

Biology

[27.150]

In addition to the standards for all science teachers that are set forth in Section 27.140 of this Part, those who specialize in the teaching of biology shall be required to meet the standards described in this Section.

STANDARD 1

The competent biology teacher applies an understanding of the concepts of cell biology.

Knowledge Indicators - *The competent biology teacher:*

- 1A. understands the structural and functional aspects of nucleic acids, proteins, carbohydrates, lipids and enzyme kinetics and reactivity.
- 1B. understands the utilization and synthesis of organic materials by living systems and the relationship of these processes to energy production and utilization at the cellular level.
- 1C. understands the basic methods and processes used in cellular and molecular biology research.
- 1D. understands the mechanisms and genetics of cellular differentiation to form specialized tissues, organs, and the organism.

Performance Indicators - *The competent biology teacher:*

- 1E. designs and/or describes models that represent nuclear and cellular chemical reactions at the microscopic and macroscopic levels.
- 1F. demonstrates the use and application of the technologies and instruments used to study biological phenomena at the cellular level for both prokaryotes and eukaryotes.
- 1G. delineates the historical progression of the studies of cellular biology, emphasizing the changes in knowledge from advances in technology and the resulting societal implications.
- 1H. develops, selects, and implements safe and appropriate laboratory, field, and classroom activities to develop students' understanding of cell biology.

STANDARD 2

The competent biology teacher applies an understanding of the molecular basis of heredity and the associated mathematical probabilities of pedigrees.

Knowledge Indicators - *The competent biology teacher:*

- 2A. understands the nature and function of the gene, with an emphasis on the molecular basis of inheritance and gene expression.
- 2B. understands the processes involved in gene sequencing and the technologies that did/will contribute to advances in this field.
- 2C. understands genetic and mathematical explanations associated with the probabilities of the transmission of traits and defects in organisms.
- 2D. understands the basis and impact of the concepts of mutations and extinction.
- 2E. understands the concepts, technologies, and consequences associated with recombinant DNA applications.

Performance Indicators - *The competent biology teacher:*

- 2F. schematically explains the technologies associated with various gene sequencing strategies and manipulations.
- 2G. designs physical and mathematical models of varying degrees of sophistication that explain the nature of the gene and its predicted expression(s) in various organisms.
- 2H. demonstrates the use and application of the instruments used in biotechnology studies.
- 2I. delineates the historical progression of the studies of biotechnology, emphasizing the changes in knowledge from advances in technology and the resulting societal implications.
- 2J. develops, selects, and implements safe and appropriate laboratory, field, and classroom activities to develop students' understanding of biotechnology.

STANDARD 3

The competent biology teacher applies an understanding of biological evolution.

Knowledge Indicators - *The competent biology teacher:*

- 3A. understands biological diversity, with an emphasis on the evolutionary relationships among the major groups.
- 3B. understands the processes of natural selection and speciation by which entire and portions of phyla, classes, orders, genus and species of organisms have evolved or become extinct over time.
- 3C. understands the evidence from comparative anatomy, behavior, embryology, genetics, paleontology, and physiological studies that contribute to the explanations of the theory of evolution.

Performance Indicators - *The competent biology teacher:*

- 3D. cites and describes examples of evolutionary evidence from the geological, biochemical, genetic, embryologic, and fossil records.
- 3E. compares and contrasts cellular and sub-cellular structures and molecular processes among the major groups of organisms.
- 3F. describes recent findings or research associated with the testing of the theory of evolution and its mechanisms.
- 3G. delineates the historical progression of the studies of evolution, emphasizing the changes in knowledge from advances in technology and the resulting societal implications.
- 3H. develops, selects, and implements appropriate classroom activities to develop students' understanding of evolution.

STANDARD 4

The competent biology teacher applies an understanding of organismal biology and diversity.

Knowledge Indicators - *The competent biology teacher:*

- 4A. understands biochemical and molecular biology of the processes fundamental to the metabolic function of the various systems of living organisms.
- 4B. understands how organisms recognize and localize various signals to maintain homeostasis throughout and beyond the whole organism.
- 4C. understands biological diversity that encompasses the structure, function, and nomenclature of the major groups of organisms on the local, regional, and global levels.
- 4D. understands the processes and requirements necessary for the maintenance and continuation of life, including humans.

Performance Indicators - *The competent biology teacher:*

- 4E. designs and explains models that demonstrate how organisms react to stimuli within and beyond the organism.
- 4F. analyzes the interrelationships among the functions of the various organismal systems.
- 4G. demonstrates the use of various instruments and technologies that enable the study of organisms on the microscopic and macroscopic levels.
- 4H. develops, selects, and implements appropriate laboratory, field and classroom activities and strategies to develop students' understanding of the biology of organisms and their diversity.

STANDARD 5

The competent biology teacher applies an understanding of ecology.

Knowledge Indicators - *The competent biology teacher:*

- 5A. understands the categories of interactions and interdependence by organisms in the various ecosystems, including the environmental influences and limiting factors that affect them.
- 5B. understands the concepts and impact of population dynamics on environments and communities.
- 5C. understands the human impact on the environment, as well as the impact of the environment on humans.
- 5D. understands the effect of biotic factors on the location of different biotic communities.

Performance Indicators - *The competent biology teacher:*

- 5E. analyzes the impact of climate, altitude, geography, etc., on the location of plant communities and animal habitats.
- 5F. explains the concepts of survival techniques by organisms in varying environments and how this knowledge can be applied in altered circumstances.
- 5G. analyzes the risk/cost/benefit factors in environmental impact studies.
- 5H. conducts field studies to detect the presence of various indicator species that mark the health of the ecosystem.
- 5I. demonstrates the use of various instruments, technologies, and strategies in the research of the ecology.
- 5J. develops, selects, and implements safe and appropriate laboratory, field, and classroom activities to develop students' understanding of the local, regional, and global ecosystems.

STANDARD 6

The competent biology teacher applies an understanding of the matter, energy, and organization in living systems.

Knowledge Indicators - *The competent biology teacher:*

- 6A. understands the flow of energy in biological systems and the physical environment.
- 6B. understands the distribution and abundance of organisms and populations in ecosystems as limited by the availability of matter and energy.
- 6C. understands the reciprocity between consumers and producers and the biochemical pathways that cause energy to be transferred.
- 6D. understands the need for obtaining, transforming, transporting, releasing, and eliminating matter and energy as accommodated by the varying complexity and organization of organisms.

Performance Indicators - *The competent biology teacher:*

- 6E. designs models that demonstrate the building and breakdown of obvious molecules in biological reactions.
- 6F. describes the transformation of energy in various biological reactions.
- 6G. analyzes the distribution and abundance of organisms within an ecosystem limited by the availability of matter and energy.
- 6H. demonstrates the use of instruments, technologies, and strategies that analyze the composition of the matter, energies, and degrees of organization in organisms.
- 6I. develops, selects, and implements safe and appropriate laboratory, field and classroom activities that develop students' understanding of the physical and chemical factors associated with living systems.