AP BIOLOGY

Course Description

AP Biology is designed to be the equivalent of an introductory course in college biology. The course is designed for high school students who have developed analytical skills and already have a knowledge and concept foundation in biology and basic chemistry. The course is built around the unifying themes of modern biology including molecules and cells, heredity and evolution, and organisms and populations.

Students develop a thorough understanding of biology concepts. Essential to this conceptual understanding are the following: a grasp of science as a process rather than as an accumulation of facts; personal experience in scientific inquiry; recognition of unifying themes that integrate the major topics of biology; and application of biological knowledge and critical thinking to environmental, social, and ethical concerns. Students participate in laboratory investigations using critical thinking skills and sophisticated tools and technology.

Successful completion of both terms of General or Honors Biology, and completion of, or concurrent enrollments in Honors or General Chemistry, or science teacher recommendation are required for AP Biology. Students are strongly encouraged to take the AP Biology exam.

Standards

Essential Standards

A student can:

1. Investigate the 12 recommended AP Biology laboratories. These investigations include:
    a. diffusion and osmosis and the concept of water potential.
    b. exploring how environmental factors affect the rate of enzyme-catalyzed reactions.
    c. demonstrating the role of meiosis in the formation of gametes in a controlled experiment using a model organism.
    d. determining why the rate of photosynthesis varies under different environmental conditions.
    e. testing the effects of temperature on the rate of cell respiration in ungerminated versus germinated seeds in a controlled experiment.
    f. genetically engineering bacteria and use gel electrophoresis to separate and identify DNA fragments.
    g. utilizing the chi-square method to analyze data from genetic crosses.
    h. detecting the presence or absence of evolution in a population using the Hardy-Weinberg equation.

i. testing the effects of environmental variable on rates of transpiration using controlled experiment.
j. analyzing cardiovascular rates in humans and other animals.
k. describing some aspects of animal behavior, such as orientation behavior, agonistic behavior, dominance display or mating behavior.
l. investigating the effects of changing light intensity and/or inorganic nutrient concentrations on primary productivity in a controlled experiment.

2. Demonstrate a conceptual understanding of the following themes:
   a. science as a process;
   b. evolution;
   c. energy transfer;
   d. continuity and change;
   e. relationship of structure to function;
   f. regulation;
   g. interdependence in nature; and
   h. science, technology, and society.

Important Standards

1. The student will comprehend that all living things are composed of cells, and that the life processes in a cell are based on molecular interactions by:
   a. comparing and contrasting the structures found in typical plant, animal and bacterial cells; and
   b. describing the role of enzymes as catalysts in metabolism and cellular synthesis of new molecules.
2. The student will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem by:
   a. describing the factors related to matter and energy in an ecosystem that both influence fluctuations in population size and determine the carrying capacity of a population;
   b. explaining how adaptations of species and co-evolution with other species are related to success in an ecosystem;
   c. identifying examples of mutualism, commensalisms, and parasitism in a stable ecosystem; and
   d. predicting and analyzing how a change in an ecosystem, resulting from natural causes, changes in climate, human activity or introduction of invasive species, can affect both the number of organisms in a population and the biodiversity of species in the ecosystem.
3. The student will explain how inherited characteristics are encoded by genes by:
   a. describing the structure and function of DNA and distinguish between replication, transcription and translation; and
   b. knowing that different species of multicellular organisms have a characteristic number of chromosomes, and that in typical humans there are 22 autosomal pairs and 2 sex chromosomes.

4. The student will understand how biological evolution provides a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms by using the principles of natural selection to explain the differential survival of groups of organisms as a consequence of:
    - The potential for a species to increase its numbers;
    - The genetic variability of offspring due to mutation and recombination of genes;
    - A finite supply of the resources required for life; and
    - The ensuing selection based on environmental factors of those offspring better able to survive and produce reproductively successful offspring.
5. The student will describe and explain the cycling of matter and flow of energy through an ecosystem's living and non-living components by explaining the relationship between abiotic and biotic components of an ecosystem in terms of the cycling of water, carbon, oxygen and nitrogen.
6. The student will understand how all organ systems, including the nervous system, interact to maintain homeostasis by:
    a. understanding and describing the basic anatomy and physiology of the nervous system and sense organs; and
    b. Describing how the functions of individual organ systems are integrated to maintain a homeostatic balance in the body.
7. The student will understand the nature of scientific ways of thinking and that scientific knowledge changes and accumulates over time by being able to explain how scientific and technological innovations as well as new evidence can challenge portions of or entire accepted theories and models including but not limited to cell theory, theory of evolution, and germ theory of disease.
8. The student will design and conduct a scientific investigation by:
    a. designing and completing a scientific experiment using scientific methods by determining a testable question, making a hypothesis, designing a scientific investigation with appropriate controls, analyzing data, making conclusions based on evidence and comparing conclusions to the original hypothesis and prior knowledge; and
    b. identifying possible sources of error and their effects on results.
9. The student will understand that the interactions of the atmosphere, biosphere, lithosphere, hydrosphere and space have resulted in ongoing change of the Earth system over geologic time by illustrating how biological processes have played significant roles in determining the character of the atmosphere, biosphere, hydrosphere and lithosphere over time.
10. The student will explain the causes and effects of the Earth's atmospheric and hydrological processes by predicting the cyclical movement of carbon and water through the lithosphere, hydrosphere, atmosphere and biosphere.

Enhancing Standards

1. The student will comprehend that all living things are composed of cells, and that the life processes in a cell are based on molecular interactions by differentiating between the processes of photosynthesis and respiration in terms of energy flow, reactants and products.
2. The student will classify, compare and contrast the diversity of organisms on Earth and their modes of accommodating the requirements for life by:
    a. relating the structure, complexity, and organization of organ systems to the methods of obtaining, transforming, releasing and eliminating the matter and energy used to sustain the organism;
    b. recognizing that organisms have both innate and learned behavioral responses to internal and external stimuli, including the tropic responses in plants; and
    c. using scientific evidence, including the fossil record, homologous structures, embryological development or biochemical similarities, to classify organisms in order to show probably evolutionary relationships and common ancestry.
3. The student will explain how inherited characteristics are encoded by genes by differentiating between dominant, recessive, co-dominant, incompletely dominant, polygenic and sex-linked traits.
4. The student will understand how biological evolution provides a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms by:
    a. describing how genetic variation between populations is due to different selective pressures acting on each population, which can lead to a new species; and
    b. Explaining the argument of how biological evolution leads to the diversity of species.
5. The student will describe and explain the cycling of matter and flow of energy through an ecosystem's living and non-living components by:
    a. knowing that all matter tends to become more disorganized over time, and that living systems require a continuous input of energy in order to maintain their chemical and physical organizations and prevent death; and
    b. understanding that matter and energy flow through different levels of organization of living systems, from cells to communities, as well as between living systems and the physical environment as chemical elements are recombined in different ways. Each recombination results in both storage dissipation and energy.
6. The student will understand the nature of scientific ways of thinking and that scientific knowledge changes and accumulates over time by:
    a. explaining how traditions of ethics, peer review, conflict and general consensus influences the conduct of science; and
    b. recognizing that some scientific ideas are incomplete, and opportunity exists in these areas for advances.
7. The student will design and conduct a scientific investigation by:
    a. distinguishing between qualitative and quantitative data;

b. applying mathematics and models to analyze data and support conclusions;
c. knowing that the professional scientists and engineers have ethical codes; and
d. giving examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.

8. The student will recognize the historical and cultural context of scientific endeavors and how they influence each other by:
a. being able to trace the development of a scientific advancement, invention, or theory and its impact on society;
b. providing examples of scientific advancements contributed by other civilizations and cultures; and
c. comparing and contrasting the differences between scientific theories and theories from other bodies of knowledge, and the importance of each in a science discussion.