# Science – A Common Core of Standards
# [27.140]

All science teachers will be required to demonstrate competence in the common core science standards. In addition, each science teacher shall be required to demonstrate competence in at least one of the science designation areas for which standards are described in Sections 27.150 through 27.190 of this Part: biology, chemistry, earth and space science, environmental science, and/or physics.

| | **Course Title and Number and/or Experiences** | **Assessment Activities** |
|---|---|---|
| ***STANDARD 1 - Science as Inquiry***<br>The competent science teacher understands scientific inquiry and has the ability to conduct scientific inquiry. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>1A. understands assumptions, processes, purposes, requirements, and tools of scientific inquiry. | | |
| 1B. understands mathematical processes and tools for collecting, managing, and communicating information. | | |
| 1C. understands different approaches to conducting scientific investigations. | | |
| ***Performance Indicators - The competent science teacher:***<br>1D. plans and conducts scientific investigations using appropriate tools and technology. | | |
| 1E. applies mathematical and statistical methods to collect, analyze, and communicate results of investigations. | | |
| 1F. displays, illustrates, and defends the results of an investigation. | | |
| 1G. uses evidence and logic in developing proposed explanations that address scientific questions and hypotheses. | | |
| ***STANDARD 2 - Technological Design***<br>The competent science teacher understands the concepts, principles and processes of technological design. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
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| ***Knowledge Indicators - The competent science teacher:***<br>2A. understands the processes, capabilities, limitations and implications of technology and technological design and redesign. | | |
| 2B. understands technology and technological design as the use of tools throughout human history. | | |
| ***Performance Indicators - The competent science teacher:***<br>2C. identifies real-world problems or needs to be solved through technological design. | | |
| 2D. addresses a problem situation by identifying a design problem, proposing a design solution, implementing the solution, evaluating the solution, revising the design upon evaluation, and communicating the design and the process. | | |
| 2E. identifies the inquiry process in the investigation of past, current, and potential technological designs. | | |
| ***STANDARD 3 - Molecular and Cellular Sciences***<br>The competent science teacher understands and can apply concepts that explain the cell, molecular basis of heredity, and biological evolution. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>3A. understands viral, subcellular and cellular structure and function. | | |
| 3B. understands the nature and function of the gene, with emphasis on the molecular basis of inheritance and gene expression. | | |
| 3C. understands the processes of change at the microscopic and macroscopic levels. | | |
| ***Performance Indicators - The competent science teacher:***<br>3D. describes the processes of the cell cycle and analyzes the transmission of genetic information. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| 3E. demonstrates an understanding of organelles, cells, tissues, organs, and organ systems and their function. | | |
| 3F. identifies scientific evidence from various sources to demonstrate knowledge of theories about processes of biological evolution. | | |
| 3G. demonstrates the ability to use instruments or to explain functions of the technologies used to study the life sciences at the molecular and cellular level. | | |
| ***STANDARD 4 - Organisms and Ecosystems***<br>The competent science teacher understands and can apply concepts that describe how living things interact with each other and with their environment. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>4A. understands how living and nonliving factors interact with one another and with their environment. | | |
| 4B. understands the strategies and adaptations used by organisms to obtain the basic requirements of life. | | |
| 4C. understands that all environments are comprised of interrelated dynamic systems. | | |
| 4D. understands the concepts of populations, communities, ecosystems, ecoregions, and the role of biodiversity in living systems. | | |
| 4E. understands that humans are living organisms who uniquely interact with the environment. | | |
| ***Performance Indicators - The competent science teacher:***<br>4F. develops a model or explanation that shows the relationships within the environment. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| 4G. demonstrates an understanding of how communities, ecosystems, and ecoregions change. | | |
| 4H. demonstrates an understanding of the human as a living organism comparable to other life forms and functions. | | |
| 4I. describes physical, ecological, and behavioral factors that influence homeostasis within an organism and interrelationships among organisms. | | |
| 4J. demonstrates the ability to use instruments or to explain functions of the technologies used to study the life sciences at the organism and ecosystem level. | | |
| ***STANDARD 5 - Matter and Energy***<br>The competent science teacher understands the nature and properties of energy in its various forms, and the processes by which energy is exchanged and/or transformed. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>5A. understands the atomic and nuclear structure of matter and the relationship to chemical and physical properties. | | |
| 5B. understands the principle of conservation as it applies to mass, charge, momentum, and energy. | | |
| 5C. understands the cause and effect of chemical reactions in natural and manufactured systems. | | |
| 5D. understands the characteristics and relationships among thermal, acoustical, radiant, electrical, chemical, mechanical, and nuclear energies. | | |
| ***Performance Indicators - The competent science teacher:***<br>5E. analyzes the properties of materials in relation to their chemical or physical structures and evaluate uses of the materials based on their properties. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| 5F. explains conservation of mass and energy and explains interactions of energy with matter, including changes in state. | | |
| 5G. uses kinetic theory and the laws of thermodynamics to explain energy transformations. | | |
| 5H. analyzes atomic and nuclear reactions in natural and man-made energy systems. | | |
| 5I. demonstrates the ability to use instruments or to explain functions of the technologies used to study matter and energy. | | |
| ***STANDARD 6 - Force and Motion***<br>The competent science teacher understands and applies the concepts that describe force and motion and the principles that explain them. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>6A. understands the concepts and interrelationships of position, time, velocity, and acceleration. | | |
| 6B. understands the concepts and interrelationships of force (including gravity and friction), inertia, work, power, energy, and momentum. | | |
| 6C. understands the nature and properties of electricity and magnetism. | | |
| 6D. understands the nature and properties of mechanical and electromagnetic waves. | | |
| ***Performance Indicators - The competent science teacher:***<br>6E. describes and predicts motions of bodies in inertial and accelerated frames of reference and in one and two dimensions in a physical system with association to the basic theories of force and motion. | | |
| 6F. analyzes and predicts motions and interactions involving forces within the context of conservation of energy and/or momentum. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| 6G. describes the effects of gravitational, electromagnetic, and nuclear forces in real life situations. | | |
| 6H. analyzes and predicts the behavior of mechanical and electromagnetic waves under varying physical conditions. | | |
| 6I. demonstrates abilities to use instruments or to explain functions of the technologies used to study force and motion. | | |
| ***STANDARD 7 - The Earth***<br>The competent science teacher understands the dynamic nature of the Earth and recognizes that its features and structures result from natural processes. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>7A. understands the structure and composition of the Earth's land, water and atmospheric systems. | | |
| 7B. understands the transfer of energy within and among Earth's land, water and atmospheric systems. | | |
| 7C. understands the scope of geologic time and the continuing physical changes of the Earth through time. | | |
| 7D. understands the interrelationships between living organisms and Earth's resources. | | |
| ***Performance Indicators - The competent science teacher:***<br>7E. analyzes and explains large-scale dynamic forces, events, and processes that affect the Earth's land, water and atmospheric systems. | | |
| 7F. identifies and explains Earth's processes and cycles and cites examples in real-life situations. | | |
| 7G. evaluates scientific theories about Earth's origin and history and how those theories explain contemporary living systems. | | |
| 7H. identifies and evaluates the uses of Earth's resources. | | |

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| 7I. demonstrates abilities to use instruments and/or to explain functions of the technologies used to study the earth sciences. | | |
| ***STANDARD 8 - The Universe***<br>The competent science teacher understands and applies concepts that explain the composition, structure of, and changes in the universe and Earth's place in it. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>8A. understands the properties and dynamic nature of the solar system. | | |
| 8B. understands the properties and dynamics of objects external to the solar system. | | |
| 8C. understands the scientific theories dealing with the origin of the universe. | | |
| ***Performance Indicators - The competent science teacher:***<br>8D. observes, describes, and explains the relative and apparent motions of objects in the sky. | | |
| 8E. compares and analyzes evidence relating to the origin and physical evolution of the universe. | | |
| 8F. compares the processes involved in the life cycle of objects within the galaxies, including their physical and chemical characteristics. | | |
| 8G. demonstrates the ability to use instruments or to explain functions of the technologies and tools used in the study of the space sciences. | | |
| ***STANDARD 9 - Practices of Science***<br>The competent science teacher understands and applies accepted practices and implications of science in contemporary and historical contexts. | | |

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|---|---|---|
| ***Knowledge Indicators - The competent science teacher:*** | | |
| 9A. understands that the nature of science is a human endeavor characterized as tentative, public, replicable, probabilistic, historic, unique, holistic and empirical. | | |
| 9B. understands the definitions of hypotheses, predictions, laws, theories, and principles and the historic and contemporary development and testing of them. | | |
| 9C. understands research and reports examples of hypotheses, predictions, laws, theories, and principles, and valid and biased thinking. | | |
| 9D. understands the basis for safety practices and regulations in the study of science. | | |
| ***Performance Indicators - The competent science teacher:*** | | |
| 9E. researches and reports examples of creative and critical thinking skills in scientific research and technological innovation. | | |
| 9F. researches and reports examples of predictions, hypotheses, and theories in both valid and biased scientific thinking. | | |
| 9G. researches and reports examples of the development of science through time and the impact of societal values on the nature of science. | | |
| 9H. documents and practices safety rules and shows evidence of their necessity in the investigation of science. | | |
| 9I. demonstrates the ability to use instruments and is able to explain functions of appropriate safety equipment used to assure and implement safe practices. | | |

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|---|---|---|
| ***STANDARD 10 - Science, Technology and Society***<br>The competent science teacher understands the interaction among science, technology and society, including historical and contemporary development of major scientific ideas and technological innovations. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>10A. understands the ways that science and technology affect people's everyday lives, societal values, and systems; the environment; new knowledge; and technologies throughout history. | | |
| 10B. understands the processes and effects of scientific and technological breakthroughs and their effect on other fields of study, careers and job markets. | | |
| ***Performance Indicators - The competent science teacher:***<br>10C. evaluates the efficacy of criteria for determining the effects of policies on local, State, national, and global environmental and technological issues. | | |
| 10D. investigates and evaluates the credibility of scientific claims made in the media, during public debates, or in advertising or marketing campaigns. | | |
| 10E. investigates issues by defining and clearly articulating the scientific, technological, and societal connections to be investigated, as well as evaluating the consequences, implications, and potential options for resolution. | | |

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|---|---|---|
| ***STANDARD 11 - Unifying Concepts***<br>The competent science teacher understands the major unifying concepts of all sciences (systems, order, and organization; evidence, models, and explanation; constancy, change, and measurement; evolution and equilibrium; form and function), and how these concepts relate to other disciplines, particularly mathematics and the social sciences. | | |
| ***Knowledge Indicators - The competent science teacher:*** | | |
| 11A. understands connections within and among the traditional scientific disciplines. | | |
| 11B. understands fundamental comparability of the processes shared within and among the traditional scientific disciplines. | | |
| 11C. understands fundamental mathematical language, knowledge and skills. | | |
| 11D. understands fundamental relationships among the sciences and the social sciences. | | |
| ***Performance Indicators - The competent science teacher:*** | | |
| 11E. identifies and describes the application of the unifying concepts in real-life situations. | | |
| 11F. utilizes the unifying concepts from science, as well as concepts from mathematics, the social sciences, and other disciplines in his or her teaching. | | |
| 11G. expresses phenomenological relationships in the language of mathematics, solving simple algebraic equations, using scientific notation, constructing and interpreting graphs and using probabilities. | | |
| ***STANDARD 12 – Curriculum in Science***<br>The competent science teacher understands how to develop learning outcomes for science instruction that incorporate State and national frameworks for teaching science and how to select appropriate curriculum materials to meet the standards-based outcomes. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| ***Knowledge Indicators - The competent science teacher:***<br>12A. understands the local, State and national goals and standards for science education. | | |
| 12B. understands the relationship of science concepts to the developmental level of students in classrooms. | | |
| 12C. understands how to articulate science instruction across units and from year to year. | | |
| ***Performance Indicators - The competent science teacher:***<br>12D. identifies how an instructional design relates to local, State, and national goals and standards for science. | | |
| 12E. identifies appropriate curricular materials from a variety of sources and selects those that meet the developmentally appropriate, standards-led instructional outcomes. | | |
| 12F. demonstrates the ability to articulate learning across and among units of instruction, courses in science, and other disciplines. | | |
| ***STANDARD 13 - Planning for Instruction in Science***<br>The competent science teacher understands how to plan learning experiences that utilize an appropriate variety of instructional methods and strategies that allow students to develop significant concepts in science and the ability to engage in scientific reasoning. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>13A. understands how to use materials from the students' environment to help them use inquiry strategies to build concepts. | | |

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|---|---|---|
| 13B. understands the appropriate use of various strategies of direct instruction, concept development, inquiry and problem solving that lead to knowledge and skills for scientific reasoning. | | |
| 13C. understands how concepts are developed in students' minds and how to address misconceptions that students have developed from prior experiences. | | |
| ***Performance Indicators - The competent science teacher:*** 13D. plans instruction that allows students to develop understanding of significant concepts and skills in science through hands-on experiences with real materials. | | |
| 13E. plans instruction that incorporates a variety of methods and strategies for learning, including demonstrations, the laboratory, and out-of-class resources. | | |
| 13F. plans instruction utilizing instructional technology, instructional materials, and scientific equipment. | | |
| 13G. plans instructional activities that create opportunities for students to test, modify, and sometimes abandon previous ideas about science. | | |
| ***STANDARD 14 - Environment for Learning*** The competent science teacher can design and manage safe and supportive learning environments in which all students can engage in scientific inquiry and concept development. | | |
| ***Knowledge Indicators - The competent science teacher:*** 14A. understands liability and negligence, especially as applied to science teaching. | | |
| 14B. understands procedures for safe and ethical use and care of animals for science instruction. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| ***Performance Indicators - The competent science teacher:***<br>14C. designs and assesses learning environments to utilize safe practices to prevent potential problems of liability and negligence regarding the inventory, storage, and disposal of chemicals, resources, and equipment. | | |
| 14D. develops a set of criteria to measure and assesses the optimum learning environment that promotes scientific inquiry and learning. | | |
| 14E. develops procedures to adapt learning environments to meet students' special needs. | | |
| ***STANDARD 15 - Teaching Science***<br>The competent science teacher understands how to guide and facilitate learning using a variety of methods and strategies that encourage students' development of scientific inquiry skills and concepts. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>15A. understands the appropriate use of strategies for questioning, facilitating, and coaching to help students develop significant concepts, problem-solving skills, and scientific habits of mind. | | |
| 15B. understands the teacher's role in different teaching strategies, including concept development, inquiry, and direct instruction. | | |
| ***Performance Indicators - The competent science teacher:***<br>15C. implements activities requiring students to collect data, reflect upon their findings, make inferences, and links new ideas to preexisting knowledge. | | |
| 15D. conducts instruction that has appropriate structure with flexibility to allow students to engage in productive inquiry as individuals and groups. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| 15E. conducts instruction that encourages curiosity, openness to new ideas and data, and skepticism that characterize science. | | |
| ***STANDARD 16 - Assessment***<br>The competent science teacher understands standards-based science assessment designs, purposes, and analysis strategies, including technological collection capabilities and performance assessments. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>16A. understands the alignment of student learning standards, instructional strategies, and local curriculum in the development of assessment tools and strategies. | | |
| 16B. understands the value of assessment data in guiding and changing instruction in science classrooms. | | |
| 16C. understands the importance of communicating criteria for success to students. | | |
| 16D. understands the importance and impact of state and local assessment policies. | | |
| ***Performance Indicators - The competent science teacher:***<br>16E. plans and conducts assessment to evaluate scientific inquiry assessment tasks in multiple disciplines. | | |
| 16F. plans and conducts assessment to evaluate technological design assessment tasks in multiple disciplines. | | |
| 16G. plans and conducts assessment to evaluate scientific case study/issue investigation assessment tasks in multiple disciplines. | | |
| 16H. plans and conducts assessment to evaluate student understanding using a variety of tools and strategies. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| 16I. designs assessment tasks with clearly articulated criteria for student impact and program evaluation. | | |
| 16J. evaluates assessment data to propose responses to program evaluation and potential improvement. | | |
| ***STANDARD 17 - Connections in Teaching Science***<br>The competent science teacher can relate science to the daily lives and interests of students as well as to the larger framework of human endeavor and to learning in other disciplines. | | |
| ***Knowledge Indicators - The competent science teacher:***<br>17A. understands how students can identify and utilize science concepts in their daily lives. | | |
| 17B. understands the relationship of learning in science to learning in other disciplines. | | |
| ***Performance Indicators - The competent science teacher:***<br>17C. engages students in the examination of science applications in their personal lives and interests and in the examination of local issues. | | |
| 17D. assists students in relating knowledge of other disciplines, particularly mathematics and social sciences, to concepts of science in applications to their personal lives. | | |
| 17E. orients students to potential careers related to applications of scientific and technological knowledge. | | |
| ***STANDARD 18 - Learning Science and the Community***<br>The competent science teacher can make effective use of human and institutional resources beyond the classroom. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|
| ***Knowledge Indicators - The competent science teacher:***<br>18A. understands applications of science concepts and inquiry to the context of a community. | | |
| 18B. understands how parents and other community members and institutions support science learning in the classroom. | | |
| 18C. understands how to use the resources of the student's community to support inquiry. | | |
| ***Performance Indicators - The competent science teacher:***<br>18D. uses data about a community in conducting learning activities in science. | | |
| 18E. conducts activities that involve parents and other members of the community in the science program. | | |
| 18F. utilizes individuals and agencies that provide science education in the community in the science program. | | |
| 18G. develops and tests a community resource inventory, including its non-formal learning opportunities, business/industry connections, and parent/community resources. | | |
| 18H. uses synchronous and asynchronous telecommunication capabilities to collaborate with community members and other experts as an integral component to projects. | | |
| ***STANDARD 19 – Content Reading***<br>The competent science teacher understands the process of reading and demonstrates instructional abilities to teach reading in the content area of science. | | |

| | Course Title and Number and/or Experiences | Assessment Activities |
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| ***Knowledge Indicators - The competent science teacher:*** | | |
| 19A. understands that the reading process is the construction of meaning through the interactions of the reader's background knowledge and experiences, the information in the text, and the purpose of the reading situation. | | |
| 19B. recognizes the relationships among the four language arts (reading, writing, listening, and speaking), and knows how to provide opportunities to integrate these through instruction. | | |
| 19C. understands how to design, select, modify, and evaluate materials in terms of the reading needs of the learner. | | |
| 19D. understands the importance of and encourages the use of literature for adolescents in the curriculum and for independent reading. | | |
| 19E. understands the relationship between oral and silent reading. | | |
| 19F. understands the role of subject-area vocabulary in developing reading comprehension. | | |
| 19G. understands the importance of the unique study strategies required of the specific content area in developing reading comprehension. | | |
| 19H. understands the importance of the relationship between assessment and instruction in planning. | | |
| ***Performance indicators: The competent science teacher:*** | | |
| 19I. plans and teaches lessons for students that develop comprehension of content-area materials through instructional practices that include analyzing critically, evaluating sources, and synthesizing and summarizing material. | | |

| | | Course Title and Number and/or Experiences | Assessment Activities |
|---|---|---|---|
| 19J. | plans and teaches lessons on how to monitor comprehension and correct confusions and misunderstandings that arise during reading. | | |
| 19K. | plans and models use of comprehension strategies before, during, and after reading of text. | | |
| 19L. | provides opportunities for students to develop content-area vocabulary through instructional practices that develop connections and relationships among words, use of context clues, and understanding of connotative and denotative meaning of words. | | |
| 19M. | plans and teaches lessons that encourage students to write about the content read in order to improve understanding. | | |
| 19N. | plans and teaches lessons to help students develop study strategies that include previewing and preparing to read text effectively, recognizing organizational patterns unique to informational text, and using graphic organizers as an aid for recalling information. | | |
| 19O. | plans and teaches units that require students to carry out research or inquiry using multiple texts, including electronic resources. | | |
| 19P. | provides continuous monitoring of students' progress through observations, work samples, and various informal reading assessments. | | |
| 19Q. | analyzes and evaluates the quality and appropriateness of instructional materials in terms of readability, content, length, format, illustrations, and other pertinent factors. | | |
| 19R. | promotes the development of an environment that includes classroom libraries that foster reading. | | |