

**MoSTEP 1.2.1.1: Unified Science 9-12 with Chemistry Competencies**

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

<p><b>1. Unifying Concepts</b> (1997 SSC: 1.2, 1.4; NSTA [2003]: C.1; NSES: UCP-1-5)</p>	<ol style="list-style-type: none"> <li>1. Multiple ways our perceptions of the world are organized and how we use systems to organize the studies and knowledge of science.</li> <li>2. Nature of scientific evidence and the use of models for explanation.</li> <li>3. Measurement as a way of knowing and organizing observations of constancy and change.</li> <li>4. Evolution of natural systems and factors that result in evolution or equilibrium.</li> <li>5. Interrelationships of form, function, and behaviors in living and nonliving systems.</li> </ol>
<p><b>2. Nature of Science</b> (1997 SSC: 1.3, 1.5; NSTA [2003]: 2.a, 2.b, 4; CR V.2.a; NSES: E-G1, G2, G3; NSES: H-G1, G2, G3; S 1-8; S 1-8; Praxis 0245: VI)</p>	<ol style="list-style-type: none"> <li>1. The historical and cultural development of science and the evolution of knowledge across the four disciplines..</li> <li>2. The philosophical tenets, assumptions, goals, and values that distinguish science from technology and from other ways of knowing the world.</li> <li>3. Strategies for engaging high-school students successfully in studies of the nature of science including, when possible, the critical analysis of false or doubtful assertions made in the name of science.</li> </ol>
<p><b>3. Inquiry</b> (1997 SSC: 1.1, 1.4; CR: see note RE: Methods course; 1.1; NSTA [2003] 3; NSES: H-A1, A2; S 1, 2, 7-8; Praxis 0245: VI); NSES (NRC, 2000)</p>	<ol style="list-style-type: none"> <li>1. The processes, tenets, and assumptions of multiple methods of inquiry leading to scientific knowledge.</li> <li>2. Strategies for engaging high school students in developmentally appropriate inquiries that require them to develop concepts and relationships from their observations, data, and inferences in a scientific manner.</li> <li>3. Engage scientifically oriented questions, give priority to evidence, formulate explanations from evidence, connect explanations to scientific knowledge, and communicate and justify explanations to others.</li> </ol>
<p><b>4. Issues</b> (1997 SSC: 1.3, 1.6; NSTA [2003] 4; NSES: M-F1, F2, F3, F4, F5, F6; S 1, 3-5; NSES: H-F1, F2, F3, F4, F5, F6; S 1, 3-5; NSES: H-E1, E2, E3; Praxis 0245: VI)</p>	<ol style="list-style-type: none"> <li>1. Understanding of socially important global and local issues related to science and technology across the four disciplines, as well as processes used to analyze and make decisions on such issues.</li> <li>2. Strategies for engaging students successfully in the analysis of problems, including considerations of risks, costs, and benefits of possible solutions; and relating these issues to the knowledge, goals and values of the students.</li> <li>3. Career opportunities in the life and physical sciences.</li> </ol>
<p><b>5. Safety and Welfare</b> (1997 SSC: 1.7; CR: see DESE CR note RE: Methods course; NSTA [2003] 9.b, 9.c, 9.a; Praxis 0245: VII)</p>	<ol style="list-style-type: none"> <li>1. Handle, label, store, &amp; dispose of chemicals, electrical equipment, &amp; scientific apparatuses &amp; take actions to prevent or report emergencies, including, but not limited to, general first aid as it relates to incidents in the science classroom or laboratory.</li> <li>2. Understand liability, ethics, and negligence, especially as applied to science teaching and take action to prevent potential problems, including proper treatment of organisms.</li> </ol>

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<p><b>6. Chemistry Core Competencies</b> (1997 SSC: 2.1-.8; NSTA C.3.a; CR: 2.c; NSES: H-B1, B2, B3, B5, B6; S 1, 2, 7-8; Praxis 0245: II, III, IV, V)</p>	<ol style="list-style-type: none"> <li>1. Fundamental structures of atoms and molecules.</li> <li>2. Basic principles of ionic, covalent, and metallic bonding.</li> <li>3. Physical and chemical properties and classification of elements including periodicity.</li> <li>4. Chemical kinetics and thermodynamics.</li> <li>5. Principles of electrochemistry.</li> <li>6. Mole concept, stoichiometry, and laws of composition.</li> <li>7. Transition elements and coordination compounds.</li> <li>8. Acids and bases; oxidation-reduction chemistry; solutions; chemical equilibrium; acid base titration/pH; instrumentation.</li> <li>9. Fundamental biochemistry.</li> <li>10. Functional and polyfunctional group chemistry.</li> <li>11. Environmental and atmospheric chemistry.</li> <li>12. Fundamental processes of investigating in chemistry, including laboratory skills.</li> <li>13. Applications of chemistry in personal and community health and environmental quality in Missouri, the U.S., and the world.</li> </ol>
<p><b>7. Biology Core Competencies</b> (1997 SSC 4.1-.7, 5.1-.6; CR: V.2.b, .e, .f; NSTA [2003] C.2.a; NSES: H-C1, C2, C3, C4, C5, C6; S 3, 4, 7-8; S 3, 4, 7-8; ETS 0245: not addressed by 0245)</p>	<ol style="list-style-type: none"> <li>1. Life processes in living systems including organization of matter and energy.</li> <li>2. Similarities and differences among animals, plants, fungi, microorganisms, and viruses.</li> <li>3. Principles and practices of biological classification.</li> <li>4. Scientific theory and principles of biological evolution.</li> <li>5. Ecological systems, biomes, and ecosystem dynamics, including the interrelationships and dependencies of organisms with each other and their environments.</li> <li>6. Population dynamics and the impact of a population on its environment.</li> <li>7. General concepts of genetics and heredity (e.g., DNA/RNA, protein synthesis, mutations, adaptations).</li> <li>8. Organization and functions of cells and multicellular systems.</li> <li>9. Behavior of organisms and their relationships to social systems.</li> <li>10. Regulation of biological systems including homeostatic mechanisms.</li> <li>11. Fundamental processes of modeling and investigating in the biological sciences, including laboratory skills.</li> <li>12. Applications of biology in environmental quality and in personal and community health.</li> </ol>
<p><b>8. Earth and Space Science Core Competencies</b> (1997 SSC: 6.1-.7, 7.1-.5; CR: V.2.e; NSTA [2003] C.4.a; NSES: H-D1, D2, D3, D4; S 5-8; S 5-8; ETS 0245: I)</p>	<ol style="list-style-type: none"> <li>1. Characteristics of and interactions among land, atmosphere, and ocean systems on Earth.</li> <li>2. Properties, measurement, and classification of Earth materials.</li> <li>3. Local and global changes in the Earth including land formation and erosion.</li> <li>4. Local and global geochemical and biogeochemical cycles including biotic and abiotic systems.</li> <li>5. Local and global energy flow and transformation in Earth systems.</li> <li>6. Local and global hydrological features of the Earth.</li> <li>7. Local and global patterns and changes in the atmosphere, weather, and climate.</li> <li>8. Origin, evolution, and planetary behaviors of Earth.</li> </ol>

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	<p>9. Origin, evolution, and properties of the universe.</p> <p>10. Fundamental processes of investigating in the Earth and space sciences, including laboratory skills.</p> <p>11. Sources and limits of natural resources in Missouri, the U.S., and the world.</p> <p>12. Applications of Earth and space sciences to environmental quality and to personal and community health and welfare (e.g., natural disasters, global climate change, acid rain, etc.) in Missouri, the U.S., and the world.</p>
<p><b>9. Physics Core Competencies</b> (1997 SSC: 3.1-7; CR: V.2.d; NSTA [2003]: C.5; NSES: H-B1, B2, B3, B5, B6; S 1, 2, 7-8; Praxis: ETS 0245: I, II, IV))</p>	<p>1. Energy, work, and power.</p> <p>2. Motion, major forces, and momentum.</p> <p>3. Newtonian principles and laws including engineering applications.</p> <p>4. Conservation of mass, momentum, energy, and charge.</p> <p>5. Physical properties of matter.</p> <p>6. Kinetic-molecular motion and atomic models.</p> <p>7. Radioactivity, nuclear reactors, fission, and fusion.</p> <p>8. Wave theory, sound, light, the electromagnetic spectrum and optics.</p> <p>9. Electricity and magnetism</p> <p>10. Fundamental processes of investigating in physics, including laboratory skills..</p> <p>11. Applications of physics in environmental quality and to personal and community health in Missouri, the U.S., and the world.</p>
<p><b>10. Chemistry Advanced Competencies</b> (1997 SSC: 2.1-8; NSTA C.3.b; CR: 2.c, 2.g; NSES: H-C1, C2, C5, C6; S 3, 4, 7-8; Praxis 0245: II, III, IV, V)</p>	<p>1. Molecular orbital theory, aromaticity, metallic and ionic structures, and correlation to properties of matter.</p> <p>2. Superconductors and principles of metallurgy.</p> <p>3. Advanced concepts of chemical kinetics, and thermodynamics.</p> <p>4. Lewis adducts and coordination compounds.</p> <p>5. Solutions, colloids, and colligative properties.</p> <p>6. Major biological compounds and natural products.</p> <p>7. Solvent system concepts including non-aqueous solvents.</p> <p>8. Chemical reactivity and molecular structure including electronic and steric effects.</p> <p>9. Organic synthesis and organic reaction mechanisms.</p> <p>10. Energy flow through chemical systems.</p> <p>11. Issues related to chemistry including ground water pollution, disposal of plastics, and development of alternative fuels.</p> <p>12. Historical development and perspectives in chemistry including contributions of significant figures and underrepresented groups, and the evolution of theories in chemistry.</p> <p>13. How to design, conduct, and report research in chemistry.</p> <p>14. Applications of chemistry and chemical technology in society, business, industry, and health fields in Missouri, the U.S., and the world.</p> <p>15. Systematic nomenclature of ionic and molecular compounds, including acids, and of organic compounds, including their functional groups.</p>
<p><b>11. Chemistry Supporting Competencies</b> (1997 SSC: 4.1-7; NSTA C.3.C; CR: 2.b,</p>	<p>1. Biology, including molecular biology, bioenergetics, and ecology.</p> <p>2. Earth science, including geochemistry, cycles of matter, and</p>

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<p><b>2.d, 2.e; NSES: H-C1, C2, C5, C6; S 3, 4, 7-8; NSES: H-D1, D2, D3, D4; S 5-8; S 5-8; Praxis 0245: VII)</b></p>	<p>energetics of Earth systems.</p> <p>3. Physics, including energy, stellar evolution, properties and functions of waves, motions and forces, electricity, and magnetism.</p> <p>4. Mathematics, including statistics, probability, calculus and differential equations.</p>
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