

**TEST FRAMEWORK FOR FIELD 238:  
Life Science 7–12**

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**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:

- A. Uses current sources of information about laboratory safety, including safety regulations and guidelines for the use of science facilities.
- B. 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.
- C. Employs safe practices in planning, implementing and managing all instructional activities and designs, and implements rules and procedures to maintain a safe learning environment.
- D. 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.
- E. Knows how to use appropriate equipment and technology (e.g., Internet, spreadsheet, calculator) for gathering, organizing, displaying, and communicating data in a variety of ways (e.g., charts, tables, graphs, diagrams, maps, satellite images, written reports, oral presentations).
- F. Understands how to use a variety of tools, techniques, and technology to gather, organize and analyze data; how to perform calculations; and how to apply appropriate methods of statistical measures and analyses.
- G. 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 (e.g., significant figures).
- H. Uses the International System of Units (i.e., metric system) and performs unit conversions within and across measurement systems.

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### 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:

- A. 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).
- B. 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.
- C. 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.
- D. Understands how logical reasoning, verifiable observational and experimental evidence, and peer review are used in the process of generating and evaluating scientific knowledge.
- E. 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.
- F. 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.
- G. Knows how to apply and analyze the systems model (e.g., interacting parts, boundaries, input, output, feedback, subsystems) across the science disciplines.
- H. Understands how shared themes and concepts (e.g., systems, order, and organization; evidence, models, and explanation; change, constancy, and measurements; evolution and equilibrium; form and function) provide a unifying framework in science.
- I. Understands the difference between a theory and a hypothesis, 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).

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### **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:

- A. 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.
- B. 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).
- C. Knows that science is a human endeavor influenced by societal, cultural and personal views of the world, and knows 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.
- D. Understands the application of scientific ethics to the conducting, analyzing and publishing of scientific investigations.
- E. 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).
- F. 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.
- G. Understands the role science can play in helping resolve personal, societal and global issues (e.g., recycling, population growth, disease prevention, resource use, evaluating product claims).

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**DOMAIN II — CELL STRUCTURE AND PROCESSES**

**Competency 004:**

**The teacher understands the structure and function of biomolecules.**

The beginning teacher:

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

**Competency 005:**

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

The beginning teacher:

- A. Differentiates among viruses, prokaryotic cells and eukaryotic cells (e.g., structure and function).
- B. Describes the basic components of prokaryotic and eukaryotic cells (e.g., cell membrane, cell wall, ribosomes, nucleus, mitochondrion, chloroplast) and the functions and relationships of the components.
- C. Identifies differences in cell structure and function in different types of organisms (e.g., differences in plant and animal cells).
- D. 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).

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**Competency 006:**

**The teacher understands how cells carry out life processes.**

The beginning teacher:

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

**Competency 007:**

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

The beginning teacher:

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

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**DOMAIN III — HEREDITY AND EVOLUTION OF LIFE**

**Competency 008:**

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

The beginning teacher:

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

**Competency 009:**

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

The beginning teacher:

- A. Applies the laws of probability to determine genotypic and phenotypic frequencies in Mendelian inheritance (e.g., using Punnett squares, pedigree charts).
- B. Compares the processes of meiosis and mitosis (in plants and animals) and describes their roles in sexual and asexual reproduction.
- C. 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).
- D. 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).
- E. Analyzes the effects of environmental factors (e.g., light, nutrition, moisture, temperature) on the expression of traits in the phenotype of an organism.

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**Competency 010:**

**The teacher understands the theory of biological evolution.**

The beginning teacher:

- A. 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).
- B. Analyzes the effects of natural selection on adaptations and diversity in populations and species.
- C. Understands the role of intraspecific and interspecific competition in evolutionary change.
- D. Compares and contrasts the different effects of selection (e.g., directional, stabilizing, diversifying) on a variable characteristic.
- E. Analyzes processes that contribute to speciation (e.g., natural selection, founder effect, reproductive isolation).
- F. Analyzes the development of isolating mechanisms that discourage hybridization between species (e.g., species' recognition marks, behavioral displays, ecological separation, seasonal breeding).

**Competency 011:**

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

The beginning teacher:

- A. Analyzes how fossils, DNA sequences, anatomical similarities, physiological similarities and embryology provide evidence of both common origin and change in populations and species.
- B. Understands the relationship between environmental change, mutations and adaptations of an organism over many generations.
- C. Identifies major developments in the evolutionary history of life (e.g., formation of organic molecules, self-replication, backbones, vascular tissue, colonization of the land).
- D. 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).

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### DOMAIN IV — DIVERSITY OF LIFE

#### Competency 012:

**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:

- A. 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).
- B. Understands the relationship between environmental changes in aquatic and terrestrial ecosystems and adaptive changes in organisms inhabiting these those ecosystems.
- C. Explains the uses and limitations of classification schemes.
- D. 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).
- E. 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) by using dichotomous keys.
- F. Identifies distinguishing characteristics of domains and kingdoms, including eubacteria, archaeobacteria, protists, fungi, plants, and animals.

#### Competency 013:

**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:

- A. Identifies the basic requirements (e.g., nutrients, oxygen, water, carbon dioxide) necessary for various organisms to carry out life functions.
- B. Compares how various organisms obtain, transform, transport, release, eliminate, and store energy and matter.
- C. 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).
- D. Analyzes characteristics, functions, and relationships of systems in plants (e.g., transport, control, reproductive, nutritional, structural systems).
- E. Identifies methods of reproduction, growth, and development of various plants and animals.

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**Competency 014:**

**The teacher understands the processes by which organisms maintain homeostasis.**

The beginning teacher:

- A. Explains the importance of maintaining a stable internal environment.
- B. Describes the relationships among internal feedback mechanisms in maintaining homeostasis.
- C. Identifies anatomical structures and physiological processes in a variety of organisms that function to maintain homeostasis in the face of changing environmental conditions.
- D. Analyzes the importance of nutrition, environmental conditions, and physical exercise on health in humans and other organisms.
- E. 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 015:**

**The teacher understands the relationship between biology and behavior.**

The beginning teacher:

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

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**DOMAIN V — INTERDEPENDENCE OF LIFE AND ENVIRONMENTAL SYSTEMS**

**Competency 016:**

**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:

- A. 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.
- B. 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.
- C. 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 versus taiga, continental shelf versus deep ocean).
- D. Explains the relationship among abiotic characteristics of different biomes and the adaptations, variations, tolerances and roles of indigenous plants and animals in those biomes.

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### Competency 017:

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

The beginning teacher:

- A. Understands the concepts of ecosystem, biome, community, habitat, and niche.
- B. 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.
- C. Understands interspecific interactions in aquatic and terrestrial ecosystems (e.g., predator-prey relationships, competition, parasitism, commensalism, mutualism) and how they affect ecosystem structure.
- D. Identifies indigenous plants and animals, assesses their roles in an ecosystem, and describes their relationships in different types of environments (e.g., freshwater, continental shelf, deep ocean, forest, desert, plains, tundra).
- E. 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.
- F. Evaluates the importance of biodiversity in an ecosystem and identifies changes that may occur if biodiversity is increased or reduced in an ecosystem.
- G. 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.
- H. Explains the significance of plants in different types of terrestrial and aquatic ecosystems.

### Competency 018:

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

The beginning teacher:

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

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### DOMAIN VI — SCIENCE LEARNING, INSTRUCTION AND ASSESSMENT

#### Competency 019:

**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:

- A. Knows research-based theories about how students develop scientific understanding and how developmental characteristics, prior knowledge, experience, and attitudes of students influence science learning.
- B. 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, possible career paths, and experiences of all students, including English-language learners.
- C. 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).
- D. 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.
- E. Understands the science teacher's role in developing the total school program by planning and implementing science instruction that incorporates school-wide objectives and the statewide curriculum as defined in the Texas Essential Knowledge and Skills (TEKS).
- F. 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.
- G. 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.
- H. 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).
- I. Knows how to assist students with generating, refining, focusing and testing scientific questions and hypotheses.
- J. 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.
- K. 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.
- L. Knows how to guide students in making systematic observations and measurements.
- M. 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.

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### Competency 020:

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

The beginning teacher:

- A. 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.
- B. 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).
- C. 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).
- D. 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.
- E. Understands strategies for assessing students' prior knowledge and misconceptions about science and how to use those assessments to develop effective ways to address the misconceptions.
- F. Understands characteristics of assessments, such as reliability, validity and the absence of bias in order to evaluate assessment instruments and their results.
- G. Understands the role of assessment as a learning experience for students and strategies for engaging students in meaningful self-assessment.
- H. Recognizes the importance of selecting assessment instruments and methods that provide all students with adequate opportunities to demonstrate their achievements.
- I. Recognizes the importance of clarifying teacher expectations by sharing evaluation criteria and assessment results with students.