

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																			
<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 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																
<p><u>E3.</u> Show an understanding of state and national curriculum standards and their impact on the content knowledge necessary for teaching 7-12 students.</p>	X	X	X	X	X	X	X																													
<p><u>E4.</u> Core Competencies. All teachers of biology will lead students to understand:</p>																																				
<p>A. Life processes in living systems including organization of matter and energy;</p>	X	X	X			X			X																											
<p>B. Similarities and differences among animals, plants, fungi, microorganisms, and viruses;</p>	X	X	X																																	
<p>C. Ecological systems including the interrelationships and dependencies of organisms with each other and their environments;</p>			X			X																														
<p>D. Population dynamics and the impact of population on its environment;</p>						X																														
<p>E. General concepts of genetics and heredity;</p>							X																													
<p>F. Organizations and functions of cells and multi-cellular systems;</p>	X	X	X	X			X																													
<p>G. Behavior of organisms and their relationships to social systems;</p>						X																														
<p>H. Regulation of biological systems including homeostatic mechanisms;</p>				X	X																															
<p>I. Fundamental processes of modeling and investigating in the biological sciences;</p>					X																															
<p>J. Applications of biology in environmental quality and in personal and community health;</p>	X	X			X	X				X																										

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																					
<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 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																		
K. Bioenergetics including major biochemical pathways;	X	X	X	X		X	X																															
L. Molecular genetics and heredity and mechanisms of genetic modification;								X																														
M. Molecular basis for evolutionary theory and classification;				X			X																															
N. Principles and practices of biological classification;	X	X	X																																			
O. Scientific theory and principles of biological evolution;	X	X	X	X																																		
P. How the stability of an ecosystem is increased by biological diversity; and							X																															
Q. Applications of biology and biotechnology in society business, industry, and health fields.	X	X	X				X	X																														
<p><u>E5.</u> Advanced Competencies. In addition to these core competencies, teachers of biology as a primary field will be prepared to effectively lead students to understand:</p>																																						
A. Biochemical interactions of organisms and their environments;			X				X	X			X																											
B. Causes, characteristics and avoidance of viral, bacterial, and parasitic diseases;		X		X			X	X																														
C. Molecular genetics;								X																														
D. Issues related to living systems such as genetic modification, uses of biotechnology, cloning, and pollution from farming;								X																														

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																					
<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>	EXAMPLE: CHEM 101 or 102 3 CR	Biol 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																	
E. Historical development and perspectives in biology including contributions of significant figures and underrepresented groups, and the evolution of theories in biology;		X	X	X	X		X	X			X																											
F. How to design, conduct, and report research in biology;							X	X																														
<u>E6.</u> Supporting Competencies. All teachers of biology will also be prepared to effectively apply concepts from other sciences and mathematics to the teaching of biology including basic concepts of:																																						
A. Chemistry including general chemistry, biochemistry and basic laboratory techniques;			X					X	X																													
B. Physics including light, sound, optics, electricity, energy and order, and magnetism;												X																										
C. Earth and space sciences including energy and geochemical cycles, climate, oceans, weather, natural resources, and changes in the Earth; and				X		X				X																												
D. Mathematics, including probability and statistics.				X	X																																	
<u>E7.</u> All secondary teachers will also be prepared to lead students to understand the unifying concepts of science, including:																																						
A. Multiple ways to organize perceptions of the world and how systems organize the studies and knowledge of science;	X	X	X	X	X	X	X	X	X	X	X	X																										
B. Nature of scientific evidence and the use of models for explanation;			X	X	X		X																															

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																					
<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>	EXAMPLE: CHEM 101 or 102 3 CR	Biol 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																		
C. Measurement as a way of knowing and organizing observations of constancy and change;	X	X	X	X	X	X	X	X	X	X	X	X																										
D. Evolution of natural systems and factors that result in evolution or equilibrium; and				X																																		
E. Interrelationships of form, function, and behaviors in living and nonliving systems.			X	X		X																																
<p>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:</p>																																						
<p><u>E1.</u> Plan multiple lessons using a variety of inquiry approaches that demonstrate their knowledge and understanding of how students learn science.</p>														X	X				X	X																		
<p><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.</p>														X	X				X	X																		
<p><u>E3.</u> Design instruction and assessment strategies that confront and address naïve concepts /preconceptions.</p>														X	X				X	X																		
<p>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 science and are aligned with state and national standards. The plans reflect the nature and social context of science, inquiry, and appropriate safety</p>																																						

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																					
<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 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																	
<p>considerations. Candidates design and select learning activities, instructional settings, and resources--including technology, to achieve those goals; and they plan fair and equitable assessment strategies to evaluate if the learning goals are met. Candidates will:</p>																																						
<p><u>E1.</u> 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 - to help all students learn.</p>														X	X	X	X		X	X																		
<p><u>E2.</u> Plans include active inquiry lessons where students collect and interpret data in order to develop concepts, understand scientific processes, relationships and natural patterns from empirical experiences.</p>															X	X			X	X																		
<p><u>E3.</u> Plan fair and equitable assessment strategies to analyze student learning and to evaluate if the learning goals are met. Assessment strategies are designed to continuously evaluate preconceptions and ideas that students hold and the understandings that students have formulated.</p>															X	X		X	X	X																		
<p><u>E4.</u> Plan a learning environment and learning experiences for all students that demonstrate chemical safety, safety procedures, and the ethical treatment of living organisms within their licensure area.</p>													X							X																		
<p>S4. Safety - Effective teachers of science can, in a 7-12 classroom setting, demonstrate and maintain chemical safety, safety procedures, and the ethical treatment of</p>																																						

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																					
<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 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																	
<p>living organisms needed in the 7-12 science classroom appropriate to their area of licensure. Candidates will:</p>																																						
<p><u>E1.</u> Design activities in a 7-12 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 7-12 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 7-12 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>55. Impact on Student Learning - Effective teachers of science provide evidence to show that 7-12 students' understanding of major science concepts, principles, theories, and laws have changed as a result of instruction by the candidate and that student knowledge is at a level of understanding beyond memorization. Candidates will:</p>																																						

Place an X in the box corresponding to the course that meets the following requirements:	List the courses the institution requires to meet Rule 24 requirements, associated Guidelines, and program hours required by the institution for this endorsement in the first row: (If more than 35 courses please fill out additional sheets)																																			
<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 101 Intro to Botany (4)	Biol 102 Intro to Zoology (4)	Biol 301 Microbiology (4)	Biol 311 Evol & System Biology (3)	Biol 312 Human Physiology (4)	Biol 317 Ecology (4)	Biol 404 Genetics (3)	Biology upper-level elective (3-4)	Chem 101 General Chemistry I (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 Tech (3)	Educ 317 Assmt for Student Learning (3)	Educ 411 Sec Student Teaching (12)	Educ 420 ST Seminar (1)																
<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 7-12 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	X			X																									
<p><u>E2.</u> Engage in professional development opportunities such as conferences, research opportunities, or projects within their community.</p>							X	X			X																									