BIOLOGY

Test Framework

	Content Domain	Range of Competencies	Approximate Percentage of Test Score
I.	Nature of Science	0001–0003	20%
II.	Biochemistry and Cell Biology	0004–0005	13%
III.	Genetics and Evolution	0006–0009	27%
IV.	Biological Unity and Diversity	0010–0012	20%
V.	Ecology and Environment	0013–0015	20%

I. Nature of Science

0001 Understand principles and procedures of scientific inquiry.

- Demonstrate knowledge of the principles and procedures for designing and carrying out various types of scientific investigations.
- Analyze methods and criteria for collecting, organizing, analyzing, interpreting, and presenting scientific data.
- Recognize the evidential basis of scientific claims.
- Apply basic mathematical procedures and scientific notation in communicating data and addressing questions in biology.
- Demonstrate knowledge of safety procedures and hazards associated with biological investigations and the materials, equipment, technology, and disposal methods used in biology.

0002 Understand the history and nature of science.

- Demonstrate knowledge of the historical development of major scientific ideas.
- Identify unifying scientific theories, models, and concepts in biology, Earth and space science, chemistry, and physics.
- Identify unifying themes, principles, and relationships that connect the different branches of science, including biology, Earth and space science, chemistry, and physics.
- Demonstrate knowledge of the nature of science and its characteristics as a system of inquiry.

0003 Understand the relationships between biology, engineering, technology, mathematics, and society.

- Analyze the interrelationships between biology, engineering, technology, mathematics, and society.
- Critically evaluate scientific research and the coverage of science in the media.
- Analyze social, economic, and ethical issues associated with technological and scientific developments.

II. Biochemistry and Cell Biology

0004 Understand the chemistry of living systems.

- Demonstrate knowledge of basic chemistry, including the characteristics of atoms and molecules, and of the physical and chemical properties of water and carbon and the biological significance of these properties.
- Analyze biological phenomena at the cellular level in terms of the basic principles of thermodynamics and the properties of chemical reactions and covalent, ionic, and hydrogen bonds.
- Analyze the structure and function of macromolecules (e.g., carbohydrates, lipids, nucleic acids, proteins) and their monomers, including metabolic pathways involving their synthesis and breakdown.
- Analyze the role of enzymatic molecules in metabolic pathways involving the synthesis and breakdown of macromolecules.

0005 Understand cell structure, function, and bioenergetics.

- Analyze the structures and functions of membranes, organelles, and other cellular components in prokaryotic and eukaryotic cells and the mechanisms by which cells maintain homeostasis.
- Analyze the process of photosynthesis and cellular respiration.
- Analyze the specializations of cells and differentiate cell types.
- Demonstrate knowledge of binary fission, mitosis, the stages of the cell cycle, and factors affecting the growth and division of cells.

III. Genetics and Evolution

0006 Understand molecular genetics.

- Analyze the synthesis, structure, and function of nucleic acids; gene structure and function and factors controlling gene expression; and the processes involved in protein synthesis.
- Analyze the types and causes of chromosomal and gene mutations, the consequences of these genetic changes, and the genetic basis of common disorders and diseases.
- Demonstrate knowledge of basic methods and applications of genetic engineering.

0007 Understand patterns and processes of inheritance.

- Analyze meiosis and fertilization and their roles in sexual life cycles.
- Analyze patterns of inheritance and the relationship between genotypic and phenotypic frequencies.
- Demonstrate knowledge of the chromosomal basis of inheritance and its relationship to observed inheritance patterns and of the characteristics of extranuclear inheritance in plants and animals.
- Solve genetics problems.

0008 Understand the mechanisms of biological evolution.

- Demonstrate knowledge of population genetics (e.g., Hardy-Weinberg), the mechanisms of natural and artificial selection, and the sources and significance of variation in populations.
- Analyze evolutionary patterns and the mechanisms of speciation.

0009 Understand the scientific explanations and evidence for the history of life on Earth.

- Demonstrate knowledge of the geologic history of Earth, current scientific theories on the origin of life, biologically significant events in Earth's history, and the fossil record.
- Demonstrate knowledge of the principles of biological classification, phylogenetic trees and their cladistic basis, evolutionary relationships of major groups of organisms, and evolution as a unifying principle in biology.
- Analyze different kinds of scientific evidence for evolution.

IV. Biological Unity and Diversity

0010 Understand the structures and functions of organisms and their life cycles.

- Demonstrate knowledge of the characteristics of viruses, prokaryotes, protists, and fungi, including their reproduction and life cycles.
- Demonstrate knowledge of the characteristics of the major groups of plants, including their reproduction and life cycles.
- Demonstrate knowledge of the characteristics of the major groups of animals, including their reproduction and life cycles.

0011 Understand how organisms obtain, store, and use energy and matter to maintain homeostasis.

- Analyze how prokaryotes, protists, and fungi obtain, store, and use energy, nutrients, and water to maintain homeostasis.
- Analyze how plants obtain, store, and use energy, nutrients, and water to maintain homeostasis.
- Analyze how animals obtain, store, and use energy, nutrients, and water to maintain homeostasis.

0012 Understand the anatomy and physiology of human organ systems.

- Analyze the general structure, organization, function, and homeostatic relationships of the skeletal, muscular, and integumentary systems.
- Analyze the general structure, organization, function, and homeostatic relationships of the respiratory, circulatory, digestive, and excretory systems.
- Analyze the general structure, organization, function, and homeostatic relationships of the immune, nervous, endocrine, and reproductive systems.
- Demonstrate knowledge of common human disorders of the major organ systems and the causes, characteristics, and avoidance of common diseases.

V. Ecology and Environment

0013 Understand populations and communities.

- Analyze the interactions of biotic and abiotic factors that limit or regulate population size, including the difference between density-independent and density-dependent factors.
- Analyze the behavior of organisms and the relationship of behavior to various social systems.
- Analyze demographic characteristics, life history patterns, population growth curves, and survivorship curves for populations occurring in different habitats and under different conditions.
- Analyze the composition of biological communities, the types of relationships that exist among organisms in communities, the concept of ecological niche, and factors that produce change in communities.

0014 Understand ecosystems and biomes.

- Analyze energy flow and biogeochemical cycling in ecosystems.
- Demonstrate knowledge of different types of biomes, their geographical distribution and physical characteristics, and their typical flora and fauna.
- Analyze the trophic roles of organisms in different ecosystems.

0015 Understand the effects of human activities on the biosphere.

- Analyze the effects of human activities on aquatic populations, communities, and ecosystems, and the implications of these effects for humans and other organisms.
- Analyze the effects of human activities on terrestrial populations, communities, and ecosystems, and the implications of these effects for humans and other organisms.
- Analyze the effects of human activities on the atmosphere and climate and the implications of these effects for humans and other organisms.