

Higher Education Teacher Preparation Standards

Science Middle Level Grades 5-8



Kansas leads the world in the success of each student.

SCIENCE

Late Childhood through Early Adolescence

Grades 5-8 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 that use 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 Skill

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 Skill

- 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 Skill

- 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 Skill

- 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 Skill

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 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 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.

Function 2: 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: Middle Level Physical Science

The teacher of middle school science can demonstrate an understanding of concepts and practices of physical science in developing instruction for students, including knowledge of atomic structure, molecular structure, states of matter, chemical reactions, energy, motion and stability of objects, forces, and waves.

Function 1: Physical Concepts and Practices

Content Knowledge

- 7.1.1 CK The teacher can explain what occurs at atomic and molecular levels relating to the different states of matter and changes between the states of matter.
- 7.1.2 CK The teacher can use models to represent what occurs during chemical reactions, including concepts of conservation of mass, formation of new molecules from existing atoms, and energy transformation.
- 7.1.3 CK The teacher can describe how thermal energy affects particles and the relationship of kinetic and potential energy to the total energy of a system.
- 7.1.4 CK Teachers can explain motion and stability of objects using Newton's First, Second and Third Laws of Motion.
- 7.1.5 CK Teachers can demonstrate that some materials are attracted to each other while others are not using concepts of gravity, electrical, and magnetic forces.
- 7.1.6 CK Teachers will explain how energy can be transferred from one object or system to another using concepts of energy conservation and transfer.
- 7.1.7 CK Teachers can describe properties of waves and how they can be used, reflected, absorbed, or transmitted through various materials.

Professional Skills

- 7.1.8 PS The teacher is able to develop lessons for students that demonstrate knowledge of the practices of Physical Science by questioning, defining problems, modeling, investigating, and analyzing evidence in order to construct explanations and alternative explanations.
- 7.1.9 PS The teacher is able to identify common student misconceptions and naïve understandings of physical science.

Standard 8: Middle Level Life Science

The teacher of middle school science can demonstrate an understanding of concepts and practices of biological science in developing instruction for students, including knowledge of cell theory, structure and function of organisms, populations of organisms, biodiversity, ecosystems, genetics, and evolution.

Function 1: Life Sciences Concepts and Practices

Content Knowledge

- 8.1.1 CK The teacher can apply knowledge that all living things are made of one or more cells, that cells have specific structures and functions, that they are the basis of organismal subsystems, and that they communicate with each other.
- 8.1.2 CK The teacher can apply knowledge that animal and plant structures are related to their functions in performing life processes: cycling of matter, flow of energy, growth, response to change, reproduction, etc.
- 8.1.3 CK The teacher can apply knowledge of the interactions of matter and energy between living and non-living components in populations and ecosystems.
- 8.1.4 CK The teacher can apply knowledge of how changes in biotic and abiotic components in an ecosystem affect populations and the ability to maintain biodiversity and ecosystem services.
- 8.1.5 CK The teacher can apply knowledge of sexual and asexual reproduction and the effect of genetic mutations on the structure and function of organisms.
- 8.1.6 CK The teacher can construct scientific explanations for similarities and differences among organisms based on fossil, anatomical, and embryological evidence.
- 8.1.7 CK The teacher can construct scientific explanations for how populations change over time based on natural and/or artificial selection.

Professional Skills

- 8.1.8 PS The teacher is able to develop lessons for students that demonstrate knowledge of the practices of Life Science by questioning, defining problems, modeling, investigating, and analyzing evidence in order to construct explanations and alternative explanations.
- 8.1.9 PS The teacher is able to identify common student misconceptions and naïve understandings of life science.

Standard 9: Middle Level Earth and Space Science

The teacher of middle school science can demonstrate an understanding of concepts and practices of earth and space science in developing instruction for students, including knowledge of the universe and solar system, Earth's geologic history and processes, Earth's structure and processes, water cycle, weather and climate, natural resources, natural hazards and catastrophes, and human influences on Earth's systems.

Function 1: Earth and Space Science Content and Practices

Content Knowledge

- 9.1.1 CK The teacher can apply knowledge of the universe and solar system to explain phenomena that include but are not limited to Earth's place in the universe, motions and scale of celestial objects, forces such as gravitational pull, and seasons.
- 9.1.2 CK The teacher can interpret evidence from Earth's rock strata and fossil record to explain geologic history and processes.
- 9.1.3 CK The teacher can apply knowledge of plate tectonics, and energy and material cycles to explain and model Earth's structures and dynamic processes.
- 9.1.4 CK The teacher can apply knowledge of the water cycle and the variety of ways it affects characteristics of the atmosphere, the oceans, and the terrestrial environments.
- 9.1.5 CK The teacher can apply knowledge of how sunlight, oceans, atmosphere, ice, landforms, living things, and position on earth influence weather and climate.
- 9.1.6 CK The teacher can apply knowledge of renewable and nonrenewable natural resources that are distributed unevenly across Earth.
- 9.1.7 CK The teacher can apply knowledge of the changing influences of human populations on Earth's natural resources, environments, and systems.
- 9.1.8 CK The teacher can apply knowledge of how data can be used to forecast and mitigate natural hazards and catastrophes.

Professional Skills

- 9.1.9 PS The teacher is able to develop lessons for students that demonstrate knowledge of the practices of Earth and Space Science by questioning, defining problems, modeling, investigating, and analyzing evidence in order to construct explanations and alternative explanations.
- 9.1.10 PS The teacher is able to identify common student misconceptions and naïve understandings of earth and space science.

Standard 10: Middle Level Unifying Concepts/Interdisciplinary Perspectives

The teacher of middle school science can demonstrate an understanding and be able to infuse into science teaching the crosscutting concepts of science and the interdisciplinary perspectives among the sciences.

Function 1: Unifying Concepts and Interdisciplinary Perspectives

Content Knowledge

- 10.1.1 CK The teacher identifies patterns across the life and physical sciences that are clues to natural or man-made organization as opposed to random phenomena. For example, crystalline structures of snowflakes and NaCl suggest that the shape of a molecule determines a pattern of organization in a snowflake or halite.
- 10.1.2 CK The teacher provides examples of cause and effect across the life and physical sciences, and can explain the concept of correlation versus cause. For example, the Black Plague had biological causes but was correlated with certain social conditions (that did not cause the disease).
- 10.1.3 CK The teacher provides examples of scale, proportion and quantity across the life and physical sciences using models to study systems that are too large or too small. For example, a paper model of the solar system can be described using simple distance measurements as well as ratios and proportions.
- 10.1.4 CK The teacher provides examples of system models across the life and physical sciences. Examples include (1) mathematical evidence that supports the claim that gravitational attraction depends on the masses of interacting objects, and (2) an ecosystem model in which a great many other systems are nested (populations, nutrient cycles, etc.).
- 10.1.5 CK The teacher provides examples of ways that different forms of energy drive the motion and/or cycling of matter across the life and physical sciences. For example, the cycling of water through Earth's systems is driven by energy from the sun and the force of gravity.
- 10.1.6 CK The teacher provides examples of and/or model the relationship of structure and function across the life and physical sciences. For example, illustrate the way that surface area for chemical reactions is gained in the chloroplast, fish gills, and clay particles.
- 10.1.7 CK The teacher provides examples of stability and change across the life and physical sciences. For example, the process of succession in an ecosystem involves changes in both the living community and the physical environment (soil, landscape, microclimate) until a state of equilibrium is reached (theoretically). Many disturbances can disrupt ecosystem stability. Homeostasis in living organisms is another example.

Professional Skills

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

10.1.9 PS The teacher is able to identify common student misconceptions and naïve understandings regarding unifying concepts.

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