# Life Sciences-Biology Subject Matter Requirements

Use the matrix below to determine if you have completed coursework that matches each of the domains for Social Science. In the right column for each subdomain:

1. provide the name and number of the course(s) you are choosing as a content match
2. **link the course name and number to the course description** showing that the same or similar topics in that sub domain are also found in the course description
3. You will also provide the number of units earned and the grade earned.

   Example: LIFE102, Attributes of Living Systems
   3.0 units, B+

Also consider the following:

- You may use community college and university coursework as long as it was credit bearing and earned a grade of C or above
- You may use one or several courses to meet each sub domain
- you may use a course more than once if it applies to several domains or sub domains
- The linked course description must also be highlighted showing the similar content to the sub domain description
- As a guide, the course description evidence you provide must meet the majority of the domain to be acceptable.
- You will provide a copy of all community college or university transcripts containing the courses used as evidence at the end of the matrix, as well as course descriptions.

***Only submissions meeting the requirements above will be sent to a team for review. Submissions not meeting this requirement will be returned to the candidate***.

Suggested process:

| |
|---|
| Have a printed copy of any college transcripts you expect to pull from, as well as the online catalog from the institution. Read the domain and sub domains to get a sense of the topics, and then highlight the courses in your transcripts that may have that subject matter. Go next to the first sub domain, re-read it, and then read the course description from the course(s) you think may be a match. Highlight particular words in that course description, and highlight the same or similar words in the sub domain. When you think the course is a match, fill in the white box on the right exactly as the example indicates above. |

# Life Sciences-Biology Subject Matter Requirements

| | | | |
|---|---|---|---|
| **First & Last Name:** | | **Date:** | |
| **Email:** | | **Credential Program:** | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 1: Scientific Practices, Engineering Design and Applications, and Crosscutting Concepts | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **1.1 Understand scientific practices**<br>a. Demonstrate knowledge of how to ask questions that can be addressed by scientific investigation, help further understanding of observed phenomena, and help clarify scientific explanations and relationships.<br>b. Apply knowledge of the development of important scientific ideas and models over time and of how history shows that evaluating a model's merits and limitations leads to its improvement.<br>c. Apply knowledge of planning and conducting scientific investigations, including safety considerations and the use of appropriate tools and technology.<br>d. Apply modeling and the mathematical concepts of statistics and probability to the analysis and interpretation of data, including analysis of errors and their origins.<br>e. Demonstrate the ability to analyze scientific data and information and draw appropriate and logical conclusions.<br>f. Use mathematics (e.g., dimensional analysis, statistics, proportional thinking) and computational thinking to represent and solve scientific problems and to assess scientific simulations.<br>g. Demonstrate the ability to construct and analyze scientific explanations.<br>h. Demonstrate the ability to evaluate scientific arguments in terms of their supporting evidence and reasoning.<br>i. Demonstrate knowledge of the ability to obtain, evaluate, interpret, and communicate scientific information (e.g., determining central ideas, integrating information from multiple sources, evaluating the validity of claims, using multiple formats to communicate scientific results). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 1: Scientific Practices, Engineering Design and Applications, and Crosscutting Concepts | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **1.2 Understand engineering practices, design, and applications**<br>a. Apply knowledge of engineering practices to define problems, determine specifications of designed systems, and identify constraints.<br>b. Evaluate design solutions in terms of their scientific and engineering constraints and the environmental, social, and cultural impacts of these solutions.<br>c. Apply knowledge of the roles of models (e.g., mathematical, physical, computer simulations) in the engineering design process.<br>d. Demonstrate knowledge of the process used to optimize a design solution (e.g., prioritizing criteria, refining a design due to test results).<br>e. Apply knowledge of the interdependence of science, engineering, and technology (e.g., in agriculture, health care, and communications).<br>f. Demonstrate knowledge of the influence of engineering, technology, and science on society and the natural world (e.g., in land use, transportation, and energy production). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 1: Scientific Practices, Engineering Design and Applications, and Crosscutting Concepts | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **1.3 Understand crosscutting concepts among the sciences and engineering**<br>a. Apply knowledge of patterns characteristic of natural phenomena and engineered systems.<br>b. Analyze cause-and-effect relationships and their mechanisms in natural phenomena and engineered systems.<br>c. Apply knowledge of the concepts of scale, proportion, and quantity to describe and compare natural and engineered systems.<br>d. Apply knowledge of how systems are defined and studied and of how system models are used to make predictions.<br>e. Apply knowledge of the flow, cycling, and conservation of energy and matter to analyze natural and engineered systems.<br>f. Analyze the relationship between structure and function in natural and engineered systems.<br>g. Analyze the factors contributing to stability and change in systems (e.g., static and dynamic equilibrium, feedback) and the rates at which systems change. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Physical Science | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.1 Understand structure and properties of matter**<br>a. Analyze the basic substructure of an atom (i.e., protons, neutrons, and electrons).<br>b. Differentiate between atoms and their isotopes, ions, molecules, elements, and compounds.<br>c. Apply knowledge of the development and organization of the periodic table and predict the properties of elements on the basis of their positions in the periodic table.<br>d. Demonstrate knowledge of nuclear forces that hold nuclei together and are responsible for nuclear processes (e.g., fission, fusion) and radioactivity (e.g., alpha, beta, and gamma decay).<br>e. Demonstrate knowledge of the characteristics of the different states of matter.<br>f. Apply knowledge of physical changes of matter and physical properties of matter.<br>g. Demonstrate knowledge of the physical and chemical characteristics, including pH, of acids, bases, and neutral solutions.<br>h. Apply knowledge of the physical and chemical properties of water. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Physical Science | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.2 Understand chemical reactions and biochemistry**<br>a. Recognize that chemical reactions can be understood in terms of the collisions between ions, atoms, or molecules and the rearrangement of particles.<br>b. Apply knowledge of the principles of conservation of matter to chemical reactions, including balancing chemical equations.<br>c. Describe the effect of temperature, pressure, and concentration on chemical equilibrium (Le Chatelier's principle) and reaction rate.<br>d. Analyze chemical bonding with respect to an element's position in the periodic table.<br>e. Demonstrate knowledge of the central role of carbon in the chemistry of living systems. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Physical Science | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.3 Understand motion and stability: forces and interactions**<br>a. Apply knowledge of Newton's laws of motion and law of universal gravitation and recognize the relationship between these laws and the laws of conservation of energy and momentum.<br>b. Demonstrate knowledge of the definition of pressure and how pressure relates to fluid flow and buoyancy, including describing everyday phenomena (e.g., the functioning of heart valves, atmospheric pressure).<br>c. Identify the separate forces that act on a system (e.g., gravity, tension/compression, normal force, friction), describe the net force on the system, and describe the effect on the stability of the system.<br>d. Analyze displacement, motion, and forces using models (e.g., vector, graphic representation, equations).<br>e. Identify fundamental forces, including gravity, nuclear forces, and electromagnetic forces (magnetic and electric), and recognize their roles in nature, such as the role of gravity in maintaining the structure of the universe. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Physical Science | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.4 Understand waves and their applications in technologies for information transfer**<br>a. Compare the characteristics of mechanical and electromagnetic waves (e.g., transverse/longitudinal, travel through various media, relative speed).<br>b. Demonstrate knowledge of the relationship between wave frequency, wavelength, and amplitude and energy.<br>c. Demonstrate knowledge of resonance and of the reflection, refraction, and transmission of waves.<br>d. Apply knowledge of electromagnetic radiation, including analyzing evidence that supports the wave and particle models that explain the properties of electromagnetic radiation.<br>e. Evaluate evidence that indicates that certain wavelengths of electromagnetic radiation may affect living cells.<br>f. Demonstrate knowledge of how lenses are used in simple optical systems, including the camera, telescope, microscope, and eye.<br>g. Compare and contrast the transmission, reflection, and absorption of light in matter.<br>h. Demonstrate knowledge of how energy and information are transferred by waves without mass transfer, including recognizing technology that employ this phenomenon. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Physical Science | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.5 Understand Energy**<br>a. Demonstrate knowledge of kinetic and potential energy.<br>b. Demonstrate knowledge of the ways in which energy manifests itself at the macroscopic level (e.g., motion, sound, light, thermal energy).<br>c. Demonstrate knowledge of the principle of conservation of energy, including analyzing energy transfers.<br>d. Demonstrate knowledge of how the transfer of energy as heat is related to changes in temperature and interpret the direction of heat flow in a system.<br>e. Apply knowledge of heat transfer by conduction, convection, and radiation, including analyzing examples of each mode of heat transfer.<br>f. Analyze how chemical energy in fuel is transformed to heat.<br>g. Demonstrate knowledge of the energy changes that accompany changes in states of matter. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Physical Science | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.6 Understand electricity and magnetism**<br>a. Demonstrate knowledge of electrostatic and magnetostatic phenomena, including evaluating examples of each type of phenomenon.<br>b. Predict charges or poles on the basis of attraction/repulsion observations.<br>c. Relate electric currents to magnetic fields and describe the application of these relationships, such as in electromagnets, electric current generators, motors, and transformers.<br>d. Demonstrate knowledge of how energy is stored and can change in electric and magnetic fields.<br>e. Interpret simple series and parallel circuits.<br>f. Demonstrate knowledge of the definitions of power, voltage differences, current, and resistance and calculate their values in simple circuits. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Life Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.1 Understand the structure and function of cells**<br>a. Demonstrate understanding that a small subset of elements (C, H, O, N, P, S) makes up most of the chemical compounds in living organisms by combining in many ways.<br>b. Recognize and differentiate the structure and function of molecules in living organisms, including carbohydrates, lipids, proteins, and nucleic acids.<br>c. Demonstrate knowledge of evidence that living things are made of cells.<br>d. Analyze the similarities and differences among prokaryotic and eukaryotic cells and viruses.<br>e. Demonstrate knowledge of organelles and their structures and functions in the cell and how differences in the structure of cells are related to cell function.<br>f. Demonstrate knowledge of the process and significance of protein synthesis. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Life Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.2 Understand growth, development, and energy flow in organisms**<br>a. Demonstrate knowledge of the importance of mitosis and meiosis as processes of cellular and organismal reproduction.<br>b. Compare single-celled and multicellular organisms, including the role of cell differentiation in the development of multicellular organisms.<br>c. Recognize the hierarchical levels of organization (e.g., cells, tissues, organs, systems, organisms) in plants and animals.<br>d. Demonstrate knowledge of the major anatomical structures and life processes (e.g., reproduction, photosynthesis, cellular respiration, transpiration) of various plant groups.<br>e. Demonstrate knowledge of feedback mechanisms responsible for maintaining homeostasis in animals, including humans, and plants, including the anatomical structures and systems involved in regulating internal conditions.<br>f. Analyze the processes of cellular respiration (anaerobic and aerobic).<br>g. Demonstrate knowledge of the conversion, flow, and storage of energy in the cell. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Life Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.3 Understand ecosystems: interactions, energy, and dynamics**<br>**a.** Demonstrate knowledge of the abiotic and biotic factors in an ecosystem and their relationship to the growth of individual organisms.<br>**b.** Demonstrate knowledge of the interrelationships within and among ecosystems and recognize factors that affect population types, size, and carrying capacity in ecosystems (e.g., availability of biotic and abiotic resources, predation, competition, disease).<br>**c.** Apply knowledge of energy flow, nutrient cycling, and matter transfer in ecosystems (e.g., food webs, biogeochemical cycles), including recognizing the roles played by photosynthesis and aerobic and anaerobic respiration.<br>**d.** Demonstrate knowledge of possible solutions for minimizing human impact on ecosystem resources and biodiversity. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Life Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.4 Understand heredity: inheritance and variation of traits**<br>a. Demonstrate knowledge of the roles of DNA (deoxyribonucleic acid) molecules in cells (e.g., storing genetic information, coding for proteins, regulatory functions, structural functions).<br>b. Apply knowledge of the structure of DNA and the process of DNA replication.<br>c. Apply knowledge of how genetic variation may be the result of errors that occur during DNA replication or mutations caused by environmental factors and explain their causes and effects.<br>d. Demonstrate knowledge of how the coding of DNA controls the expression of traits by genes and influences essential life functions (e.g., how DNA determines protein structure and other heritable genetic variations).<br>e. Demonstrate knowledge of the relationship between genes and their interaction with the environment in terms of organisms' development and functions.<br>f. Compare and contrast sexual and asexual reproduction.<br>g. Apply knowledge of genotypes and phenotypes and the inheritance of traits that are determined by one or more genes (e.g., dominant, recessive, and sex-linked alleles; incomplete dominance).<br>h. Solve problems from representations of monohybrid and dihybrid crosses. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Life Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.5 Understand biological evolution: unity and diversity**<br>a. Apply knowledge of anatomical, embryological, and genetic evidence of biological evolution and common ancestry and interpret branching diagrams (cladograms).<br>b. Demonstrate knowledge of the theory of natural selection, including how genetic variation and its expression leads to differences in characteristics among individuals in a population, adaptation, speciation, and extinction.<br>c. Demonstrate knowledge of major events that affected the evolution of life on Earth (e.g., climate changes, asteroid impacts).<br>d. Demonstrate knowledge of technologies that allow humans to influence the genetic traits of organisms. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Earth and Space Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **4.1 Understand Earth's place in the universe**<br>a. Demonstrate knowledge of the evidence for the Big Bang model (e.g., light spectra, motion of distant galaxies, spectra of primordial radiation).<br>b. Demonstrate knowledge of how astronomical instruments are used to collect data and how astronomical units are used to describe distances.<br>c. Demonstrate knowledge of the factors that contribute to a star's color, size, and luminosity and how a star's light spectrum and brightness can be used to identify compositional elements, movements, and distance from Earth.<br>d. Demonstrate knowledge of nuclear fusion in stars, including the relationship between a star's mass and stage of its lifetime and the elements produced.<br>e. Demonstrate knowledge of the formation and structure of the solar system, its place in the Milky Way galaxy, and the characteristics of various objects in the solar system.<br>f. Recognize how evidence from the study of lunar rocks, asteroids, and meteorites provides information about Earth's formation and history.<br>g. Compare and contrast uniformitarianism and catastrophism.<br>h. Demonstrate knowledge of the regular and predictable patterns of movements of stars, planets, and the moon and their effects on Earth's systems (e.g., seasons, eclipses, tides).<br>i. Apply knowledge of how Kepler's laws are used to predict the motion of orbiting objects. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Earth and Space Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **4.2 Understand Earth's materials and systems and surface processes**<br>a. Recognize various forms of evidence (e.g., seismic waves, iron meteorites, magnetic field data) that led to the current model of Earth's structure (i.e., hot but solid inner core, a liquid outer core, a solid mantle and crust).<br>b. Demonstrate knowledge of the dynamic processes of erosion, deposition, and transport, including evidence for connections between these processes and the formation of Earth's materials.<br>c. Demonstrate knowledge of relative and absolute dating techniques, including how half-lives are used in radiometric dating and of how evidence from rock strata is used to establish the geologic timescale.<br>d. Recognize the factors that can alter the flow of energy into and out of Earth's systems (e.g., tectonic events, ocean circulation, volcanic activity, vegetation).<br>e. Relate the abundance of liquid water on Earth's surface and water's physical and chemical properties to the dynamic processes shaping the planet's materials and surface.<br>f. Demonstrate knowledge of surficial processes that form geographic features of Earth's surface (e.g., mechanical, chemical, and biological weathering). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Earth and Space Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **4.3 Understanding plate tectonics and large-scale system interactions**<br>a. Demonstrate knowledge of the evidence for plate tectonics (e.g., the ages of crustal rocks, distribution of fossils and rocks, continental shapes) and relate plate movements to continental and ocean-floor features.<br>b. Demonstrate knowledge of the thermal processes driving plate movement and relate density and buoyancy to plate tectonics.<br>c. Demonstrate knowledge of the differences between types of plate boundaries, causes of volcanoes, earthquakes, and how Earth's resources relate to tectonic processes.<br>d. Demonstrate knowledge of the factors contributing to the extent of damage caused by an earthquake (e.g., epicenter, focal mechanism, distance, geologic substrate). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Earth and Space Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **4.4 Understand weather and climate**<br>a. Demonstrate knowledge of the water cycle and the interrelationships of surface and subsurface reservoirs.<br>b. Demonstrate knowledge of the causes of daily, seasonal, and climatic changes and analyze the uneven heating of Earth by the sun.<br>c. Analyze the effects of air movements on weather and interpret weather maps to predict weather patterns.<br>d. Demonstrate knowledge of the energy transfer processes of convection, conduction, and radiation in relation to the atmosphere/ocean and Earth's interior structure.<br>e. Demonstrate knowledge of the mechanisms and the significance of the greenhouse effect on Earth, including the roles of the oceans and biosphere in absorbing greenhouse gases.<br>f. Demonstrate knowledge of human activities and their impact on global climate change. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Earth and Space Sciences | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **4.5 Understand natural resources and natural hazards**<br>a. Demonstrate knowledge of renewable and nonrenewable energy resources (e.g., fossil fuels, nuclear fuels, solar, biomass).<br>b. Demonstrate knowledge of Earth's materials as resources (e.g., rocks, minerals, soils, water) that have a global distribution affected by past and current geological processes.<br>c. Analyze extraction and recycling processes in relation to energy, cost, and demand.<br>d. Demonstrate knowledge of sustainable uses of resources with respect to utility, cost, and demand.<br>e. Demonstrate knowledge of the effects of natural hazards (e.g., earthquakes, landslides, floods) on natural and human-made habitats.<br>f. Demonstrate knowledge of how the availability of natural resources and the existence of natural hazards and other geologic events have influenced the development of human society. | |

**Life Sciences-Biology Subject Matter Requirements**

Complete the matrix below by including links to course syllabi. Within each subdomain include direct links to supporting evidence addressing the subject matter requirement. These links must go directly the point in the syllabus where the subject matter requirement is addressed. Only submissions meeting this requirement will be sent to a team for review. Submissions not meeting this requirement will be returned to the institution.

# Life Sciences-Biology Subject Matter Requirements

**Domains in Life Sciences-Biology**

| **Domain 1: From Molecules of Organisms: Structures and Processes** | **Course number/name, units earned, grade earned; include a brief course description from the course syllabus** |
|---|---|
| **1.1 Understand the structure and function of cells**<br>a. Apply knowledge of the process by which DNA (deoxyribonucleic acid) within cells is responsible for determining the structure of the proteins that carry out the work of cells.<br>b. Analyze prokaryotic cells, eukaryotic cells, and viruses in terms of complexity, general structure (e.g., structure and function of cell organelles), and differentiation.<br>c. Demonstrate knowledge of the role of the endoplasmic reticulum and Golgi apparatus/complex in the production, transport, and secretion of proteins.<br>d. Apply knowledge of the structure of membranes (e.g., those found in chloroplasts, mitochondria, and cells) and analyze their role in cellular communication, transport, energy flow, and chemiosmosis.<br>e. Analyze methods of transport across the membrane (e.g., diffusion, active transport, endocytosis, exocytosis). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 1: From Molecules of Organisms: Structures and Processes | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **1.2 Understand the hierarchical organization and functioning of systems in multicellular organisms**<br>a. Demonstrate knowledge of the hierarchical structure, functions, and interactions of major organ systems (e.g., nutrient uptake, water delivery, physical support, reproduction) in plants and fungi.<br>b. Demonstrate knowledge of the hierarchical structure, functions, and interactions of major organ systems (e.g., circulatory, digestive, excretory, reproductive, respiratory) in animals, including humans.<br>c. Analyze feedback mechanisms that maintain homeostasis in plants and animals, including humans (e.g., endocrine and nervous systems), and mediate behaviors under a range of external conditions.<br>d. Analyze the various responses of the human immune system to infection, including the consequences of a compromised immune system as it relates to interactions with other systems. | |
| **1.3 Understand growth and development of organisms**<br>a. Demonstrate knowledge of the stages of the cell cycle.<br>b. Distinguish between the processes of mitosis and meiosis, including their purposes.<br>c. Demonstrate knowledge of the stages of mitosis; its significance in asexual reproduction; and its role in the growth, development, and maintenance of organisms.<br>d. Explain how cell division and differentiation produce and maintain a complex organism composed of systems of tissues and organs that work together to meet the needs of the whole organism. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 1: From Molecules of Organisms: Structures and Processes | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **1.4 Understand matter and energy flow in organisms**<br>a. Demonstrate knowledge of the process of photosynthesis, including the role of chloroplasts in obtaining and storing usable energy.<br>b. Analyze the process of cellular respiration, including the role of mitochondria and how cellular respiration results in the net transfer of energy from one system of interacting molecules to another.<br>c. Demonstrate knowledge of the anabolic and catabolic pathways involved in the metabolism of macromolecules (e.g., polysaccharides, nucleic acids, proteins, lipids).<br>d. Analyze the role of enzymes in chemical reactions and analyze experiments designed to investigate the catalytic role of enzymes and factors that affect enzyme activity (e.g., levels of protein organization, temperature, ionic conditions, concentration of enzyme and substrate, pH). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Ecosystems: Interactions, Energy, and Dynamics | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **2.1 Understand interdependent relationships in ecosystems**<br>a. Analyze factors affecting the carrying capacity of an ecosystem (e.g., availability of abiotic and biotic resources).<br>b. Apply knowledge of factors affecting population sizes of species within an ecosystem, (e.g., carrying capacity, predation, disease, life history characteristics).<br>c. Analyze the biotic interactions among organisms in ecosystems (e.g., competition, mutualism, pollination).<br>d. Analyze how individual and group behavior (e.g., nest building, flocking, schooling, herding, hunting) influence the chances of survival and reproduction for individuals and species. | |
| **2.2 Understand cycles of matter and energy transfer in eco systems**<br>a. Analyze the roles of organism in the flow of matter and energy in food webs (e.g., producers, consumers, decomposers).<br>b. Analyze the flow of matter and energy through trophic levels of ecosystems.<br>c. Demonstrate knowledge of how photosynthesis and cellular respiration (including anaerobic respiration) provide the energy for life processes.<br>d. Analyze how chemical elements are transferred among biotic and abiotic components of ecosystems (e.g., biogeochemical cycles) and how changes in amount and distribution of chemical elements can impact ecosystems. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 2: Ecosystems: Interactions, Energy, and Dynamics | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| 2.3 Understand ecosystem dynamics, functioning, and resilience<br>a. Apply knowledge of the biodiversity (e.g., genetic diversity, species diversity, ecosystem diversity) present in different types of biomes.<br>b. Demonstrate knowledge of how natural events and human activity (e.g., fire, flood, habitat destruction, introduction of invasive species) can adversely affect biodiversity and can disrupt an ecosystem.<br>c. Apply knowledge of how ecosystems respond to modest and catastrophic change (e.g., resilience, ecological<br>d. Evaluate possible solutions for mitigating adverse impacts of human activity on biodiversity. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Heredity: Inheritance and Variations of Traits | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.1 Understand inheritance of traits**<br>a. Analyze the structure of DNA and its relationship to genes.<br>b. Apply knowledge of how genes expressed by a cell may be regulated in different ways and that specialization of cells in multicellular organisms is due to different patterns of gene expression.<br>c. Analyze how DNA codes for proteins and DNA's regulatory or structural functions.<br>d. Apply knowledge of the role of alleles and chromosomes in determining phenotypes (e.g., sex determination, chromosomal aberrations).<br>e. Predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (e.g., autosomal or X-linked, dominant or recessive, codominance).<br>f. Apply knowledge of the genetic and cellular basis of Mendel's laws of dominance, segregation, and independent assortment. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 3: Heredity: Inheritance and Variations of Traits | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **3.2 Understand variation of traits and genetic engineering**<br>a. Recognize how sexual reproduction results in genetic variation as a result of chromosomal reorganization.<br>b. Apply knowledge of how genetic variation may be the result of error that occur during DNA replication or mutations caused by environmental factors, how these mutations are inherited, and the factors affecting whether or not these mutations are expressed.<br>c. Relate the structure and function of DNA and RNA (ribonucleic acid) to the concept of variation in organisms.<br>d. Apply knowledge of the genetic and environmental factors that affect variation and distribution of traits in a population, including how alleles that are lethal in a homozygous individual may be maintained in a gene pool.<br>e. Demonstrate knowledge of how genetic engineering (i.e., biotechnology) produces biomedical and agricultural products.<br>f. Demonstrate knowledge of issues of bioethics, including those related to genetic engineering, cloning, the Human Genome Project, and gene therapy and its medical implications. | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Biological Evolution: Unity and Diversity | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| **4.1 Understand evidence of common ancestry and diversity**<br>a. Apply knowledge of how conditions on early Earth led to the evolution of life, as well as how the evolution of life altered Earth's conditions.<br>b. Apply knowledge of anatomical, embryological, and genetic evidence to explain biological evolution and common ancestry.<br>c. Analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.<br>d. Analyze a branching diagram (cladogram) illustrating the phylogeny between organisms of currently identified taxonomic groups and demonstrate understanding that cladograms are hypotheses and can change with the discovery of new information (e.g., fossils, genetics). | |
| **4.2 Understand natural selection**<br>a. Apply knowledge of how genetic variation and its expression leads to differences in reproductive success among individuals in a population.<br>b. Analyze how natural selection acts on the phenotype rather than the genotype of an organism to alter genotypes in populations.<br>c. Analyze the role of diversity in gene pools.<br>d. Apply knowledge of Hardy-Weinberg equilibrium and its assumptions, and solve equations to predict the frequency of genotypes in a population.<br>e. Demonstrate knowledge of evolutionary mechanisms (e.g., genetic drift, reproductive isolation, patterns of selection) and their effects on patterns of speciation (e.g., convergent evolution). | |

# Life Sciences-Biology Subject Matter Requirements

| Domain 4: Biological Evolution: Unity and Diversity | Course number/name, units earned, grade earned; include a brief course description from the course syllabus |
|---|---|
| 4.3 Understand adaptation<br>a. Apply knowledge of factors affecting the adaptation of species (e.g., heritable genetic variation, competition, differential survival and reproduction of organisms).<br>b. Distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.<br>c. Apply knowledge of how natural selection results in genetic change in populations.<br>d. Analyze how changes in the physical environment may result in changes in the distribution of traits in a population and the emergence, decline, or extinction of species over time. | |

***To Be Completed by the Program:***

| | |
|---|---|
| **Total credits for all domains:** | |
| **Credits needed for Bachelor's Degree** | |