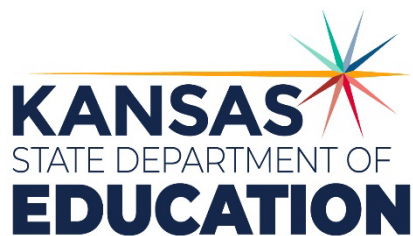


Higher Education Teacher Preparation Standards

Biology grades 6-12



Kansas leads the world in the success of each student.

BIOLOGY

Early Adolescence through Late Adolescence

Grades 6-12, adopted November 9, 2016

“Learner(s)” is defined as children including those with disabilities or exceptionalities, who are gifted, and students who represent diversity based on ethnicity, race, socioeconomic status, gender, language, religion, and geographic origin.

Standard 1: Content Pedagogy

Effective science teachers understand how students learn and develop science and engineering concepts and practices. They incorporate disciplinary core ideas, scientific and engineering practices, and crosscutting concepts into instruction.

Function 1: Teacher plans multiple lessons using a variety of inquiry approaches incorporating science and engineering practices.

Content Knowledge

1.1.1 CK Knows how to locate resources, design and conduct inquiry-based open-ended science investigations, interpret findings, communicate results, and make judgments based on evidence.

Professional Skills

1.1.2 PS Supports student learning through appropriate curricular and instructional experiences linked to the standards.

1.1.3 PS The teacher is able to develop lessons for students that demonstrate knowledge of the practices of science and engineering by questioning, defining problems, modeling, investigating, and analyzing evidence in order to construct explanations and alternative explanations.

1.1.4 PS The teacher is able to develop lessons in which students collect and interpret data, develop and communicate concepts, and understand scientific processes, relationships and natural patterns from empirical experiences. Applications of science-specific technology are included in the lessons when appropriate.

Function 2: Teacher demonstrates knowledge and understanding of how diverse students learn science.

Content Knowledge

1.2.1 CK Knows learning is influenced by cultural and environmental differences of the student and family.

1.2.2 CK Understands developmentally and chronologically age-appropriate needs and practices of students.

1.2.3 CK Understands diverse learning styles.

Professional Skills

1.2.4 PS Gains and values information about the family's culture and environment and uses it to understand individual development and learning.

1.2.5 PS Promotes developmentally and chronologically age- appropriate educational experiences to meet the learning abilities, strengths, needs, and preferences of students.

Function 3: The teacher designs instruction and assessment strategies that confront and address naïve concepts/preconceptions.

Content Knowledge

1.3.1 CK The teacher knows learning is influenced by cultural and environmental differences of the student and family.

1.3.2 CK The teacher understands formative and summative assessment and how they are used.

Professional Skills

1.3.3 PS The teacher uses appropriate formal and informal evaluation/assessment instruments to identify learning needs of students.

1.3.4 PS The teacher is able to identify common student misconceptions and naïve understandings and design and implement appropriate instruction to address these.

Standard 2: Learning Environments

Teachers work with students and others to create and manage environments that support learning.

Function 1: The teacher supports individual and group learning.

Content Knowledge

2.1.1 CK The teacher understands the importance of rigor, respect, and responsibility for the learning environment.

2.1.2 CK The teacher understands how teacher feedback influences student learning.

Professional Skills

2.1.3 PS The teacher sets and articulates appropriate goals that are consistent with knowledge of how students learn science.

2.1.4 PS The teacher sets goals that are aligned with state and other professional standards.

2.1.5 PS The teacher manages the environment to make learning experiences appropriately challenging.

Function 2: The teacher encourages positive social interaction.

Content Knowledge

2.2.1 CK The teacher understands how learner diversity can affect communication and knows how to communicate effectively in differing environments.

2.2.2 CK The teacher understands how learning occurs, how learners construct knowledge, acquire skills, and develop disciplined thinking processes and knows how to use instructional strategies that promote student learning.

Professional Skills

2.2.3a PS The teacher plans fair and equitable assessment strategies to analyze student learning and to evaluate if the learning goals are met.

2.2.3b PS The teacher promotes celebration of learning by providing positive reinforcement and encouraging learners to present work demonstrating their learning and interacting with community members about their work.

2.2.3c PS The teacher communicates verbally and nonverbally, with families, communities, colleagues, and other professionals, in ways that demonstrate respect for and responsiveness to the cultural backgrounds and differing perspectives learners bring to the learning environment.

2.2.3d PS The teacher knows how to help learners work productively and cooperatively with each other to achieve learning goals.

2.2.4a PS The teacher develops plans that reflect the nature and social context of science and inquiry.

- 2.2.4b PS The teacher creates developmentally appropriate instruction that takes into account individual learners' strengths, interests, and needs and that enables each learner to advance and accelerate his/her learning.

Function 3: The teacher promotes active engagement in learning and self-motivation.

Content Knowledge

- 2.3.1 CK The teacher understands the relationships between motivation, engagement, and self-efficacy, and knows how to design learning experiences using strategies that build learner self direction and ownership of learning.
- 2.3.2 CK The teacher creates learning environments where students have an opportunity to actively engage in the practices of science and engineering.

Professional Skills

- 2.3.3a PS The teacher shows the ability to use a variety of strategies that demonstrate the candidates' knowledge and understanding of how to select the appropriate teaching and learning activities, including laboratory or field settings and applicable instruments and technology.
- 2.3.3b PS The teacher incorporates differentiated instruction strategies to engage students with diverse learning needs.
- 2.3.3c PS The teacher incorporates tools of language development into planning and instruction, including strategies for making content accessible to English language learners and for evaluating and supporting their development of English proficiency.
- 2.3.4a PS The teacher will develop lesson plans that include active inquiry lessons where students are collecting, analyzing and interpreting data.
- 2.3.4b PS The teacher will develop lesson plans that allow students to engage in developing and using models, constructing explanations and designing solutions, engaging in argument from evidence, and evaluating and communicating information.

Standard 3: Safety

Effective teachers of science demonstrate and implement safety procedures, material safety practices, and the ethical treatment and use of living organisms (appropriate to their area of licensure).

Function 1: The teacher implements safe and proper techniques for the preparation, storage, dispensing, supervision, and disposal of all materials.

Content Knowledge

- 3.1.1 CK The teacher understands safety considerations affecting the purchase, storage, maintenance, and disposal of materials such as minimizing quantities in ordering, tracking usage of materials and production of waste, and keeping current on inventory of materials.
- 3.1.2 CK The teacher understands proper techniques and precautions for controlling access to materials in the student laboratory including appropriate dispensing, supervision of materials, and handling of waste.

Professional Skills

- 3.1.3 PS The teacher understands, applies, and promotes the maintenance of a safe environment in accordance with the recommendations of the National Science Teachers Association.
- 3.1.4 PS The teacher maintains an orderly environment, uses safe and appropriate storage of materials and equipment, and minimizing clutter so as to reduce the potential for accidents.

Function 2: The teacher designs and models activities to implement emergency procedures. The teacher understands the maintenance of safety equipment and follows policies and procedures that comply with established state and/or national guidelines. The teacher ensures safe science activities appropriate for the abilities of all students.

Content Knowledge

- 3.2.1 CK The teacher understands appropriate emergency procedures and maintenance of safety equipment, policies and procedures that comply with established state and/or national guidelines.
- 3.2.2 CK The teacher understands how students' developmental levels affect safety in classroom, laboratory and field environments, and considers this in designing activities to maintain a safe environment.

Professional Skills

- 3.2.3 PS The teacher designs and implements activities that demonstrate emergency procedures and the proper use of safety equipment in accordance with the recommendations of the National Science Teachers Association.

3.2.4 PS The teacher enforces safe science practices in activities appropriate to the abilities of all students.

Function 3: The teacher designs and implements activities that demonstrate ethical decision-making with respect to the treatment of living organisms in and out of the classroom. The teacher emphasizes safe, humane, and ethical treatment of animals and complies with the legal restrictions on the collection, keeping, use, and treatment of living organisms.

Content Knowledge

- 3.3.1 CK The teacher understands the principles of ethical decision-making with respect to the treatment of living organisms in and out of the classroom.
- 3.3.2 CK The teacher knows the legal restrictions on the collection, keeping, use, and treatment of living organisms.
- 3.3.3 CK The teacher is aware of hazards from exposure to allergens, toxins, and pathogens in the classroom, laboratory, or field environment.

Professional Skills

- 3.3.4 PS The teacher designs and implements activities that demonstrate ethical decision-making with respect to the treatment of living organisms in and out of the classroom.
- 3.3.5 PS The teacher complies with the legal restrictions on the collection, keeping, and use of living organisms.

Standard 4: Impact on Student Learning

Science teachers provide evidence that students' understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts have increased in sophistication as a result of instruction. Candidates provide evidence representative of the entire population they teach.

Function 1: Collect, organize, analyze, and reflect on diagnostic, formative and summative evidence of student learning.

Content Knowledge

4.1.1 CK The teacher understands the various methodologies to assess and analyze student learning, and address misconceptions.

Professional Skills

4.1.2 PS The teacher utilizes knowledge of appropriate developmental levels within the classroom environment.

4.1.3 PS The teacher reflects on formative and summative assessments, and adjusts instruction appropriately.

Function 2: Provide data to show that students are able to distinguish science from nonscience, understand the evolution and practice of science as a human endeavor, and critically analyze the quality of evidence supporting scientific claims.

Content Knowledge

4.2.1 CK The teacher understands the distinction between science and nonscience, and can distinguish between the two.

4.2.2 CK The teacher understands the history, development and practice of science as a human endeavor.

4.2.3 CK The teacher critically analyzes the quality of evidence supporting scientific claims.

Professional Skills

4.2.4 PS The teacher demonstrates that students are able to understand the distinction between science and nonscience, and can distinguish between the two.

4.2.5 PS The teacher demonstrates that students are able to understand the history, development and practice of science as a human endeavor.

4.2.6 PS The teacher demonstrates that students are able to use mathematics to engage in argumentation and critically analyze the quality of evidence supporting scientific claims.

Standard 5: Professional Knowledge and Skills

Effective science teachers are aware of and engage in professional development opportunities to continually improve their knowledge and understanding of science content and pedagogy. They conduct themselves as part of the science education community.

Function 1: Teachers engage in professional development opportunities in their content field such as talks, symposiums, research opportunities, projects within their community, and/or social media.

Content Knowledge

5.1.1 CK The teacher demonstrates an awareness of professional organizations in science/education, and professional development available from these organizations.

Professional Skills

5.1.2 PS Teachers engage in professional development opportunities such as conferences, research opportunities, projects within their community, and/or social media.

Standard 6: Engineering, Technology, and the Applications of Science

The teacher demonstrates an understanding of concepts and practices of engineering, technology, and the applications of science that can be used in developing instruction for students.

Function 1: The teacher incorporates engineering design in instruction to solve problems. Engineering design includes the iterative processes of defining problems, developing solutions, and optimizing solutions.

Content Knowledge

- 6.1.1 CK The teacher can define and delimit engineering problems with precision, and specify the goals intended to be reached.
- 6.1.2 CK The teacher can develop possible solutions for a defined problem.
- 6.1.3 CK The teacher can systematically evaluate alternative solutions to engineering problems, analyzing data from tests of different solutions, and combining the best ideas into an improved solution.

Professional Skills

- 6.1.4 PS The teacher develops and implements lessons in which students use engineering design principles (define the problem, develop solutions, and optimize solutions) in applications appropriate to their content area.

Function2: The teacher makes authentic connections among engineering, technology, science, and society.

Content Knowledge

- 6.2.1 CK The teacher understands the interdependence of science, engineering, and technology.
- 6.2.2 CK The teacher understands the influences of engineering, technology, and science to the broader society and environment.

Professional Skills

- 6.2.3 PS The teacher incorporates into instruction examples of the interdependence of science, engineering, and technology. Examples include: 1) advances in scientific understanding in genetics can be translated into medical treatments, and 2) new technology such as advanced telescopes and probes provide new understandings of outer space.
- 6.2.4 PS The teacher incorporates into instruction examples of the influences of engineering, technology, and science to the broader society and environment. Examples include: 1) how measurement technologies have changed civilizations throughout history, and 2) how the use of natural resources has impacted the natural world.

Standard 7: From molecules to organisms; Structures and processes

Effective biology teachers demonstrate an understanding of how organisms live and grow.

Function 1: Life processes in living systems including organization of matter and energy.

Content Knowledge

7.1.1 CK Teacher candidate understands and is able to explain the methods and mechanisms by which energy enters and moves through living systems.

7.1.2 CK Teacher candidate demonstrates understanding of biogeochemical cycles, biomolecules, and their relation to energy in systems.

Professional Skills

7.1.3 PS Teacher candidate models movement of energy and conservation of matter in biological systems.

7.1.4 PS Teacher candidate uses models to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Function 2: Similarities and differences among animals, plants, fungi, microorganisms, and viruses.

Content Knowledge

7.2.1 CK Teacher candidate demonstrates knowledge of characteristic structures and functions used for classification of animals, plants, fungi, microorganisms, and viruses.

7.2.2 CK Teacher candidate demonstrates understanding of organ systems, organs, and cellular structures and their functions within plants, animals, fungi, microorganisms, and viruses.

7.2.3 CK Teacher candidate demonstrates understanding of growth and development in multicellular organisms.

Professional Skills

7.2.4 PS Teacher candidate can identify structures and explain their functions to learners.

7.2.5 PS Teacher candidate can develop and use a model to illustrate the hierarchical organization of interacting systems of structures that provide specific functions within cellular and multicellular organisms.

7.2.6 PS Teacher candidate can model and explain growth and development of multicellular organisms.

Standard 8: Ecosystems; Interactions, energy, and dynamics

Effective biology teachers demonstrate an understanding of how and why do organisms interact with their environment, and what are the effects of these interactions.

Function 1: Ecological systems including the interrelationships and dependencies of organisms with each other and their environments.

Content Knowledge

8.1.1 CK Teacher demonstrates understanding levels and interactions within ecological organization.

8.1.2 CK Teacher demonstrates understanding of energy flow and feeding relationships.

8.1.3 CK Teacher demonstrates understanding of the interrelationships among ecosystems.

Professional Skills

8.1.4 PS Teacher classifies biomes according to their biotic and abiotic components.

8.1.5 PS Teacher creates a trophic pyramid with organisms placed at an appropriate trophic level.

8.1.6 PS Teacher analyzes the impact of one ecosystem's biotic and abiotic components on another ecosystem.

Function 2: Population dynamics and the impact of population on its environment.

Content Knowledge

8.2.1 CK Teacher demonstrates understanding of the factors that affect population size and growth rate.

8.2.2 CK Teacher demonstrates understanding of different growth population growth rates (zero, exponential, logistic).

8.2.3 CK Teacher demonstrates understanding of population density and its impact on the environment.

Professional Skills

8.2.4 PS Teacher investigates the impact of biotic and abiotic factors on the population size of a featured species.

8.2.5 PS Teacher collects and analyzes data of a species' population growth with graphical representation and models.

8.2.6 PS Teacher evaluates the development of life history patterns of a species and the impact on reproduction and survival.

Function 3: Behavior of organisms and their relationships to social systems.

Content Knowledge

8.3.1 CK Teacher demonstrates understanding of interspecific relationships.

8.3.2 CK Teacher demonstrates understanding of human impact on ecological systems.

8.3.3 CK Teacher demonstrates understanding of the adaptive value of social behavior.

Professional Skills

8.3.4 PS Teacher categorizes relationships between various species (predation, parasitism, commensalism, mutualism).

8.3.5 PS Teacher investigates and proposes alternative human activities to decrease greenhouse gas production, ozone layer depletion, and deforestation.

8.3.6 PS Teacher analyzes advantages and disadvantages of sociality on species populations.

Standard 9: Genetics and Heredity

Effective biology teachers demonstrate an understanding of how characteristics of one generation passed to the next and how individuals of the same species and even siblings have different characteristics.

Function 1: General Concepts of inheritance and variation of traits.

Content Knowledge

9.1.1 CK Teacher demonstrates knowledge of Mendelian genetics and the chromosomal basis of inheritance.

9.1.2 CK Teacher demonstrate understanding of complex patterns of inheritance and how environment can affect expression.

Professional Skills

9.1.3 PS Teacher can ask questions, make and defend a claim, and use concepts of probability to explain the genetic variation in a population.

9.1.4 PS Teacher can demonstrate understanding of why individuals of the same species vary in how they look, function, and behave.

Function 2: Molecular genetics and heredity and mechanisms of genetic modification.

Content Knowledge

9.2.1 CK Teacher understands molecular mechanisms of genetic inheritance.

9.2.2 CK Teacher describes the environmental and genetic causes of gene mutation and the alteration of gene expression.

Professional Skills

9.2.3 PS Teacher asks questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

9.2.4 PS Teacher can make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis and sexual reproduction, (2) viable errors occurring during replications, and/or (3) mutations caused by environmental factors.

Standard 10: Biological Evolution: Unity and diversity

Effective biology teachers demonstrate an understanding of evolution and evidence shows that different species are related.

Function 1: Molecular basis for evolutionary theory and classification.

Content Knowledge

10.1.1 CK Teacher demonstrates an understanding of the idea of common ancestry and biological evolution.

10.1.2 CK Teacher demonstrates knowledge of the factors which influence evolution & evolution rates (environment, genetics, competition, etc.).

10.1.3 CK Teacher demonstrates understanding of connections between genetics & the evolutionary process.

Professional Skills

10.1.4 PS Teacher can construct an explanation based on evidence for how natural selection leads to adaptation and genetic change in populations.

10.1.5 PS Teacher can explain the effect of various factors (such as availability of resources) on population survival and competition.

10.1.6 PS Teacher can utilize evidence, statistics and probability to support explanations for advantageous traits spreading through populations.

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