).
- Compares and contrasts transverse and longitudinal waves.
- Describes how various waves are propagated through different media.
- Applies properties of reflection and refraction to analyze optical phenomena (e.g., mirrors, lenses, fiber-optic cable).
- Applies principles of wave interference to analyze wave phenomena, including acoustical (e.g., harmonics) and optical phenomena (e.g., patterns created by thin films and diffraction gratings).
- Identifies and interprets how wave characteristics and behaviors are used in medical, industrial, and other real-world applications.

Competency 011

The teacher understands the fundamental concepts of quantum physics.

The beginning teacher:

- Interprets wave-particle duality.
- Identifies examples and consequences of the Uncertainty Principle.
- Understands the photoelectric effect.
- Uses the quantum model of the atom to describe and analyze absorption and emission spectra (e.g., line spectra, blackbody radiation).
- Explores real-world applications of quantum phenomena (e.g., lasers, photoelectric sensors, semiconductors, superconductivity).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN III—CHEMISTRY

Competency 012

The teacher understands the characteristics of matter and atomic structure.

The beginning teacher:

- Differentiates between physical and chemical properties and changes of matter.
- Explains the structure and properties of solids, liquids, and gases.
- Identifies and analyzes properties of substances (i.e., elements and compounds) and mixtures.
- Models the atom in terms of protons, neutrons, and electron clouds.
- Identifies elements and isotopes by atomic number and mass number.
- Understands atomic orbitals and electron configurations and describes the relationship between electron energy levels and atomic structure.
- Understands the nature and historical significance of the periodic table.
- Applies the concept of periodicity to predict the physical and chemical properties of an element.

Competency 013

The teacher understands the properties of gases.

The beginning teacher:

- Understands interrelationships among temperature, moles, pressure, and volume of gases contained within a closed system.
- Analyzes data obtained from investigations with gases in a closed system and determines whether the data are consistent with the ideal gas law.
- Applies the gas laws (e.g., Charles's law, Boyle's law, combined gas law) to predict gas behavior in a variety of situations.
- Applies Dalton's law of partial pressure in various situations (e.g., collecting a gas over water).
- Understands the relationship between Kinetic Molecular Theory and the ideal gas law.
- Knows how to apply the ideal gas law to analyze mass relationships between reactants and products in chemical reactions involving gases.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 014

The teacher understands properties and characteristics of ionic and covalent bonds.

The beginning teacher:

- Relates the electron configuration of an atom to its chemical reactivity.
- Compares and contrasts characteristics of ionic and covalent bonds.
- Applies the "octet" rule to construct Lewis structures.
- Identifies and describes the arrangement of atoms in molecules, ionic crystals, polymers, and metallic substances.
- Understands the influence of bonding forces on the physical and chemical properties of ionic and covalent substances.
- Identifies and describes intermolecular and intramolecular forces.
- Uses intermolecular forces to explain the physical properties of a given substance (e.g., melting point, crystal structure).
- Applies the concepts of electronegativity, electron affinity, and oxidation state to analyze chemical bonds.
- Evaluates energy changes in the formation and dissociation of chemical bonds.
- Understands the relationship between chemical bonding and molecular geometry.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 015

The teacher understands and interprets chemical equations and chemical reactions.

The beginning teacher:

- Identifies elements, common ions, and compounds using scientific nomenclature.
- Uses and interprets symbols, formulas, and equations in describing interactions of matter and energy in chemical reactions.
- Understands mass relationships involving percent composition, empirical formulas, and molecular formulas.
- Interprets and balances chemical equations using conservation of mass and charge.
- Understands mass relationships in chemical equations and solves problems involving moles, limiting reagents, and reaction yield.
- Identifies factors (e.g., temperature, pressure, concentration, catalysts) that influence the rate of a chemical reaction and describes their effects.
- Understands principles of chemical equilibrium and solves problems involving equilibrium constants.
- Identifies the chemical properties of a variety of common household chemicals (e.g., baking soda, bleach, ammonia) in order to predict the potential for chemical reactivity.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 016

The teacher understands types and properties of solutions.

The beginning teacher:

- Analyzes factors that affect solubility (e.g., temperature, pressure, polarity of solvents and solutes).
- Identifies characteristics of saturated, unsaturated, and supersaturated solutions.
- Determines the molarity, molality, normality, and percent composition of aqueous solutions.
- Analyzes precipitation reactions and derives net ionic equations.
- Understands the colligative properties of solutions (e.g., vapor pressure lowering, osmotic pressure changes, boiling-point elevation, freezing-point depression).
- Understands the properties of electrolytes and explains the relationship between concentration and electrical conductivity.
- Understands methods for measuring and comparing the rates of reaction in solutions of varying concentration.
- Analyzes models to explain the structural properties of water and evaluates the significance of water as a solvent in living organisms and the environment.

Competency 017

The teacher understands energy transformations that occur in physical and chemical processes.

The beginning teacher:

- Analyzes the energy transformations that occur in phase transitions.
- Solves problems in calorimetry (e.g., determining the specific heat of a substance, finding the standard enthalpy of formation and reaction of substances).
- Applies the law of conservation of energy to analyze and evaluate energy exchanges that occur in exothermic and endothermic reactions.
- Understands thermodynamic relationships among spontaneous reactions, entropy, enthalpy, temperature, and Gibbs free energy.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 018

The teacher understands nuclear fission, nuclear fusion, and nuclear reactions.

The beginning teacher:

- Uses models to explain radioactivity and radioactive decay (i.e., alpha, beta, gamma).
- Interprets and balances equations for nuclear reactions.
- Compares and contrasts fission and fusion reactions (e.g., relative energy released in the reactions, mass distribution of products).
- Knows how to use the half-life of radioactive elements to solve real-world problems (e.g., carbon dating, radioactive tracers).
- Understands stable and unstable isotopes.
- Knows various issues associated with using nuclear energy (e.g., medical, commercial, environmental).

Competency 019

The teacher understands oxidation and reduction reactions.

The beginning teacher:

- Determines the oxidation state of ions and atoms in compounds.
- Identifies and balances oxidation and reduction reactions.
- Uses reduction potentials to determine whether a redox reaction will occur spontaneously.
- Explains the operation and applications of electrochemical cells.
- Analyzes applications of oxidation and reduction reactions from everyday life (e.g., combustion, rusting, electroplating, batteries).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 020

The teacher understands acids, bases, and their reactions.

The beginning teacher:

- Identifies the general properties of, and relationships among, acids, bases, and salts.
- Identifies acids and bases using models of Arrhenius, Brønsted-Lowrey, and Lewis.
- Differentiates between strong and weak acids and bases.
- Applies the relationship between hydronium ion concentration and pH for acids and bases.
- Understands and analyzes acid-base equilibria and buffers.
- Analyzes and applies the principles of acid-base titration.
- Analyzes neutralization reactions based on the principles of solution concentration and stoichiometry.
- Describes the effects of acids and bases in the real world (e.g., acid precipitation, physiological buffering).

DOMAIN IV—CELL STRUCTURE AND PROCESSES

Competency 021

The teacher understands the structure and function of biomolecules.

The beginning teacher:

- Identifies the chemical elements necessary for life and understands how these elements combine to form biologically important compounds.
- Relates the physical and chemical properties of water and carbon to the significance of these properties in basic life processes.
- Analyzes how a molecule's biological function is related to its shape (e.g., enzymes, tRNA, DNA, receptors, neurotransmitters, lipids).
- Understands the importance of chemical reactions in the synthesis and degradation of biomolecules.
- Identifies and compares the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids.
- Explains how enzymes function in synthesis and degradation of biomolecules (e.g., DNA, food).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 022

The teacher understands that cells are the basic structures of living things and have specialized parts that perform specific functions.

The beginning teacher:

- Differentiates among viruses, prokaryotic cells, and eukaryotic cells (e.g., structure and function).
- Describes the basic components of prokaryotic and eukaryotic cells (e.g., cell membrane, cell wall, ribosomes, nucleus, mitochondrion, chloroplast), the functions, and the interrelationships of these components.
- Identifies differences in cell structure and function in different types of organisms (e.g., differences in plant and animal cells).
- Analyzes specialization of structure and function in different types of cells in living organisms (e.g., skin, nerve and muscle cells in animals; root, stem, and leaf cells in plants).

Competency 023

The teacher understands how cells carry out life processes.

The beginning teacher:

- Analyzes how cells maintain homeostasis (e.g., the effects of concentration gradients, rate of movement, and surface area/volume ratio).
- Understands processes by which cells transport water, nutrients, and wastes across cell membranes (e.g., osmosis, diffusion, transport systems).
- Analyzes energy flow in the processes of photosynthesis and cellular respiration.
- Compares and contrasts anaerobic and aerobic respiration and their products.

Competency 024

The teacher understands how specialized cells, tissues, organs, organ systems, and organisms grow and develop.

The beginning teacher:

- Understands factors (e.g., hormones, cell size) that regulate the cell cycle and the effects of unregulated cell growth.
- Analyzes the role of cell differentiation in the development of tissues, organs, organ systems, and living organisms.
- Analyzes factors (e.g., genetics, disease, nutrition, exposure to toxic chemicals) affecting cell differentiation and the growth and development of organisms.
- Identifies the different levels of organization in multicellular organisms and relates the parts to each other and to the whole.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN V—HEREDITY AND EVOLUTION OF LIFE

Competency 025

The teacher understands the structures and functions of nucleic acids in the mechanisms of genetics.

The beginning teacher:

- Relates the structure of DNA (e.g., bases, sugars, phosphates) to the nature, function, and relationships of genes, chromatin, and chromosomes.
- Relates the structures of DNA and RNA to the processes of replication, transcription, translation, and genetic regulation.
- Compares and contrasts the organization and control of the genome in viruses, prokaryotic cells, and eukaryotic cells.
- Understands the types, biological significance, and causes of mutations.
- Identifies methods and applications of genetic identification and manipulation (e.g., production of recombinant DNA, cloning, PCR).
- Analyzes human karyotypes in order to identify chromosomal disorders and sex.

Competency 026

The teacher understands the continuity and variations of traits from one generation to the next.

The beginning teacher:

- Applies the laws of probability to determine genotypic and phenotypic frequencies in Mendelian inheritance (e.g., using Punnett squares, pedigree charts).
- Compares the processes of meiosis and mitosis (in plants and animals) and describes their roles in sexual and asexual reproduction.
- Recognizes factors influencing the transmission of genes from one generation to the next (e.g., linkage, position of genes on a chromosome, crossing over, independent assortment).
- Understands how the genotype of an organism influences the expression of traits in its phenotype (e.g., dominant and recessive traits; monogenic, polygenic, and polytypic inheritance; genetic disorders).
- Analyzes the effects of environmental factors (e.g., light, nutrition, moisture, temperature) on the expression of traits in the phenotype of an organism.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 027

The teacher understands the theory of biological evolution.

The beginning teacher:

- Understands stability and change in populations (e.g., Hardy-Weinberg equilibrium) and analyzes factors leading to genetic variation and evolution in populations (e.g., mutation, gene flow, genetic drift, recombination, nonrandom mating, natural selection).
- Analyzes the effects of natural selection on adaptations and diversity in populations and species.
- Understands the role of intraspecific and interspecific competition in evolutionary change.
- Compares and contrasts the different effects of selection (e.g., directional, stabilizing, diversifying) on a variable characteristic.
- Analyzes processes that contribute to speciation (e.g., natural selection, founder effect, reproductive isolation).
- Analyzes the development of isolating mechanisms that discourage hybridization between species (e.g., species' recognition marks, behavioral displays, ecological separation, seasonal breeding).

Competency 028

The teacher understands evidence for evolutionary change during Earth's history.

The beginning teacher:

- Analyzes how fossils, DNA sequences, anatomical similarities, physiological similarities, and embryology provide evidence of change in populations and species.
- Understands the relationship between environmental change, mutations, and adaptations of an organism over many generations.
- Identifies major developments in the evolutionary history of life (e.g., backbones, vascular tissue, colonization of the land).
- Understands theories regarding the causes of extinction of species and the pace and mode of evolutionary change (e.g., punctuated equilibrium, mass extinctions, adaptive radiation).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN VI—DIVERSITY OF LIFE

Competency 029

The teacher understands similarities and differences between living organisms and how taxonomic systems are used to organize and interpret the diversity of life.

The beginning teacher:

- Compares and contrasts structural and physiological adaptations of plants and animals living in various aquatic and terrestrial environments (e.g., freshwater and marine; forest and plain; desert and tundra).
- Understands the relationship between environmental changes in aquatic and terrestrial ecosystems and adaptive changes in organisms inhabiting these ecosystems.
- Explains the uses and limitations of classification schemes.
- Relates taxonomic classification to evolutionary history and knows how to distinguish between traits that are taxonomically useful (e.g., homologous traits) and those that are not (e.g., convergent traits).
- Analyzes relationships among organisms to develop a model of a hierarchical classification system and knows how to classify aquatic and terrestrial organisms at several taxonomic levels (e.g., species, phylum/division, kingdom) using dichotomous keys.
- Identifies distinguishing characteristics of kingdoms, including monerans (i.e., eubacteria, archaeobacteria), protists, fungi, plants, and animals.

Competency 030

The teacher understands that, at all levels of nature, living systems are found within other living systems, each with its own boundaries and limits.

The beginning teacher:

- Identifies the basic requirements (e.g., nutrients, oxygen, water, carbon dioxide) necessary for various organisms to carry out life functions.
- Compares how various organisms obtain, transform, transport, release, eliminate, and store energy and matter.
- Analyzes characteristics, functions, and relationships of systems in animals including humans (e.g., digestive, circulatory, nervous, endocrine, reproductive, integumentary, skeletal, respiratory, muscular, excretory, immune systems).
- Analyzes characteristics, functions, and relationships of systems in plants (e.g., transport, control, reproductive, nutritional, structural systems).
- Identifies methods of reproduction, growth, and development of various plants and animals.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 031

The teacher understands the processes by which organisms maintain homeostasis.

The beginning teacher:

- Explains the importance of maintaining a stable internal environment.
- Describes the relationships among internal feedback mechanisms in maintaining homeostasis.
- Identifies anatomical structures and physiological processes in a variety of organisms that function to maintain homeostasis in the face of changing environmental conditions.
- Analyzes the importance of nutrition, environmental conditions, and physical exercise on health in humans and other organisms.
- Analyzes the role of viruses and microorganisms in maintaining or disrupting homeostasis in different organisms (e.g., the role of bacteria in digestion, diseases of plants and animals).

Competency 032

The teacher understands the relationship between biology and behavior.

The beginning teacher:

- Understands how the behavior of organisms, including humans, responds to internal and external stimuli.
- Recognizes that behavior in many animals is determined by a combination of genetic and learned factors.
- Identifies adaptive advantages of innate and learned patterns of behavior.
- Explains mediating factors in innate (e.g., imprinting, hormonal system) and learned (e.g., classical conditioning, play) behavior.
- Understands concepts linking behavior and natural selection (e.g., kin selection, courtship behavior, altruism).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN VII—INTERDEPENDENCE OF LIFE AND ENVIRONMENTAL SYSTEMS

Competency 033

The teacher understands the relationships between abiotic and biotic factors of terrestrial and aquatic ecosystems, habitats, and biomes, including the flow of matter and energy.

The beginning teacher:

- Analyzes types, sources, and flow of energy through different trophic levels (e.g., producers, consumers, decomposers) and between organisms and the physical environment in aquatic and terrestrial ecosystems.
- Analyzes the flow of energy and the cycling of matter through biogeochemical cycles (e.g., carbon, water, oxygen, nitrogen, phosphorus) in aquatic and terrestrial ecosystems.
- Understands the concept of limiting factors (e.g., light intensity, temperature, mineral availability) and the effects that they have on the productivity and complexity of different ecosystems (e.g., tropical forest vs. taiga, continental shelf vs. deep ocean).
- Explains the relationship among abiotic characteristics of different biomes and the adaptations, variations, tolerances, and roles of indigenous plants and animals in these biomes.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 034

The teacher understands the interdependence and interactions of living things in terrestrial and aquatic ecosystems.

The beginning teacher:

- Understands the concepts of ecosystem, biome, community, habitat, and niche.
- Analyzes interactions of organisms, including humans, in the production and consumption of energy (e.g., food chains, food webs, food pyramids) in aquatic and terrestrial ecosystems.
- Understands interspecific interactions in aquatic and terrestrial ecosystems (e.g., predator-prey relationships, competition, parasitism, commensalism, mutualism) and how they affect ecosystem structure.
- Identifies indigenous plants and animals, assesses their roles in an ecosystem, and describes their relationships in different types of environments (e.g., fresh water, continental shelf, deep ocean, forest, desert, plains, tundra).
- Analyzes how the introduction, removal, or reintroduction of an organism may alter the food chain, affect existing populations, and influence natural selection in terrestrial and aquatic ecosystems.
- Evaluates the importance of biodiversity in an ecosystem and identifies changes that may occur if biodiversity is increased or reduced in an ecosystem.
- Understands types and processes of ecosystem change over time in terrestrial and aquatic ecosystems (e.g., equilibrium, cyclical change, succession) and the effects of human activity on ecosystem change.
- Explains the significance of plants in different types of terrestrial and aquatic ecosystems.

Competency 035

The teacher understands the relationship between carrying capacity and changes in populations and ecosystems.

The beginning teacher:

- Identifies basic characteristics of populations in an ecosystem (e.g., age pyramid, density, patterns of distribution).
- Compares concepts of population dynamics, including exponential growth, logistic (i.e., limited) growth, and cycling (e.g., boom-and-bust cycles).
- Relates carrying capacity to population dynamics, including human population growth.
- Analyzes the impact of density-dependent and density-independent factors (e.g., geographic locales, natural events, diseases, birth and death rates) on populations.
- Compares *r*- and *K*-selected reproductive strategies (e.g., survivorship curves).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN VIII—EARTH'S HISTORY AND THE STRUCTURE AND FUNCTION OF EARTH SYSTEMS

Competency 036

The teacher understands structure and function of the geosphere.

The beginning teacher:

- Analyzes the internal structure and composition of Earth and methods used to investigate Earth's interior (e.g., seismic waves, chemical composition of rocks).
- Classifies rocks according to how they are formed as described by the rock cycle (e.g., igneous, sedimentary, metamorphic) and identifies the economic significance of rocks and minerals.
- Uses physical properties (e.g., density, hardness, streak, cleavage) to identify common minerals and understands processes affecting rock and mineral formation (e.g., temperature, pressure, rate of cooling).
- Identifies different types of landforms and topographic features on the surface of Earth, including the ocean floor (e.g., faults, volcanoes, mid-ocean ridges, deltas).
- Identifies the types, characteristics, and uses of Earth's renewable and nonrenewable resources including marine resources (e.g., ores, minerals, soil, fossil fuels).
- Identifies sources and reservoirs for matter and energy (e.g., carbon, nitrogen, water, solar radiation, radioactive decay).
- Analyzes the cycling and transformation of matter and energy through the geosphere (e.g., mantle convection).
- Relates the principles of conservation of mass and energy to processes that occur in the geosphere (e.g., the melting of rock).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 037

The teacher understands processes of plate tectonics, weathering, erosion, and deposition that change the Earth's surface.

The beginning teacher:

- Understands how the theory of plate tectonics explains the movement and structure of Earth's crustal plates (e.g., sea-floor spreading, subduction).
- Understands evidence for plate movement (e.g., magnetic reversals, distribution of earthquakes, GPS measurements).
- Describes the historical development of the theory of plate tectonics (e.g., Wegener's continental drift hypothesis).
- Analyzes the effects of plate movement, including faulting, folding, mineral formation, earthquakes, and volcanic activity.
- Knows the processes (e.g., freezing/thawing, chemical reactions) and products of weathering (e.g., soils, karst features) and compares and contrasts chemical and mechanical weathering.
- Identifies the causes (e.g., wind, water, gravity, glaciers) and effects of erosion and deposition (e.g., removal of topsoil, sedimentation).

Competency 038

The teacher understands the formation and history of Earth.

The beginning teacher:

- Knows the historical development of scientific theories relating to the origin and development of Earth (e.g., Hutton's uniformitarianism).
- Understands how Earth's geosphere, hydrosphere, and atmosphere have changed over time and analyzes the significance of these changes (e.g., formation of oxygen in the atmosphere).
- Understands the organization of the geologic time scale and methods of relative (e.g., superposition, fossils) and absolute (e.g., radiometric, dendrochronology) dating.
- Identifies important events in the history of Earth (e.g., formation of major mountain chains, breakup of continents, appearance of life, appearance of multicellular organisms) and locates these events on the geologic time scale.
- Understands relationships between physical changes during Earth's history and biological evolution (e.g., plate movement and biogeography; meteoric impacts, global temperature changes, extinctions, adaptive radiations).
- Analyzes processes involved in the formation of fossils and how fossils are used to interpret the history of Earth.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 039

Understands structure and function of the hydrosphere.

The beginning teacher:

- Identifies the components and distribution of hydrologic systems (e.g., rivers, lakes, aquifers, oceans) and compares and contrasts the chemical composition (e.g., salinity, acidity) and physical attributes (e.g., density, turbidity) of fresh, brackish, and salt water.
- Understands the water cycle and processes by which water moves through the water cycle (e.g., infiltration, runoff, evaporation, condensation, transpiration).
- Identifies the tools and procedures needed to collect and analyze quantitative data (e.g., pH, salinity, temperature, mineral content, nitrogen compounds, turbidity) from hydrologic systems.
- Knows how to use principles of fluid statics and dynamics (e.g., Archimedes' principle, turbulence, viscosity, hydrostatic pressure) to analyze hydrologic systems.
- Identifies characteristics of a local watershed and the effects of natural events (e.g., floods, droughts) and human activities (e.g., irrigation, industrial use, municipal use) on a local watershed.
- Analyzes patterns of ocean circulation (e.g., upwelling, surface currents) and factors that influence these patterns (e.g., winds, heating).
- Understands the relationship between ocean depth and temperature, pressure, density, and light penetration.
- Analyzes the causes and effects of waves, tides, tidal bores, and tsunamis.
- Identifies the characteristics of different ocean zones (e.g., coastal, lighted, deep, estuaries, bays).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 040

The teacher understands structure and function of the atmosphere.

The beginning teacher:

- Understands the composition of Earth’s atmosphere.
- Understands the range of atmospheric conditions that organisms will tolerate (e.g., types of gases, temperature, particulate matter, moisture).
- Identifies the layers of the atmosphere (e.g., troposphere, ionosphere, mesosphere) and the characteristics of each layer.
- Recognizes that the sun is the ultimate source of energy for the atmosphere.
- Understands processes of energy transfer (e.g., convection, radiation, conduction, phase changes of water) within the atmosphere and at the boundaries between the atmosphere, landmasses, and oceans.
- Knows types, characteristics, and processes of formation of clouds (e.g., cumulus, stratus, cirrus) and precipitation (e.g., rain, snow, hail).
- Knows the characteristics of air masses (e.g., temperature, moisture) and how air masses form and interact (e.g., fronts).
- Understands the types (e.g., blizzards, hurricanes, tornadoes), characteristics, and causes of severe weather.
- Identifies the types, characteristics, and distribution of climates and the factors (e.g., latitude, maritime effect, deforestation) that affect local and global climate.
- Identifies the effects of global phenomena (e.g., jet stream, El Niño) on local weather patterns.
- Understands weather maps and the principles, procedures, and technology of weather forecasting (e.g., satellite technology, computer models).
- Understands that climate changes over time (e.g., ice ages).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 041

The teacher understands the effects of natural events and human activity on Earth systems.

The beginning teacher:

- Analyzes issues (e.g., economic impact, environmental effects, availability) regarding the use of Earth resources (e.g., fossil fuels, renewable and nonrenewable resources).
- Analyzes the effects of natural events (e.g., fires, hurricanes, volcanic eruptions) and human activity (e.g., mining, fishing, reforestation, ocean dumping, municipal development) on aquatic and terrestrial ecosystems.
- Demonstrates an understanding of factors affecting the quality, use, and conservation of water (e.g., floods, droughts, agriculture, dams).
- Evaluates methods of land use and understands issues in land-use management (e.g., development of barrier islands).
- Identifies the sources (e.g., burning of fossil fuels, industrial production of heavy metals, release of chlorofluorocarbons) and effects of pollution (e.g., mercury contamination of fish, acid rain, lead poisoning, ozone depletion).
- Recognizes that Earth is composed of interacting systems and that regional changes in the environment may have global effects (e.g., weather changes due to reforestation, global warming).
- Demonstrates an understanding of how individuals, communities, and governments can conserve, protect, and restore habitats and ecosystems.

DOMAIN IX—COMPONENTS AND PROPERTIES OF THE SOLAR SYSTEM AND THE UNIVERSE

Competency 042

The teacher understands the implications of Earth's placement and orientation in the solar system.

The beginning teacher:

- Analyzes the relationship between Earth's placement in the solar system and the conditions on Earth that enable organisms to survive.
- Demonstrates an understanding of the sun's effects (e.g., gravitational, electromagnetic, solar wind, solar flares) on Earth.
- Understands the effects of Earth's rotation, revolution, and tilt of axis on its environment (e.g., day/night length, seasons).
- Identifies the effects of the moon and sun on tides.
- Analyzes information about lunar phases and lunar and solar eclipses to model Earth, moon, and sun system.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 043

The teacher understands the role of the sun in the solar system and the characteristics of planets and other objects that orbit the sun.

The beginning teacher:

- Knows the approximate size, mass, motion, temperature, structure, and composition of the sun.
- Compares and contrasts conditions essential to life on Earth (e.g., temperature, water, mass, gases) to conditions on other planets.
- Compares and contrasts the planets in terms of orbit, mass, size, composition, rotation, atmosphere, moons, and geologic activity.
- Identifies objects other than planets that orbit the sun (e.g., asteroids, comets) and analyzes their characteristics (e.g., mass, size, composition, trajectory, origin).
- Relates gravitational force to the motion and interactions of objects within the solar system (e.g., sun, planets, moons, comets, meteors).
- Understands theories of the formation of the solar system.

Competency 044

The teacher understands composition, history, and properties of the universe.

The beginning teacher:

- Describes how nuclear fusion produces energy in stars, such as the sun.
- Identifies different types of stars, their characteristics and motions (e.g., temperature, age, relative size, composition, and radial velocity) and understands the use of spectral analysis to determine these characteristics.
- Describes stages in the life cycle of stars using the Hertzsprung-Russell diagram.
- Compares and contrasts characteristics of different types of galaxies.
- Interprets data to make inferences about the formation of stars and galaxies.
- Identifies types, characteristics, and significance of other deep-space objects in the universe (e.g., pulsars, nebulae, black holes).
- Interprets empirical data and scientific theories regarding the estimated age, origin, and evolution of the universe (e.g., big bang, inflation).
- Describes the role of supernovas on the chemical composition of the universe (e.g., origin of carbon on Earth).

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 045

The teacher understands the history and methods of astronomy.

The beginning teacher:

- Recognizes that all of science including current theories of the origin and evolution of the universe are based on the assumption that the fundamental laws of nature do not change over space and time.
- Describes the historical origins of the perceived patterns of constellations and their role in navigation.
- Describes the historical development and significance of the law of universal gravitation and planetary motion, the big bang theory of the origin of the universe, and the theory of special relativity.
- Recognizes and explains the patterns of movement of the sun, moon, planets, and stars in the sky.
- Demonstrates the use of units of measurement in astronomy (e.g., light year, astronomical units).
- Explains how various technologies (e.g., Earth- and space-based telescopes, deep-space probes, artificial satellites) are used in advancing knowledge about the universe.
- Understands how mathematical models, computer simulations, and data collected by the space and other science programs have contributed to scientific knowledge about Earth, the solar system, and the universe.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

DOMAIN X—SCIENCE LEARNING, INSTRUCTION, AND ASSESSMENT

Competency 046

The teacher understands research-based theoretical and practical knowledge about teaching science, how students learn science, and the role of scientific inquiry in science instruction.

The beginning teacher:

- Knows research-based theories about how students develop scientific understanding and how developmental characteristics, prior knowledge, experience, and attitudes of students influence science learning.
- Understands the importance of respecting student diversity by planning activities that are inclusive and selecting and adapting science curricula, content, instructional materials, and activities to meet the interests, knowledge, understanding, abilities, and experiences of all students, including English Language Learners.
- Knows how to plan and implement strategies to encourage student self-motivation and engagement in their own learning (e.g., linking inquiry-based investigations to students' prior knowledge, focusing inquiry-based instruction on issues relevant to students, developing instructional materials using situations from students' daily lives, fostering collaboration among students).
- Knows how to use a variety of instructional strategies to ensure all students comprehend content-related texts, including how to locate, retrieve, and retain information from a range of texts and technologies.
- Understands the science teacher's role in developing the total school program by planning and implementing science instruction that incorporates schoolwide objectives and the statewide curriculum as defined in the Texas Essential Knowledge and Skills (TEKS).
- Knows how to design and manage the learning environment (e.g., individual, small-group, whole-class settings) to focus and support student inquiries and to provide the time, space, and resources for all students to participate in field, laboratory, experimental, and nonexperimental scientific investigation.
- Understands the rationale for using active learning and inquiry methods in science instruction and how to model scientific attitudes such as curiosity, openness to new ideas, and skepticism.
- Knows principles and procedures for designing and conducting an inquiry-based scientific investigation (e.g., making observations; generating questions; researching and reviewing current knowledge in light of existing evidence; choosing tools to gather and analyze evidence; proposing answers, explanations, and predictions; and communicating and defending results).
- Knows how to assist students with generating, refining, focusing, and testing scientific questions and hypotheses.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

- Knows strategies for assisting students in learning to identify, refine, and focus scientific ideas and questions guiding an inquiry-based scientific investigation; to develop, analyze, and evaluate different explanations for a given scientific result; and to identify potential sources of error in an inquiry-based scientific investigation.
- Understands how to implement inquiry strategies designed to promote the use of higher-level thinking skills, logical reasoning, and scientific problem solving in order to move students from concrete to more abstract understanding.
- Knows how to guide students in making systematic observations and measurements.
- Knows how to sequence learning activities in a way that uncovers common misconceptions, allows students to build upon their prior knowledge, and challenges them to expand their understanding of science.

**FIELD 136: SCIENCE 8–12
TEST FRAMEWORK**

Competency 047

The teacher knows how to monitor and assess science learning in laboratory, field, and classroom settings.

The beginning teacher:

- Knows how to use formal and informal assessments of student performance and products (e.g., projects, laboratory and field journals, rubrics, portfolios, student profiles, checklists) to evaluate student participation in and understanding of inquiry-based scientific investigations.
- Understands the relationship between assessment and instruction in the science curriculum (e.g., designing assessments to match learning objectives, using assessment results to inform instructional practice).
- Knows the importance of monitoring and assessing students' understanding of science concepts and skills on an ongoing basis by using a variety of appropriate assessment methods (e.g., performance assessment, self-assessment, peer assessment, formal/informal assessment).
- Understands the purposes, characteristics, and uses of various types of assessment in science, including formative and summative assessments, and the importance of limiting the use of an assessment to its intended purpose.
- Understands strategies for assessing students' prior knowledge and misconceptions about science and how to use these assessments to develop effective ways to address these misconceptions.
- Understands characteristics of assessments, such as reliability, validity, and the absence of bias in order to evaluate assessment instruments and their results.
- Understands the role of assessment as a learning experience for students and strategies for engaging students in meaningful self-assessment.
- Recognizes the importance of selecting assessment instruments and methods that provide all students with adequate opportunities to demonstrate their achievements.
- Recognizes the importance of clarifying teacher expectations by sharing evaluation criteria and assessment results with students.