AP Biology

Course Description:

Advanced Placement Biology is a 2-trimester-elective course. This course is designed to be the equivalent of a college introductory biology course usually taken by most college freshman. The curriculum, typical of an introductory college-level biology course, is developed from the College Board Advanced Placement Biology Curriculum. AP Biology is aimed at providing students with the conceptual framework, factual knowledge and analytical skills necessary to deal critically with the rapidly changing science of biology. The foundation of the course are the Big Ideas: *Evolution (EVO), Energetics (ENE), Information Storage and Transmission (IST), and Systems Interactions (SYI).* This class also prepares students to think critically about science as a process, including experimental design. AP Biology is a rigorous course and requires the student to have excellent study habits including reading, writing and notetaking. The information in this course overview outlines what students should understand and be able to do by the end of the school year.

Mastery Standards:

Living systems are organized in a hierarchy of structural levels that interact (SYI-1).

Competition and cooperation are important aspects of biological systems (SYI-2).

Naturally occurring diversity among and between components within biological systems affects interactions with the environment (SYI-3).

The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules (ENE-1).

Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments (ENE-2).

Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues (ENE-3).

Communities and ecosystems change on the basis of interaction among the population and disruption to the environment (ENE-4).

Heritable information provided for continuity of life (IST-1).

Differences in the expression of genes account for some of the phenotypic differences between organisms (IST-2).

Cells communicate by generating, transmitting, receiving and responding to chemical signals (IST-3).

The processing of genetic information is imperfect and is a source of genetic variation (IST-4).

Transmission of information results in changes within and between biological systems (IST-5).

Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence (EVO-1).

Organisms are linked by lines of descent from common ancestry (EVO-2).

Life continues to evolve within a changing environment (EVO-3).

Unit	Description of Unit and Learning Targets
Unit Title: Chemistry of Life Essential Questions: ● What is the role of energy in the making and breaking of polymers? ● How do living systems transmit information in order to ensure survival? ● How would living systems function without the polarity of the water molecule?	Students will be able to: ● Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function. ● Describe the composition of macromolecules required by living organisms. ● Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules. ● Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule. ● Describe the structural differences between DNA and RNA.
Unit Title: Cell Structure and Function Essential Questions: ● How do you defend the origin of eukaryotic cells? ● How do the mechanisms for transport across membranes support energy conservation? ● What are the advantages and disadvantages of cellular compartmentalization? ● How are living systems affected by the presence or absence of subcellular components?	Students will be able to: ● Describe the structure and/or function of subcellular components and organelles. ● Explain how subcellular components and organelles contribute to the function of a cell. ● Describe the structural features of a cell that allow organisms to capture, store and use energy. ● Explain the effect of surface area-to-volume ratios on the exchange of materials between cells or organisms and the environment. ● Explain how specialized structure and strategies are used for the efficient exchange of molecules to the environment. ● Describe the roles of each of the components of the cell membrane in maintaining the internal environment of the cell. ● Describe the Fluid Mosaic Model of cell membranes. ● Describe how the structure of biological membranes influences selective permeability. ● Describe the role of the cell wall in maintaining cell structure and function. ● Describe the mechanisms that organisms use to maintain solute and water balance. ● Describe the mechanisms that organisms use to transport large molecules across the plasma membrane. ● Explain how the structure of a molecule affects its ability to pass through the plasma membrane ● Explain how concentration gradients affect the movement of molecules across membranes ● Explain how osmoregulatory mechanisms contribute to the health and survival of organisms. ● Describe the processes that allow ions and other molecules to move across membranes. ● Describe the membrane-bound structures of the eukaryotic cell. ● Explain how internal membranes and membrane-bound organelles contribute to compartmentalization of eukaryotic cell functions. ● Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells. ● Describe the relationship between the functions of endosymbiotic organelles and their free-living ancestral

	counterparts.
Unit Title: Cellular Energetics <u>Essential Questions:</u> ● How is energy captured and then used by a living system? ● How do organisms use energy or conserve energy to respond to environmental stimuli?	Students will be able to: ● Describe the properties of enzymes. ● Explain how enzymes affect the rate of biological reactions. ● Explain how changes to the structure of an enzyme may affect its function. ● Explain how the cellular environment affects enzyme activity ● Describe the role of energy in living organisms. ● Describe the photosynthetic processes that allow organisms to capture and store energy. ● Explain how cells capture energy from light and transfer it to biological molecules for storage and use. ● Describe the processes that allow organisms to use energy stored in biological macromolecules. ● Explain how cells obtain energy from biological macromolecules in order to power cellular functions. ● Explain the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments
Unit Title: Cell Communication and Cell Cycle <u>Essential Questions:</u> ● In what ways do cells use energy to communicate with one another? ● How does the cell cycle aid in the conservation of genetic information? ● Why and in what ways do cells communicate with one another?	Students will be able to: ● Describe the ways that cells can communicate with one another. ● Explain how cells communicate with one another over short and long distances ● Describe the components of a signal transduction pathway. ● Describe the role of components of a signal transduction pathway in producing a cellular response. ● Describe the role of the environment in eliciting a cellular response. ● Describe the different types of cellular responses elicited by a signal transduction pathway ● Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway. ● Describe positive and/ or negative feedback mechanisms. ● Explain how negative feedback helps to maintain homeostasis. ● Explain how positive feedback affects homeostasis. ● Describe the events that occur in the cell cycle. ● Explain how mitosis results in the transmission of chromosomes from one generation to the next. ● Describe the role of checkpoints in regulating the cell cycle. ● Describe the effects of disruptions to the cell cycle on the cell or organism.
Unit Title: Heredity <u>Essential Questions:</u> ● How is our understanding of evolution influenced by our knowledge of genetics? ● Why is it important that not all inherited characteristics get expressed in the next generation? ● How would Mendel's laws have been affected if he had studied a different type of plant?	Students will be able to: ● Explain how meiosis results in the transmission of chromosomes from one generation to the next. ● Describe similarities and/ or differences between the phases and outcomes of mitosis and meiosis. ● Explain how the process of meiosis generates genetic diversity ● Explain how shared, conserved, fundamental processes and features support the concept of common ancestry for all organisms. ● Explain the inheritance of genes and traits as described by Mendel's laws.

● How does the diversity of a species affect inheritance?	● Explain deviations from Mendel's model of the inheritance of traits. ● Explain how the same genotype can result in multiple phenotypes under different environmental conditions. ● Explain how chromosomal inheritance generates genetic variation in sexual reproduction.
Unit Title: Gene Expression and Regulation <u>Essential Questions:</u> ● How does gene regulation relate to the continuity of life? ● How is a species' genetic information diversified from generation to generation?	Students will be able to: ● Describe the structures involved in passing hereditary information from one generation to the next. ● Describe the characteristics of DNA that allow it to be used as the hereditary material. ● Describe the mechanisms by which genetic information is copied for transmission between generations. ● Describe the mechanisms by which genetic information flows from DNA to RNA to protein. ● Describe how the phenotype of an organism is determined by its genotype. ● Describe the types of interactions that regulate gene expression. ● Explain how the location of regulatory sequences relates to their function. ● Explain how the binding of transcription factors to promoter regions affects gene expression and/or the phenotype of the organism. ● Explain the connection between the regulation of gene expression and phenotypic differences in cells and organisms. ● Describe the various types of mutation. ● Explain how changes in genotype may result in changes in phenotype. ● Explain how alterations in DNA sequences contribute to variation that can be subject to natural selection. ● Explain the use of genetic engineering techniques in analyzing or manipulating DNA
Unit Title: Natural Selection <u>Essential Questions:</u> ● What conditions in a population make it more or less likely to evolve? ● Scientifically defend the theory of evolution. ● How does species interaction encourage or slow changes in species?	Students will be able to: ● Describe the causes of natural selection. ● Explain how natural selection affects populations. ● Describe the importance of phenotypic variation in a population. ● Explain how humans can affect diversity within a population. ● Explain the relationship between changes in the environment and evolutionary changes in the population. ● Explain how random occurrences affect the genetic makeup of a population. ● Describe the role of random processes in the evolution of specific populations. ● Describe the change in the genetic makeup of a population over time. ● Describe the conditions under which allele and genotype frequencies will change in populations. ● Explain the impacts on the population if any of the conditions of HardyWeinberg are not met. ● Describe the types of data that provide evidence for evolution. ● Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time. ● Describe the fundamental molecular and cellular features shared across all domains of life, which provide evidence of

	common ancestry. ● Describe structural and functional evidence on cellular and molecular levels that provides evidence for the common ancestry of all eukaryotes. ● Explain how evolution is an ongoing process in all living organisms. ● Describe the types of evidence that can be used to infer an evolutionary relationship. ● Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness. ● Describe the conditions under which new species may arise. ● Describe the rate of evolution and speciation under different ecological conditions. ● Explain the processes and mechanisms that drive speciation. ● Describe factors that lead to the extinction of a population. ● Explain how the risk of extinction is affected by changes in the environment. ● Explain species diversity in an ecosystem as a function of speciation and extinction rates. ● Explain how extinction can make new environments available for adaptive radiation. ● Explain how the genetic diversity of a species or population affects its ability to withstand environmental pressures. ● Describe the scientific evidence that provides support for models of the origin of life on Earth.
Unit Title: Ecology <u>Essential Questions:</u> ● How does diversity among and between species in a biological system affect the evolution of species within the system? ● How does the acquisition of energy relate to the health of a biological system? ● How do communities and ecosystems change, for better or worse, due to biological disruption? ● How does a disruption of a biological system affect genetic information storage and transmission? ● How do species interactions affect the survival of an ecosystem?	Students will be able to: ● Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment. ● Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment. ● Describe the strategies organisms use to acquire and use energy ● Explain how changes in energy availability affect populations and ecosystems. ● Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem. ● Describe factors that influence growth dynamics of populations. ● Explain how the density of a population affects and is determined by resource availability in the environment. ● Describe the structure of a community according to its species composition and diversity. ● Explain how interactions within and among populations influence community structure. ● Explain how community structure is related to energy availability in the environment. ● Describe the relationship between ecosystem diversity and its resilience to changes in the environment. ● Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long-term structure. ● Explain the interaction between the environment and random or preexisting variations in populations. ● Explain how invasive species affect ecosystem dynamics. ● Describe human activities that lead to changes in ecosystem

	structure and/ or dynamics. ● Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics.