Agricultural Biology

Exam Information

Exam number
1911

Items
45

Points
58

Prerequisites
None

Recommended course length
One semester

National Career Cluster
Agriculture, Food, and Natural Resources

Performance standards
Included (Optional)

Certificate available
Yes

Description

The Agricultural Biology industry certification exam assesses learners' knowledge of the patterns, processes, relationships, and environments of living organisms. The exam assesses their understanding of the following topics: the role of matter cycles and energy flow when organisms interact with their environment, including how the stability and change of an ecosystem and biodiversity can be affected, the structures and functions of living organisms, the cause-and-effect relationships of heredity, the role of DNA in gene expression and protein synthesis, how gene expression can be altered by environmental and genetic causes, how the mechanisms of genetic variation can lead to diversity and explain unity among species, and evolution by natural selection.

Exam Blueprint

Standard	Percentage of exam
1. Interactions with Organisms and the Environment	24%
2. Structure and Function of Life	34%
3. Genetic Patterns	28%
4. Evolutionary Change	14%

Standard 1

Interactions with Organisms and the Environment

The cycling of matter and flow of energy are part of a complex system of interactions within an ecosystem. Through these interactions, an ecosystem can sustain relatively stable numbers and types of organisms. A stable ecosystem is capable of recovering from moderate biological and physical changes. Extreme changes may have a significant impact on an ecosystem's carrying capacity and biodiversity, altering the ecosystem. Human activities can lead to significant impacts on an ecosystem.

Objective 1 Plan and carry out an investigation to analyze and interpret data to determine how biotic and abiotic factors can affect the stability and change of a population. Emphasize stability and change in populations' carrying capacities and an ecosystem's biodiversity.

Objective 2 Develop and use a model to explain the cycling of matter and flow of energy among organisms in an ecosystem. Emphasize the movement of matter and energy through the different living organisms in an ecosystem. Examples of models could include food chains, food webs, energy pyramids, or pyramids of biomass.

Objective 3 Analyze and interpret data to determine the effects of photosynthesis and cellular respiration on the scale and proportion of carbon reservoirs in the carbon cycle. Emphasize the cycling of carbon through the biosphere, atmosphere, hydrosphere, and geosphere and how changes to various reservoirs impact ecosystems. Examples of changes to the scale and proportion of reservoirs could include deforestation, fossil fuel combustion, or ocean uptake of carbon dioxide.

Objective 4 Develop an argument from evidence for how ecosystems maintain relatively consistent numbers and types of organisms in stable conditions. Emphasize how changing conditions may result in changes to an ecosystem. Examples of changes in ecosystem conditions could include moderate biological or physical changes such as moderate hunting or a seasonal flood; and extreme changes, such as climate change, volcanic eruption, or sea level rise.

Objective 5 Design a solution that reduces the impact caused by human activities on the environment and biodiversity. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions and optimize a solution. Examples of human activities could include building dams, pollution, deforestation, or the introduction of invasive species.

Standard 2

Structure and Function of Life

Living cells are composed of chemical elements and molecules that form macromolecules. The macromolecules in a cell function to carry out important reactions that allow the cycling of matter and the flow of energy within and between organisms. All organisms are made of one or more cells. The structure and function of a cell determines the cell's role in an organism. Multicellular organisms have systems of tissues and organs that work together to meet the needs of the whole organism. Cells grow, divide, and function in order to accomplish essential life processes. Feedback systems help organisms maintain homeostasis.

Objective 1 Construct an explanation based on evidence that all organisms are primarily composed of carbon, hydrogen, oxygen, and nitrogen, and that the matter taken into an organism is broken down and recombined to make macromolecules necessary for life functions. Emphasize that molecules are often transformed through enzymatic processes and the atoms involved are used to make carbohydrates, proteins, fats/lipids, and nucleic acids.

Objective 2 Ask questions to plan and carry out an investigation to determine how (a) the structure and function of cells, (b) the proportion and quantity of organelles, and (c) the shape of cells result in cells with specialized functions. Examples could include mitochondria in muscle and nerve cells, chloroplasts in leaf cells, ribosomes in pancreatic cells, or the shape of nerve cells and muscle cells.

Objective 3 Develop and use a model to illustrate the cycling of matter and flow of energy through living things by the processes of photosynthesis and cellular respiration. Emphasize how the products of one reaction are the reactants of the other and how the energy transfers in these reactions.

Objective 4 Plan and carry out an investigation to determine how cells maintain stability within a range of changing conditions by the transport of materials across the cell membrane. Emphasize that large and small particles can pass through the cell membrane to maintain homeostasis.

Objective 5 Construct an explanation about the role of mitosis in the production, growth, and maintenance of systems within complex organisms. Emphasize the major events of the cell cycle including cell growth and DNA replication, separation of chromosomes, and separation of cell contents.

Objective 6 Ask questions to develop an argument for how the structure and function of interacting organs and organ systems, that make up multicellular organisms, contribute to homeostasis within the organism. Emphasize the interactions of organs and organ systems with the immune, endocrine, and nervous systems.

Objective 7 Plan and carry out an investigation to provide evidence of homeostasis and that feedback mechanisms maintain stability in organisms. Examples of investigations could include heart rate response to changes in activity, stomata response to changes in moisture or temperature, or root development in response to variations in water level.

Standard 3

Genetic Patterns

Heredity is a unifying biological principle that explains how information is passed from parent to offspring through deoxyribonucleic acid (DNA) molecules in the form of chromosomes. Distinct sequences of DNA, called genes, carry the code for specific proteins, which are responsible for the specific traits and life functions of organisms. There are predictable patterns of inheritance; however, changes in the DNA sequence and environmental factors may alter genetic expression. The variation and distribution of traits observed in a population depend on both genetic and environmental factors. Research in the field of heredity has led to the development of multiple genetic

technologies that may improve the quality of life but may also raise ethical issues.

Objective 1 Construct an explanation for how the structure of DNA is replicated, and how DNA and RNA code for the structure of proteins that regulate and carry out the essential functions of life and result in specific traits. Emphasize a conceptual understanding that the sequence of nucleotides in DNA determines the amino acid sequence of proteins through the processes of transcription and translation.

Objective 2 Use computational thinking and patterns to make predictions about the expression of specific traits that are passed in genes on chromosomes from parents to offspring. Emphasize that various inheritance patterns can be predicted by observing the way genes are expressed. Examples of tools to make predictions could include Punnett squares, pedigrees, or karyotypes. Examples of allele crosses could include dominant/recessive, incomplete dominant, codominant, or sex-linked alleles.

Objective 3 Engage in argument from the evidence that inheritable genetic variation is caused during the formation of gametes. Emphasize that genetic variation may be caused by epigenetics, during meiosis from new genetic combinations, or viable mutations.

Objective 4 Plan and carry out an investigation and use computational thinking to explain the variation and patterns in the distribution of the traits expressed in a population. Emphasize the distribution of traits as it relates to both genetic and environmental influences on the expression of those traits. Examples of variation and patterns in the distribution of traits could include sickle-cell anemia and malaria, hemoglobin levels in humans at high elevation, or antibiotic resistance.

Objective 5 Evaluate design solutions where biotechnology was used to identify and/or modify genes in order to solve (effect) a problem. Define the problem, identify criteria and constraints, analyze available data on BIO-proposed solutions, and determine an optimal solution. Emphasize arguments that focus on how effective the solution was at meeting the desired outcome.

Standard 4

Evolutionary Change

The unity among species, as evidenced in the fossil record, similarities in DNA and other bio-molecules, anatomical structures, and embryonic development, is the result of evolution. Evolution also explains the diversity within and among species. Evolution by natural selection is the result of environmental factors selecting for and against genetic traits. Traits that allow an individual to survive and reproduce are likely to increase in the next generation, causing the proportions of specific traits to change within a population. Over longer periods of time, changes in the proportions of traits due to natural selection and changes in selective pressures can cause both speciation and extinction. Changes in environmental conditions impact biodiversity in ecosystems and affect the natural selection of species.

Objective 1 Obtain, evaluate, and communicate information to identify the patterns in the evidence that support biological evolution. Examples of evidence could include DNA sequences, amino acid sequences, anatomical structures, the fossil record, or the order of appearance of structures during embryological development.

Objective 2 Construct an explanation based on evidence that natural selection is a primary cause of evolution. Emphasize that natural selection is primarily caused by the potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources, and the proliferation of those organisms that are better able to survive and reproduce in the environment.

Objective 3 Analyze and interpret data to identify patterns that explain the claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Emphasize analyzing shifts in the numerical distribution of traits and using these shifts as evidence to support explanations.

Objective 4 Engage in argument from evidence that changes in environmental conditions may cause increases in the number of individuals of some species, the emergence of new species over time, and/or the extinction of other species. Emphasize the cause-and-effect relationships for how changes and the rate of change to the environment affect the distribution or disappearance of traits in a species. Examples of changes in environmental conditions could include deforestation, application of fertilizers, drought, or flood.

Objective 5 Evaluate design solutions that can best solve a real-world problem caused by natural selection and adaptation of populations. Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Examples of real-world problems could include bacterial resistance to drugs, plant resistance to herbicides, or the effect of changes in climate on food LOG sources and pollinators.

Agricultural Biology

Performance assessments may be completed and evaluated at any time during the course. The following performance skills are to be used in connection with the associated standards and exam. To pass the performance standard the student must attain a performance standard average of 8 or higher on the rating scale. Students may be encouraged to repeat the objectives until they average 8 or higher.

Student's Name: _____

Class: _____