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<p>D Certification Endorsement Requirements: This endorsement shall require a minimum of 36 semester hours of laboratory based courses in the natural sciences (biology, chemistry, Earth and space science, and physics), of which</p>	<p>EXAMPLE: CHEM 101 or 102 3 CR</p>		Biol 102 Intro to Zoology (4)	Biol 330 Cellular Biology (3)	Chem 101 General Chemistry I (4)	Chem 102 General Chemistry II (4)	Chem 210 Analytical Chemistry (4)	Chem 303 Organic Chemistry I (5)	Chem 304 Organic Chemistry II (5)	Chem 431 Biochemistry & Bio Tech (4)	Esci 230 Limnology (4)	Phys 201 General Physics I (5)					Educ 300 Mng the Learning Env (3)	Educ 309 Secondary Practicum (2)	Educ 310 Sec Teaching Methods (3)	Educ 315 Educational Technology (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)															
<p><u>E2.</u> Understand the central concepts of the supporting disciplines as outlined in the content analysis form.</p>			X	X	X	X	X	X																														
<p><u>E3.</u> Show an understanding of state and national curriculum standards and their impact on the content knowledge necessary for teaching P-12 students.</p>			X	X	X		X	X																														
<p><u>E4.</u> Core Competencies. All teachers of chemistry will lead students to understand:</p>																																						
<p>A. Fundamental structures of atoms and molecules;</p>			X	X																																		
<p>B. Basic principles of ionic, covalent, and metallic bonding;</p>			X	X																																		
<p>C. Periodicity of physical and chemical properties of elements;</p>			X	X																																		
<p>D. Laws of conservation of matter and energy;</p>			X	X																																		
<p>E. Fundamentals of chemical kinetics, equilibrium, and thermodynamics;</p>					X																																	
<p>F. Kinetic molecular theory and gas laws;</p>			X	X																																		
<p>G. Mole concept, stoichiometry, and laws of composition;</p>			X	X																																		
<p>H. Solutions, colloids, and colligative properties;</p>					X	X																																
<p>I. Acids/base chemistry;</p>					X	X																																
<p>J. Fundamental oxidation-reduction chemistry, fundamental organic chemistry and biochemistry;</p>																																						

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L. Nature of Science and the fundamental processes in chemistry;		X	X	X	X	X	X	X																												
M. Applications of chemistry in personal and community health and environmental quality;						X	X	X	X																											
N. Fundamentals of nuclear chemistry; and					X																															
O. Historical development and perspectives in chemistry				X	X				X																											
<p><u>E5.</u> Advanced Competencies. In addition to the core competencies, teachers of chemistry as a primary field will be prepared to effectively lead students to understand:</p>																																				
A. Principles of electrochemistry;				X	X																															
B. Transition elements and coordination compounds;				X																																
C. Molecular orbital theory, aromaticity, metallic and ionic structures, and correlation to properties of matter;			X	X	X	X	X	X																												
D. Advanced concepts in chemical kinetics, equilibrium, gas laws, and thermodynamics;			X	X	X	X	X	X	X	X	X																									
E. Lewis structures and molecular geometry;				X		X	X																													
F. Advanced concepts in acid/base chemistry, including buffers;					X			X																												
G. Major biological compounds and reactions;		X		X					X																											
H. Solvent system concepts;			X		X	X	X	X																												
I. Chemical reactivity and molecular structure including electronic and steric effects;		X		X		X	X																													

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B. Nature of scientific evidence and the use of models for explanation;			X					X	X	X	X																											
C. Measurement as a way of knowing and organizing observations of constancy and change;			X	X	X	X		X	X	X		X																										
D. Evolution of natural systems and factors that result in evolution or equilibrium; and		X								X	X																											
E. Interrelationships of form, function, and behaviors in living and nonliving systems.		X								X	X																											
S2. Content Pedagogy – Effective teachers of science understand how students learn and develop scientific knowledge. Candidates use scientific inquiry to develop this knowledge. Candidates will:																																						
<u>E1.</u> Plan multiple lessons using a variety of inquiry approaches that demonstrate their knowledge and understanding of how students learn science.																	X	X				X	X															
<u>E2.</u> Include active inquiry lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, relationships and natural patterns from empirical experiences.																	X	X				X	X															
<u>E3.</u> Design instruction and assessment strategies that confront and address naïve concepts/preconceptions.																	X	X				X	X															
S3. Learning Environments – Effective teachers of science are able to plan for engaging students in science learning by setting appropriate goals that are consistent with knowledge of how students learn																																						

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<p>S4. Safety – Effective teachers of science can, in a P-12 classroom setting, demonstrate and maintain chemical safety, safety procedures, and the ethical treatment of living organisms needed in the P-12 science classroom appropriate to their area of licensure. Candidates will:</p>																																						
<p><u>E1.</u> Design activities in a P-12 classroom that demonstrate the safe and proper techniques for the preparation, storage, dispensing, supervision, and disposal of all materials used within their subject area science instruction.</p>															X					X	X																	
<p><u>E2.</u> Design and demonstrate activities in a P-12 classroom that demonstrate an ability to implement emergency procedures and the maintenance of safety equipment, policies and procedures that comply with established state and/or national guidelines. Candidates ensure safe science activities appropriate for the abilities of all students.</p>															X					X	X																	
<p><u>E3.</u> Design and demonstrate activities in a P-12 classroom that demonstrate ethical decision-making with respect to the treatment of all living organisms in and out of the classroom. They emphasize safe, humane, and ethical treatment of animals and comply with the legal restrictions on the collection, keeping, and use of living organisms.</p>															X					X	X																	
<p>S5. Impact on Student Learning – Effective teachers of science provide evidence to show that P-12 students’ understanding of major science concepts, principles, theories, and laws have changed as a result of instruction by the candidate and that student</p>																																						

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<p>knowledge is at a level of understanding beyond memorization. Candidates will:</p>																																						
<p><u>E1.</u> Collect, organize, analyze, and reflect on diagnostic, formative and summative evidence of a change in mental functioning demonstrating that scientific knowledge is gained and/or corrected.</p>																				X	X																	
<p><u>E2.</u> Provide data to show that P-12 students are able to distinguish science from nonscience, understand the evolution and practice of science as a human endeavor, and critically analyze assertion made in the name of science.</p>																				X	X																	
<p><u>E3.</u> Engage students in developmentally appropriate inquiries that require them to develop concepts and relationships from their observations, data, and inferences in a scientific manner.</p>																				X	X																	
<p>S6. Professional Knowledge and Skills – Effective teachers of science strive continuously to improve their knowledge and understanding of the ever changing knowledge base of both content and science pedagogy. They identify with and conduct themselves as part of the science education community. Candidates will:</p>																																						
<p><u>E1.</u> Engage in professional development opportunities in their content field such as talks, symposiums, research opportunities, or projects within their community.</p>										X																												
<p><u>E2.</u> Engage in professional development opportunities such as conferences, research opportunities, or projects within their community.</p>										X																												

