The beginning (preservice) **Chemistry 9-12** teacher will demonstrate knowledge of and/or competency in the following areas of study:

1: Unifying Concepts and Processes The beginning teacher of science is familiar with, and teaches, the major concepts and principles that unify all scientific effort and that are used in each of the science disciplines. **(1997 SSC: 1.2; CR GenEd, III.Sc-Chem; NSTA [2001]: Standard 1; NSTA [1998], Standard 1; NSES: UCP-1-5)**	1.1 systems, order, and organization; 1.2 evidence, models, and explanation; 1.3 change, constancy, and measurement; 1.4 evolution and equilibrium; and 1.5 form and function
2: Science As Inquiry The beginning teacher of science understands and practices the science inquiry process. **(1997 SSC: 1.1, 1.4; CR GenEd, III.Sc-Chem; NSTA [2001]: Standard 3, 9; NSTA [1998], Standard 3, 9; NSES: H-A1, A2; S 1, 2, 7-8[1]; ETS 0245: VI, VII)**	2.1 identify questions and concepts that guide scientific investigations. 2.2 design and conduct scientific investigations, including understanding of the major concepts in the area being investigated, of proper equipment, of safety precautions; resolving methodological problems; using technologies; clarifying ideas that guide the inquiry; and obtaining scientific knowledge from sources other than the actual investigation; clarifying the question, method, controls, and variables; organizing and displaying data; revising methods and explanations; and public presentation of the results with a critical response from peers; using evidence; applying logic; and constructing an argument for the proposed explanations. 2.3 use appropriate tools (e.g., hand tools, measuring instruments, calculators, and computers for the collection, summary, and display of evidence), techniques, and mathematics to gather, analyze, and interpret data, including selecting the scientific apparatus or instrument appropriate to a specified laboratory or field task and identifying proper operation of such equipment; using the metric system of measurement, recognizing equivalents within that system and selecting units appropriate to a given laboratory or field task; converting between scientific notation and conventional numerals and using scientific notation to perform calculations. 2.4 formulate and revise scientific explanations and models using logic and evidence, including discussing, formulating, and revising an explanation or physical, conceptual, and/or mathematical models based on scientific knowledge, use of logic, and evidence from the investigation. 2.5 think critically and logically to make the relationships between evidence and explanations, including deciding what evidence should be used and accounting for anomalous data; reviewing data from an experiment, summarizing the data, and forming a logical argument about the cause-and-effect relationships in the experiment; and stating some explanations in terms of the relationship between two or more variables.

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	2.6 recognize, construct, and analyze alternative explanations and models, including the abilities of analyzing an argument by reviewing current scientific understanding, weighing the evidence, examining the logic so as to decide which explanations and models are best, and using scientific criteria to find the preferred explanations. 2.7 communicate and defend a scientific argument, including writing and following procedures, expressing concepts, reviewing information, summarizing data, using language appropriately, developing diagrams and charts, explaining statistical analysis, speaking clearly and logically, constructing a reasoned argument, and responding appropriately to critical comments. 2.8 use mathematics in all aspects of scientific inquiry to ask questions; to gather, organize, and present data; and to structure convincing explanations. 2.9 handle, label, store, and dispose of chemicals, electrical equipment, and scientific apparatuses and take actions to prevent or report an emergencies, including, but not limited to, general first aid as it relates to incidents in the science classroom or laboratory. (NSTA 9.b) 2.10 understand liability and negligence, especially as applied to science teaching and can take action to prevent potential problems. (NSTA 9.c)
3: Physical Science: The beginning teacher of science understands the central concepts, tools of inquiry, and structures of the physical sciences and makes these aspects of subject matter meaningful for students. **(1997 SSC: 2.1-2.8; CR GenEd, III.Sc-Chem; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: H-B1, B2, B3, B5, B6; S 1, 2, 7-8; ETS 0245: I, II, IV)**	3.1 Structure of Atoms (NSES: H-B1) 3.2 Structure and Properties of Matter (1997 SSC: 2.1-.8; NSES: H-B2) 3.3 Interactions of Energy and Matter (1997 SSC: 2.1-.8; NSES: H-B6) 3.4 General Chemistry and Chemical Reactions in Physical and Life Science (1997 SSC: 2.2-.5; NSES: H-B3) 3.5 Conservation of Energy and Increase in Disorder (1997 SSC: 2.7; NSES: H-B5)
4: Life Science: The beginning teacher of science understands the central concepts, tools of inquiry, and structures of the life sciences and makes these aspects of subject matter meaningful for students. **(1997 SSC 4.1-.7, 5.1-.6; CR GenEd, III.Sc-Chem; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: H-C1, C2, C5, C6; S 3, 4, 7-8; ETS 0245: I, IV)**	4.1 Structure and Function in Living Systems (1997 SSC: 4.3-.7; NSES: high-school extension of M-C1) 4.2 The Cell (1997 SSC: 4.4; NSES: H-C1) 4.3 Molecular Basis of Heredity (1997 SSC 4.2; NSES: H-C2) 4.4 Behavior of Organisms (1997 SSC: 5.1-.6; NSES: H-C6) 4.5 Matter, Energy, and Organization in Living Systems (1997 SSC: 5.3; NSES: H-C5)
5: Earth and Space Science (combines existing SSC strands of "Earth Processes and Interactions" & "Earth-	5.1 Properties of Earth Materials (1997 SSC: 6.1-.3, 6.5-.6; extension of elementary & middle school competencies)

Moon Systems": The beginning teacher of science understands the central concepts, tools of inquiry, and structures of the earth and space sciences and makes these aspects of subject matter meaningful for students. **(1997 SSC 6.1-.7, 7.1-.5; CR GenEd, III.Sc-Chem; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: H-D1, D2, D3, D4; S 5-8; S 5-8; ETS 0245: I, IV, V)**	5.2 Energy in the Earth System (1997 SSC: 6.1-.7; NSES: H-D1) 5.3 Geochemical Cycles (1997 SSC: 6.5; NSES: H-D2) 5.4 Origin and Evolution of the Earth System (1997 SSC: 6.2; NSES: H-D3) 5.5 Origin and Evolution of the Universe (1997 SSC: 7.3-.5; NSES: H-D4)
6: Science and Technology: The beginning teacher of science understands the relationship between science and technology, can distinguish between natural objects and objects made by humans, and makes these aspects of subject matter meaningful for students by creating experiences in making models of useful things and by developing students' abilities to identify and communicate a problem and to design, implement, and evaluate a solution. **(1997 SSC: 1.3, 1.4; NSTA [2001], Standards 4, 5.d; NSTA [1998] Standards 2, 4, 5; NSES: H-E1, E2, E3; S 8; ETS 0245: VI)**	6.1 compare/contrast scientific inquiry and technological design (NSES: H-E2) 6.2 explain the reciprocal relationship between science and technology (NSES: H-E2) 6.3 explain why technological knowledge is often not made public (e.g., patents and the financial potential of the idea or invention) while scientific knowledge is made public through presentations at professional meetings and publications in scientific journals (NSES: H-E2) 6.4 explain the intended and unintended consequences of technological designs (NSES: H-E2) 6.5 identify appropriate problems for technological design (NSES: H-E2) 6.6 use computer and related technologies to extend investigative activities (NSES: H-E2) 6.7 identify and organize materials and other resources, choose suitable tools and techniques, and work with appropriate measurement methods to ensure adequate accuracy in the implementation of a proposed design. (NSES: H-E1) 6.8 analyze and interpret data obtained from an experiment or investigation, including graphical data, and identify and demonstrate an understanding of sources of error in data that is presented (NSES: H-E1) 6.9 demonstrate understanding of scientific measurement and notation systems, including systems for describing very large and very small units (NSES: H-E1) 6.10 collaborate as a team-member in the identification, communication, and resolution of scientific and technological problems. (NSES: H-E2) 6.11 describe how scientific investigations require the contributions of individuals from different disciplines, including engineering, and how problems contribute to the formation of new disciplines of science (e.g., geophysics, biochemistry) (NSES: H-E1) 6.12 use words, drawings, and models to communicate the process and products of technological design and scientific investigation (NSES: H-E1) 6.13 use criteria relevant to the original purpose or need to evaluate completed technological designs or products

	(NSES: H-E1)
7: Science in Personal and Social Perspectives: The beginning teacher of science understands the context of science (i.e., relationships among systems of human endeavor including science and technology; relationships among scientific, technological, personal, social and cultural values; and the relevance and importance of science to the personal lives of students) and the social context of science teaching (i.e., the social and community support network within which science teaching and learning occur; relationship of science teaching and learning to the needs and values of the community; and involvement of people and institutions from the community in the teaching of science) and uses this knowledge to enrich the science learning of all students. **(1997 SSC: 1.3, 4.3, 4.6, 5.1, 5.4-.6, 6.1; NSTA [2001]: Standards 4, 7; NSTA [1998], Standards 4, 7; NSES: H-F1, F2, F3, F4, F5, F6; S 1, 3-5; ETS 0245: VI)**	7.1 Personal and Community Health (1997 SSC: 4.3, 4.6; NSES: H-F1) 7.2 Population Growth (1997 SSC: 5.1, 5.4-.6; NSES: H-F2) 7.3 Natural Resources (1997 SSC: 6.1; NSES: H-F3) 7.4 Environmental Quality (1997 SSC: 5.1, 5.6; NSES: H-F4) 7.5 Natural and Human-induced Hazards (1997 SSC: 1.3; NSES: H-F5) 7.6 Risks and Benefits (1997 SSC: 1.3; high-school extension of NSES: M-F4) 7.7 Science and Technology in Local, National, and Global Challenges (1997 SSC: 1.3; NSES: H-F6)
8: History and Nature of Science (incorporates the existing strand "The Nature of Science"): The beginning teacher of science understands the history and nature of science as a human endeavor and uses this knowledge to make subject matter meaningful for students. **(1997 SSC: 1.2, 1.5, 1.6; NSTA [2001]: Standard 2.a & 2.b, 4; Standard 7; NSTA [1998], Standard 2.d, 4.b; NSES: H-G1, G2, G3; S 1-8; ETS 0245: VI)**	8.1 Science as a Human Endeavor (1997 SSC: 1.2, 1.5, 1.6; NSES: H-G1) 8.2 Nature of Scientific Knowledge (1997 SSC: 1.2, 1.5, 1.6; NSES: H-G2) 8.3 Historical Perspectives (1997 SSC: 1.2, 1.5, 1.6; NSES: H-G3)