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Science Education (Biology)		Program Requirements				
	Subject Area Competencies and Skills (22nd Edition)	**ESE 6344** Classroom Practices in Secondary Education	**SCE 6647** Global Studies Methods in Science	**SCE 6338** Secondary Science Methods and Assessment	**Florida Teacher Certification Exam (FTCE) -** Subject Area Examination	**Undergraduate Coursework (3.0 GPA)**
	Biology 6-12	**"C" below indicates where**				
1. Knowledge of the investigative processes of science						
1.	Identify components, proper use, and care of light microscopes.				C	C
2.	Distinguish between the types of microscopy (e.g., scanning electron microscopy, transmission electron microscopy, phase contrast) and their applications.				C	C
3.	Identify proper techniques for common laboratory procedures (e.g., dissecting; preserving, staining, and mounting microscope specimens; preparing laboratory solutions; using chromatography; performing gel electrophoresis).				C	C
4.	Identify proper techniques for field studies (e.g., site selection, sampling, transects, collecting techniques, environmental measurements).				C	C
5.	Select appropriate uses of common laboratory procedures (e.g., polymerase chain reaction, chromatography, spectrophotometry, centrifugation, gel electrophoresis).				C	C
6.	Calculate measurements in the appropriate metric units.			C	C	C
7.	Differentiate between assumptions, inferences, observations, hypotheses, conclusions, theories, and laws.			C		
8.	Interpret empirical data (e.g., charts, graphs, tables, diagrams).	C			C	C
9.	Differentiate the characteristics and methodologies of scientific and nonscientific knowledge.	C		C		
10.	Identify relationships between the variables and possible outcomes of a specific experiment.			C	C	C
11.	Relate the validity and reliability of scientific knowledge to reproducibility, statistical significance, technological limitations, bias, and types of error.			C	C	C
12.	Identify the development of biological theories and knowledge through important historical events, creative endeavors of diverse individuals, and experimental evidence.				C	C
13.	Differentiate between qualitative and quantitative data in experimental, observational, and modeling methods of research.				C	C
14.	Determine the elements of a well-designed and controlled experiment.			C		
15.	Identify evidence of the dynamic nature of science in the face of new scientific information.			C		
16.	Identify patterns (e.g., circadian rhythms, migration, succession, cycles) at the level of organisms, populations, or ecosystems that govern the occurrence of natural events.				C	C

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2. Knowledge of the interactions between science, technology, and society						
1.	Analyze the ethical, legal, economic, and social implications of current scientific research and practices (e.g., reproductive and life-sustaining technologies, genetic basis for behavior, population growth and control, government and business influences on biotechnology, cloning, genomics, genetic engineering).		C	C		
2.	Analyze environmental challenges (e.g., ozone depletion, pollution, climate change, health effects) that may result from scientific and technological advances.		C			
3.	Analyze the effects (e.g., multidrug resistance, rapid transmission across international boundaries) of globalization on the spread and treatment of pathogens and invasive species.		C			
4.	Identify pertinent legislation and national guidelines (e.g., National Association of Biology Teachers, International Society of Environmental Forensics, Occupational Safety and Health Administration chemical safety guidelines, material safety data sheets) regarding laboratory safety, hazardous materials, experimentation, and the use and handling of organisms in the classroom.	C		C		

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3. Knowledge of the chemical processes of living things						
1.	Identify the structures, functions, and importance of inorganic and organic compounds (e.g., water, mineral salts, carbohydrates, lipids, proteins, nucleic acids) in cells.				C	C
2.	Apply the laws of thermodynamics to living systems, including the role of enzymes in biological reactions.				C	C
3.	Predict the effects of changes in pH, temperature, substrate concentration, and enzyme concentration on reaction rate.				C	C
4.	Identify substrates, products, and relationships in aerobic respiration (e.g., glycolysis, the Krebs cycle, electron transport), including metabolism of carbohydrates, fats, and amino acids, and in anaerobic respiration (e.g., alcoholic fermentation, lactic acid fermentation).				C	C
5.	Compare end products and energy yields of anaerobic and aerobic respiration.				C	C
6.	Identify the raw materials and products of C3 photosynthesis, as well as factors that affect the rate of light-dependent reactions and the Calvin cycle.				C	C
7.	Identify key differences between C3, C4, and CAM photosynthesis, and the evolutionary and ecological significance of these pathways.				C	C
8.	Analyze the role of chemiosmosis in photosynthesis and respiration.				C	C
9.	Compare heterotrophy and autotrophy and the roles of these processes in the environment.				C	C
10.	Evaluate the components and roles of the antigen-antibody reaction.				C	C
11.	Compare active and passive immunity.				C	C
12.	Evaluate the roles of cell recognition (e.g., cell-to-cell signaling, autoimmune diseases, tissue rejection, cancer, pollen or stigma-style interaction) in normal and abnormal cell activity.				C	C
13.	Identify the effect of environmental factors on the biochemistry of living things (e.g., ultraviolet light effects on melanin and vitamin D production).				C	C
14.	Identify the roles of ATP and ADP in cellular processes				C	C
15.	Compare chemosynthetic and photosynthetic processes and the roles of organisms using these processes in the ecosystem.				C	C
16.	Identify cell-to-cell communication (e.g., electrical, chemical) in living things.				C	C
17.	Identify specific and nonspecific immune responses to vaccines and inoculations.				C	C

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4. Knowledge of the interactions between cell structure and cell function						
1.	Identify the major scientists and events that contributed to the development of the cell theory.				C	C
2.	Distinguish between the major structural characteristics of prokaryotic and eukaryotic cells.				C	C
3.	Relate the structure of cell organelles to their functions.				C	C
4.	Differentiate the events of each phase of the cell cycle (e.g., G1, S, G2, M) and the regulatory mechanisms of the cycle.				C	C
5.	Compare the mechanisms and results of nuclear division (i.e., karyokinesis) and cell division (i.e., cytokinesis) in plant and animal cells.				C	C
6.	Compare characteristics of the major taxa (e.g., domains, kingdoms, phyla), including cellular characteristics.				C	C
7.	Evaluate the relationships between the structures and functions of cell membrane components.				C	C
8.	Compare active and passive cellular transport mechanisms.				C	C
5. Knowledge of genetic principles, processes, and applications						
1.	Evaluate the relationships between structure and function in nucleic acids.				C	C
2.	Sequence the principal events of DNA replication.				C	C
3.	Sequence the principal events of protein synthesis.				C	C
4.	Distinguish between the functions of DNA and RNA.				C	C
5.	Distinguish between the regulatory systems for prokaryotic and eukaryotic protein synthesis.				C	C
6.	Identify proper techniques for recombinant DNA technology (e.g., Southern blotting, creation of transgenic organisms, gene splicing, mitochondrial DNA isolation).				C	C
7.	Evaluate possible effects of environmental and genetic influences (e.g., viruses, oncogenes, carcinogenic agents, mutagenic agents, epigenetic factors) on gene structure and expression.				C	C
8.	Analyze the processes and products of meiosis in plants, animals, and fungi.				C	C
9.	Identify Mendelian laws of inheritance, their relationship to chromosomes, and related terminology.				C	C
10.	Analyze applications of probability and statistical analysis (e.g., chi-square, Punnett square) in genetics.				C	C
11.	Analyze various patterns of inheritance (e.g., sex-linked, sex-influenced, sex-limited, incomplete dominance, codominance, autosomal linkage, multiple alleles, polygenic inheritance).				C	C
12.	Identify the causes of genetic disorders (e.g., point mutation, nondisjunction, aneuploidy, translocation, deletion, insertion, inversion, duplication).				C	C
13.	Identify the effect of a mutation in a DNA sequence on the products of protein synthesis				C	C

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6. Knowledge of the structural and functional diversity of viruses and prokaryotic organisms						
1.	Distinguish the structure and function of viruses and prokaryotic organisms.				C	C
2.	Identify the effects of viruses (e.g., AIDS, influenza, measles, feline leukemia, some human cancers) and prokaryotes (e.g., tuberculosis, bubonic plague, cholera) on organisms.				C	C
3.	Relate the structures and functions (e.g., morphology, motility, reproduction and growth, metabolic diversity) of prokaryotes to their behavior and identification.				C	C
4.	Differentiate the major types of bacterial genetic recombination (i.e., transduction, transformation, conjugation).				C	C
5.	Relate microbial processes and products to their uses in biotechnology.				C	C
7. Knowledge of the structural and functional diversity of protists, fungi, and plants						
1.	Identify major types of protists, fungi, and plants.				C	C
2.	Identify the positive and negative effects of protists, fungi, and plants on other living things.				C	C
3.	Relate the structures of specialized plant tissues to their functions.				C	C
4.	Relate the characteristics of vascular and nonvascular plants to adaptations allowing these organisms to broaden their ecological niches.				C	C
5.	Identify the functions of the major organs of angiosperms and gymnosperms and the survival advantages associated with those organs.				C	C
6.	Compare the structures of monocots and dicots (e.g., seeds, vascular bundles, venation, flower parts).				C	C
7.	Relate the major mechanisms (e.g., transport, storage, water conservation, reproduction, transpiration) in plants to environmental stimuli.				C	C
8.	Analyze the role of major plant growth regulators (e.g., auxins, gibberellins, ethylene).				C	C
9.	Identify methods of reproduction in plants.				C	C
10.	Analyze patterns of alternation of generations in plants, fungi, and algae.				C	C

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8. Knowledge of the structural and functional diversity of animals						
1.	Relate the structures of animal tissue types (e.g., epithelial, connective, muscle, nervous) to their functions.				C	C
2.	Characterize major animal body plans (e.g., symmetry, coelomic character, embryonic origin).				C	C
3.	Identify the stages, sequence, and processes of differentiation in embryological development for representative animal phyla.				C	C
4.	Relate the structures of circulatory and lymphatic systems to their functions.				C	C
5.	Relate the structures of excretory and digestive systems to their functions.				C	C
6.	Relate the structures of endocrine and nervous systems to their functions.				C	C
7.	Relate the structures of integumentary and musculoskeletal systems to their functions.				C	C
8.	Relate the structures of reproductive systems to their functions.				C	C
9.	Relate the structures of respiratory systems to their functions.				C	C
10.	Analyze how body systems contribute to the human immune response.				C	C
11.	Analyze the interconnectedness of animal organ systems.				C	C
12.	Analyze the effects of positive and negative feedback loops in human systems (e.g., vertebrate hormones, fight or flight).				C	C
13.	Identify aspects of animal social behavior (e.g., communication and signals, dominance hierarchy, territoriality, aggression, courtship, innate and learned behavior).				C	C

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9. Knowledge of ecological principles and processes						
1.	Distinguish between individuals, populations, communities, ecosystems, biomes, and the biosphere.				C	C
2.	Analyze the relationship between organisms (e.g., producers, consumers, decomposers) and their trophic levels.				C	C
3.	Identify processes, components, and roles of organisms in the hydrologic, carbon, nitrogen, and phosphorous cycles.				C	C
4.	Analyze patterns of energy flow in an ecosystem.				C	C
5.	Evaluate factors that affect population composition, growth, size, and geographic distribution.		C		C	C
6.	Classify examples of species interactions (e.g., competition, predation, parasitism, mutualism, commensalism).				C	C
7.	Distinguish between primary and secondary succession in biotic communities.				C	C
8.	Analyze the costs and benefits of managing renewable and nonrenewable resources.		C		C	C
9.	Evaluate the effects of human population size, resource use, and technology on environmental quality.		C		C	C
10.	Evaluate the consequences of loss of biodiversity		C		C	C
11.	Characterize the biotic and abiotic components that define Florida's ecosystems (e.g., freshwater, marine, estuary, terrestrial).				C	C

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10. Knowledge of evolutionary mechanisms						
1.	Compare the current theory of evolution by natural selection with previous scientific theories of evolution (e.g., Lamarck, Darwin).			C	C	C
2.	Analyze exceptions to and limitations of the biological species concept.				C	C
3.	Compare systems of classification (e.g., classical taxonomy, phenetics, cladistics).			C	C	C
4.	Apply a taxonomic (e.g., dichotomous) key to a set of objects.				C	C
5.	Analyze variation within a species along an environmental cline.				C	C
6.	Identify factors affecting speciation (e.g., mutation, recombination, types of isolation, sexual reproduction and selection, genetic drift, plate tectonics, geographic distribution).				C	C
7.	Evaluate the roles of mutation, recombination, isolation, sexual reproduction and selection, genetic drift, plate tectonics, and geographic distribution in evolution.				C	C
8.	Compare the concepts of punctuated equilibrium and gradualism.			C	C	C
9.	Interpret examples of evidence for evolutionary theory (e.g., molecular, morphological, embryological, paleontological).			C	C	C
10.	Analyze aspects of modern scientific theories (e.g., primitive precell, endosymbiotic) on the origin and early evolution of life on Earth.				C	C
11.	Differentiate patterns of evolutionary change (e.g., coevolution, convergent evolution, divergent evolution, parallel evolution) as they relate to major taxa.				C	C
12.	Apply the Hardy-Weinberg equilibrium, using the formula and assumptions, to predict changes in genotypic frequencies in a population.				C	C
13.	Identify basic trends in hominid evolution from early ancestors to modern humans.				C	C