8710.4750 TEACHERS OF SCIENCE: Life 9-12 FORM I- C MATRIX

Professional Education Program Evaluation Report (PEPER II)	**MATRIX Form I-C**										
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Subp. 6. **Subject matter standards for teachers of life science.** A candidate for licensure as a teacher of life science in grades 9 through 12 must complete a preparation program under subpart 2, item C, that must include the candidate's demonstration of the knowledge and skills in items A to C.											
A. A teacher of life science must demonstrate a conceptual understanding of life science. The teacher must:											
(1) use sources of information to solve unfamiliar quantitative problems and communicate the solution in a logical and organized manner as evidenced by the ability to:											
(a) describe, using appropriate alternative forms including pictorial, graphical, or written descriptions, the known and unknown quantities of a given problem; and			**A**	K			K				
(b) describe, in terms of the relevant numerical and algebraic quantities and equations required to solve the problem, the relevant numerical and algebraic quantities and equations required to solve a given problem mathematically;	K		K		**A**			K			
(2) use computers to display and analyze experimental and theoretical data as evidenced by the ability to:											
(a) describe data graphically using a computer; and					**A**					A	
(b) design a mathematical model to provide a reasonable fit to a given set of data;					**A**			A			
(3) use mean, standard deviation, chi-squared, linear regression, and correlation to describe and analyze experimental and theoretical data; and			**A**		**A**						
(4) develop a plan to ensure a safe environment and practices in all life science learning activities.	K	K			K		K				**A**
B. A teacher of life science must demonstrate knowledge of biological concepts. The teacher must:											
(1) understand structural and functional relationships as evidenced by the ability to:											
(a) perform observations to describe the structures of a given common organism;	K	K						A			
(b) describe, using words, descriptions of appropriate experimental procedures, and diagrams, the characteristics of what determines life in a given common organism;	A	K					**A**				
(c) predict, using structure-function relationships, the system function from which a given set of plant and animal tissue samples is derived;	K	K						**A**			

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(d) describe, using words, diagrams, and pictures, immune system responses that take place in human cells, tissues, organs, and organ systems throughout the progression of a given viral, bacterial, fungal, and parasitic disease; and							**A**				
(e) design a personal course of action to prevent a given human disease;							**A**				
(2) understand molecular and cellular life processes as evidenced by the ability to:											
(a) perform measurements to describe cellular structures and physiological processes;	K						K	**A**			
(b) describe, using words, chemical formulas and equations, and diagrams, the cellular processes of a given plant or animal cell;	K						K	**A**			
(c) explain, using the structure-function relationship of the chloroplast, conservation of energy, and the fundamental nature of light, how solar energy is transformed during photosynthesis into cellular energy in a given plant cell;	K							**A**			
(d) explain, using the structure-function relationship of the mitochondria and molecular energy transformations involving ATP, how energy stored in food molecules is released during cellular respiration in a given cell;	K						K	**A**			
(e) qualitatively predict, using structure-function relationships and relationships between organelles and the cellular environment, the effect of a given natural and applied physical and chemical change in the environment of a cell on photosynthesis and cellular respiration;	K							**A**			
(f) design experiments to test the properties of structure-function relationships in photosynthesis or cellular respiration;	K							**A**			
(g) explain, using the processes of replication, transcription, and translation, how proteins are synthesized in a cell; and	K		**A**								
(h) predict the amino acid sequence of a protein from a given codon sequence;	K		**A**								
(3) understand molecular reproduction and heredity as evidenced by the ability to:											
(a) perform measurements and statistical analyses to describe the results from a given plant and animal breeding experiment;	K		**A**								
(b) describe, using words, pictures, and diagrams, and models, the changes in the visibility, arrangement, and number of chromosomes at each given state of mitosis and meiosis;	K		**A**								
(c) explain, using the Laws of Segregation and Independent Assortment, why fertilization and the production of sperm and eggs through meiosis is necessary for species variability;	K		**A**								

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(d) describe, using words, diagrams, and charts, how a given trait is inherited and expressed;	K		**A**								
(e) explain and predict qualitatively and quantitatively, using rules of probability and heredity, the genotype and phenotype of the offspring of parents with given genotypic traits to include dominant-recessive traits, incomplete and co-dominant traits, polygenic traits, and sex-linked and sex-influenced traits;	K		**A**								
(f) explain, using the Laws of Segregation and Independent Assortment, how the sex is determined in humans;	K		**A**								
(g) describe, using words, diagrams, and charts, how a mutation occurs;			**A**						A		
(h) explain and predict, using the relationship between genes and their expression, the effect an environmental change will have on the expression of a given genetic trait;			**A**						A		
(i) describe, using words, diagrams, and charts, the process of producing recombinant DNA; and			**A**								
(j) describe, using words, pictures, and diagrams, how genetic technology is used in treatment of human disease and development of agriculture products;			**A**								
(4) understand diversity and biological evolution as evidenced by the ability to:											
(a) describe in words, pictures, and diagrams the range of physical, behavioral, and biochemical adaptations that can occur in response to environmental stresses for a given species;		K	A						**A**		
(b) explain, using the principles of mutation and natural selection, how a specific adaptation of a given species might have developed in response to environmental stresses;		K							**A**		
(c) describe, using words, diagrams, charts, and statistical relationships, the range of phenotypes of a given species in a given environment;		K				A			**A**		
(d) explain and predict, using the principles of mutation, recombination, and natural selection, changes in the range of phenotypes of a species when a given change occurs in the environment of the species;		K				A			**A**		
(e) explain, using the principles of mutation, recombination, and natural selection, why certain species are found in the fossil records relatively unchanged while others are not and others are extinct;		K							**A**		
(f) explain and predict, using the evolutionary tree, morphological variations between two or more given species; and		K							**A**		

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(g) explain the variations in morphological characteristics and DNA composition of two or more given species;		K							**A**		
(5) understand the interdependence among living things as evidenced by the ability to:											
(a) perform measurements and statistical analyses to describe results of a study investigating the relationship between a given common organism and its environment;					**A**						
(b) perform measurements and statistical analyses to describe the diversity and number of species in a given ecosystem;		K		A	**A**						
(c) describe, using words, pictures, and diagrams, the cycling of a given substance among living and nonliving components of the biosphere;		K		**A**							
(d) describe, using words, pictures, diagrams, and simple mathematical relationships, the cycling of matter and the flow of energy both within a given system, and between the system and the biosphere;		K		**A**							
(e) explain, using the relationships between biotic and abiotic components of that system, why the population size and diversity of species is different between two different niches, habitats, ecosystems, or biomes;		K		**A**							
(f) explain and predict, using population growth dynamics and interspecific and intraspecific interactions, changes in population size of organisms in an ecosystem for a given change in the biotic and abiotic components of the ecosystem; and		K		**A**							
(g) design an experiment to investigate relationships within and among species in a simple ecosystem; and					**A**	K					
(6) understand behavior of organisms as evidenced by the ability to:											
(a) perform measurements and statistical analyses to describe the physical behavior of animals in a given natural and perturbed situation;		K				**A**			K		
(b) describe, using words, pictures, and diagrams, behaviors of a given animal that allow it to interact with organisms of its own and other species and to respond to environmental changes;						**A**					
(c) explain and predict, in terms of the principles of animal communication and adaptation, the behavioral responses of an animal to a given set of interactions or environmental changes; and						**A**					
(d) explain behavioral responses of a given animal in terms of natural selection.						**A**			K		

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C. A teacher of life science must demonstrate an advanced conceptual understanding of life science and the ability to apply its fundamental principles, laws, and concepts by completing a full research experience. The teacher must:											
(1) identify various options for a research experience including independent study projects, participation in research with an academic or industry scientist, directed study, internship, or field study;								K		**A**	
(2) select an option and complete a research experience that includes conducting a literature search on a problem;								K		**A**	
(3) design and carry out an investigation;								K		**A**	
(4) identify modes for presenting the research project; and								K		**A**	
(5) present the research project in the selected mode.								K		**A**	

Standards that integrate knowledge of science with knowledge of pedagogy, students, learning environments, and professional development were articulated in subpart 3 E of rule 8710.4750. These pedagogy standards need to be evidenced in addition to the specific content science standards.

E. A teacher of science must have a broad-based knowledge of teaching science that integrates knowledge of science with knowledge of pedagogy, students, learning environments, and professional development. A teacher of science must understand:						
(1) curriculum and instruction in science as evidence by the ability to:						
(a) select, using local, state, and national science standards, appropriate science learning goals and content;						**A**
(b) plan a coordinated sequence of lessons and instructional strategies that support the development of students' understanding and nurture a community of science learners including appropriate inquiry into authentic questions generated from students' experiences; strategies for eliciting students' alternative ideas; strategies to help students' understanding of scientific concepts and theories; and strategies to help students use their scientific knowledge to describe real-world objects, systems, or events;						**A**
(c) plan assessments to monitor and evaluate learning of science concepts and methods of scientific inquiry; and						**A**
(d) justify and defend, using knowledge of student learning, research in science						**A**

education, and national science education standards, a given instructional model or curriculum;						
(2) safe environments for learning science as evidenced by the ability to:						
(a) use required safety equipment correctly in classroom, field, and laboratory settings;						**A**
(b) describe, using knowledge of ethics and state and national safety guidelines and restrictions, how to make and maintain a given collection of scientific specimens and data;						**A**
(c) describe, using knowledge of ethics and state and national safety guidelines and restrictions, how to acquire, care for, handle, and dispose of live organisms;						**A**
(d) describe, using state and national guidelines, how to acquire, care for, store, use, and dispose of given chemicals and equipment used to teach science;						**A**
(e) implement safe procedures during supervised science learning experiences in the public schools; and						**A**
(f) develop a list of materials needed in an elementary science safety kit;						**A**
(3) how to apply educational principles relevant to the physical, social, emotional, moral, and cognitive development of preadolescents and adolescents;						**ED 3110, ED 3350**
(4) how to apply the research base for and the best practices of middle level and high school education;						**ED 3350**
(5) how to develop curriculum goals and purposes based on the central concepts of science and how to apply instructional strategies and materials for achieving student understanding of the discipline;						**A**
(6) the role and alignment of district, school, and department mission and goals in program planning;						**ED 4830**
(7) the need for and how to connect students' schooling experiences with everyday life, the workplace, and further educational opportunities;						**ED 4830**
(8) how to involve representatives of business, industry, and community organizations as active partners in creating educational opportunities;						**ED 4830**
(9) the role and purpose of cocurricular and extracurricular activities in the teaching and learning process;						**ED 4830**
(10) the impact of reading ability on student achievement in science, recognize the varying reading comprehension and fluency levels represented by students, and possess the strategies to assist students to read science content more effectively; and						**ED 3780 ED 3350 ED 4830**
(11) how to apply the standards of effective practice in teaching through a variety of early and ongoing clinical experiences with middle level and high school students within a range of educational programming models.						**ED 3100 ED 4830 SCI 3450**