CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS (CEOE™)

OKLAHOMA SUBJECT AREA TESTS (OSAT™)

FIELD 10: BIOLOGICAL SCIENCES

TEST FRAMEWORK

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OKLAHOMA SUBJECT AREA TESTS (OSAT™)

FIELD 10: BIOLOGICAL SCIENCES
TEST FRAMEWORK

Foundations of Scientific Inquiry
Cell Structure and Function
Heredity and Biological Adaptation
Matter, Energy, and Organization in Organisms
Interdependence of Organisms

SUBAREA I—FOUNDATIONS OF SCIENTIFIC INQUIRY

Competency 0001

Understand unifying concepts among the sciences and the relationships that connect science and technology.

The following topics are examples of content that may be covered under this competency.

Recognize conceptual and procedural themes that unify the disciplines of science (e.g., structure and function, models, measurement).

Analyze similarities among systems (e.g., stability, equilibrium, scale).

Apply concepts and theories from other sciences to a biological system.

Analyze the use of biology and other sciences in the design of a technological solution to a given problem.

Competency 0002

Understand the nature of science including the historical and contemporary contexts of biological study.

The following topics are examples of content that may be covered under this competency.

Recognize science as an ongoing human endeavor that is based on empirical standards, logical arguments, and questioning.

Analyze the significance of key events in the history of biological study (e.g., development of the microscope, understanding the structure of DNA).

Recognize the societal implications of recent developments in biology and biotechnology (e.g., medical technology, genetic engineering, wastewater treatment).

Analyze the role of science and technology in local, national, and global challenges.

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Competency 0003

Understand the process of scientific inquiry and the role of observation, experimentation, and communication in explaining natural phenomena.

The following topics are examples of content that may be covered under this competency.

Analyze processes by which scientific knowledge and hypotheses are generated and revised.

Analyze ethical practices related to the process of scientific research and reporting.

Evaluate the appropriateness of a specified experimental design to test a hypothesis.

Analyze the use of models in explaining and investigating natural phenomena.

Competency 0004

Understand principles of measurement and the processes of gathering, interpreting, and communicating scientific data.

The following topics are examples of content that may be covered under this competency.

Evaluate the appropriateness and limitations of units of measurement, measuring devices, or methods of measurement.

Evaluate the appropriateness of a given method or procedure for collecting data for a specified purpose.

Make inferences, predictions, or conclusions based on given data.

Select an effective graphic representation (e.g., graph, table, diagram) for organizing, reporting, and analyzing given experimental data.

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Competency 0005

Understand equipment, materials, chemicals, and organisms used in biological studies and the application of procedures for their proper, safe, and legal use.

The following topics are examples of content that may be covered under this competency.

Demonstrate knowledge of the appropriate use of laboratory instruments and equipment (e.g., balance, glassware, microscope, Bunsen burner, centrifuge, spectrophotometer).

Demonstrate knowledge of the use of technologies to model and solve problems in biology.

Apply proper methods for identifying, storing, and dispensing chemicals used in biology and identify sources for such information.

Demonstrate an understanding of the proper and humane treatment of living organisms in biological studies.

Apply proper procedures for promoting laboratory safety and responding to accidents and injuries in the biology laboratory.

SUBAREA II—CELL STRUCTURE AND FUNCTION

Competency 0006

Understand basic chemistry and biochemistry, and use this understanding to analyze the role of biologically important elements and compounds in living organisms.

The following topics are examples of content that may be covered under this competency.

Compare and contrast hydrogen, ionic, and covalent bonds.

Relate the structure and function of carbohydrates, lipids, proteins, and nucleic acids to cellular activities, including hydrolysis and dehydration synthesis (condensation).

Analyze the properties of water and the significance of these properties to living organisms.

Analyze the structure and function of enzymes and factors that affect the rate of enzyme action.

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Competency 0007

Understand the functions and interrelatedness of cell structures, and identify the structural features of different types of cells.

The following topics are examples of content that may be covered under this competency.

Compare and contrast prokaryotic and eukaryotic cells.

Demonstrate knowledge of the primary functions, processes, products, and interactions of various cellular structures (e.g., lysosomes, microtubules, cell membrane).

Analyze the importance of active and passive transport processes in maintaining homeostasis in cells and the relationships between these processes and the cellular membranes.

Competency 0008

Understand the processes of photosynthesis and cellular respiration and their relationships to cell structure and function.

The following topics are examples of content that may be covered under this competency.

Recognize the importance of the processes of photosynthesis and respiration to organisms.

Analyze limiting factors that affect the yield of energy from the breakdown of organic molecules in a cell.

Analyze limiting factors that affect the storage of energy from the production of organic molecules in a cell.

Analyze the biochemical pathways of photosynthesis and respiration (e.g., Calvin cycle, glycolysis, Krebs cycle).

Evaluate the significance of chloroplast structure and mitochondrion structure in the processes of photosynthesis and respiration.

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Competency 0009

Understand the cell cycle, the stages and end products of meiosis and mitosis, and the role of cell division in unicellular and multicellular organisms.

The following topics are examples of content that may be covered under this competency.

Interpret the results of experiments relating to the eukaryotic cell cycle.

Compare chromosomal changes during the stages of meiosis and mitosis.

Analyze the significance of meiosis and fertilization in relation to phylogeny and genetic diversity.

Demonstrate an understanding of the process of cell differentiation.

Recognize the relationship between unrestricted cell division and cancer.

SUBAREA III—HEREDITY AND BIOLOGICAL ADAPTATION

Competency 0010

Understand the structure and function of DNA and RNA.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the mechanism of DNA replication and the types of errors that can occur.

Analyze the roles of DNA and ribosomal, messenger, and transfer RNA in protein synthesis.

Analyze the implications of mutations in DNA molecules for protein structure and function.

Analyze the control of gene expression in prokaryotes (e.g., *lac* operon in *E. coli*) and eukaryotes.

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Competency 0011

Understand the procedures involved in the isolation, manipulation, and expression of genetic material and the application of genetic engineering in basic and applied research.

The following topics are examples of content that may be covered under this competency.

Recognize the role of genetic engineering techniques in the basic discoveries of molecular genetics.

Analyze the role of genetic engineering in the development of microbial cultures capable of producing valuable products (e.g., human insulin).

Demonstrate an understanding of genetic engineering techniques and their uses (e.g., plasma probes, sequencing, DNA hybridization).

Competency 0012

Understand concepts, principles, and applications of classical and molecular genetics.

The following topics are examples of content that may be covered under this competency.

Analyze the significance of Mendel's pea plant experiments and their implications regarding basic principles of heredity (e.g., dominance, segregation, independent assortment).

Analyze techniques used to determine the presence of human genetic diseases (e.g., PKU, cystic fibrosis).

Analyze genetic inheritance problems involving genotypic and phenotypic frequencies.

Recognize the role of nonnuclear inheritance (e.g., mitochondrial DNA, chloroplastic DNA) in phenotypic expression.

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Competency 0013

Understand the processes of natural selection and biological adaptation.

The following topics are examples of content that may be covered under this competency.

Recognize adaptations as products of selection of naturally occurring variations in populations.

Analyze factors that contribute to speciation (e.g., geographic and reproductive isolation).

Analyze proposed mechanisms of evolution (e.g., gradualism, punctuated equilibrium).

Apply principles of population genetics to explain evolutionary change or stasis in a population.

Evaluate observations made in various areas of biology (e.g., embryology, biochemistry, anatomy) in terms of evolutionary theory.

Competency 0014

Understand the principles of classification and taxonomy.

The following topics are examples of content that may be covered under this competency.

Analyze criteria used to classify organisms (e.g., morphology, biochemical comparisons, dichotomous keys).

Interpret a given phylogenetic tree or cladogram of related species.

Demonstrate knowledge of the contributions of Linnaeus to the modern system of classification.

Relate changes in the structure and organization of the classification system to developments in biological thought (e.g., evolution, modern genetics).

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SUBAREA IV—MATTER, ENERGY, AND ORGANIZATION IN ORGANISMS

Competency 0015

Understand the characteristics of life and the organization of organisms.

The following topics are examples of content that may be covered under this competency.

Identify characteristics of living organisms (e.g., differences between organisms and nonliving things) and requirements needed to sustain life.

Recognize levels of organization in organisms (e.g., cells, tissues, systems) and the relationships among the levels.

Compare the organization and structures of diverse organisms from single-celled to complex multicellular organisms.

Recognize the functions of specialized structures at all levels of complexity (e.g., leaves on trees, wings on birds).

Competency 0016

Understand matter and energy in organisms.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the need for organisms to obtain, transform, transport, release, and eliminate matter and energy.

Compare ways in which organisms obtain, transform, transport, release, and eliminate matter and energy.

Recognize sources of energy used by various organisms (e.g., archaebacteria, plants, animals).

Recognize the implications of conservation of energy and matter for living systems.

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Competency 0017

Understand regulatory processes in organisms.

The following topics are examples of content that may be covered under this competency.

Identify anatomical structures and physiological processes that are involved in maintaining homeostasis.

Analyze behavioral responses (e.g., taxes, tropisms) to internal and external stimuli (e.g., light, gravity, chemical concentrations).

Recognize ways in which organisms monitor internal and external conditions (e.g., light-sensing cells, nervous system, endocrine system).

Evaluate the adaptive significance of a given behavior.

Competency 0018

Understand reproduction, development, and life cycles of organisms.

The following topics are examples of content that may be covered under this competency.

Compare and contrast asexual and sexual reproduction.

Recognize characteristics of the reproductive strategies of common organisms.

Recognize developmental processes of plants and animals.

Analyze the adaptive significance of various reproductive strategies (e.g., development of seeds, internal fertilization).

Compare the life cycles of various organisms (e.g., insect, plant, vertebrate).

Competency 0019

Understand human biology.

The following topics are examples of content that may be covered under this competency.

Identify structures of the body systems and their related functions.

Analyze physiological processes (e.g., excretion, respiration) and their role in regulation.

Demonstrate knowledge of the human life cycle, including reproduction, growth, and development.

Recognize characteristics of human diseases, their causes, and methods of prevention and treatment.

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SUBAREA V—INTERDEPENDENCE OF ORGANISMS

Competency 0020

Understand the characteristics of populations and communities, and use this knowledge to analyze population growth and community interactions.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of factors that affect population size and growth rate (e.g., carrying capacity, limiting factors).

Determine and interpret population growth curves, and utilize sampling methods.

Analyze relationships among organisms in a community (e.g., competition, predation, symbiosis).

Competency 0021

Understand the characteristics of ecosystems and major biomes.

The following topics are examples of content that may be covered under this competency.

Compare different types of ecosystems (e.g., terrestrial, aquatic) in terms of biotic and abiotic factors.

Recognize the importance of the process of ecological succession and the role of biotic and abiotic factors in this process.

Analyze factors that influence the characteristics of the major types of biomes.

Recognize the effect of biome degradation and destruction on biosphere stability (e.g., climate changes, deforestation, reduction of species diversity).

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Competency 0022

Understand the flow of energy and matter through living systems and between living systems and the physical environment.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the flow of energy through the trophic levels of an ecosystem.

Compare the strengths and limitations of various pyramid models (e.g., biomass, numbers, energy).

Demonstrate an understanding of the role of bacteria in nutrient cycling in ecosystems.

Analyze biogeochemical cycles.

Evaluate the effects of limiting factors on ecosystem productivity (e.g., light intensity, gas concentrations, mineral availability).

Competency 0023

Understand concepts of human ecology and the impact of human decisions and activities on the abiotic and biotic environments.

The following topics are examples of content that may be covered under this competency.

Recognize the importance and implications of influencing factors (e.g., nutrition, public health, biodegradation) on human population dynamics.

Predict the impact of human use of natural resources (e.g., forests, rivers) on organisms.

Analyze types of resource misuse and their long- and short-term effects.

Evaluate methods and technologies that reduce or mitigate environmental degradation.

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