SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Advanced Placement Biology	**Length of Course:** Full Year
Grade Level(s): 11-12	**Periods Per Cycle:** 9
Units of Credit: 1.5	**Length of Period:** 40 Minutes
Classification: Elective	**Total Instructional Time:** 180 Hours

Course Description

The Advanced Placement (AP) Biology course is designed to be taken by students after the successful completion of a first course in both high school biology and chemistry. The AP Biology course is similar in scope and sequence to an introductory college Biology course and therefore, is designed to prepare students for the College Board Advanced Placement Exam. The course will cover advanced topics in the study of cellular and molecular biology, genetics, ecology, and evolution. AP Biology will offer a variety of in-depth laboratory experiences with the use of biotechnological applications throughout the year.

Instructional Strategies, Learning Practices, Activities, and Experiences

Teacher Demonstration Detailed Laboratory Experiments Inquiry Laboratory Experiments Textbook Reading Homework	Practice AP Exams and Essays Formal Assessments Guided Practice Online Tutorials/Resources Critical Thinking	Bell Ringers Class Discussion Flexible Groups Posted Objectives and Agenda

Assessments

Chapter Examinations (AP Formatted) Laboratory Write-Ups/Reports	End of Marking Period Cumulative Practice Exam	Study Guides

Materials/Resources

Biology for AP® courses, Julianne Zedalis & John Eggebrecht, © 2017 (OpenStax)	PowerPoint Lectures Note Packets Online Resources	Laboratory Resources & Equipment Laboratory Experiments College Board Materials

Adopted: 6/20/11
Revised: 5/19/14, 5/22/23

1. Chemistry of Life	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
1.1 Structure of Water and Hydrogen Bonding 1.2 Elements of Life 1.3 Introduction to Biological Macromolecules 1.4 Properties of Biological Macromolecules 1.5 Structure and Function of Biological Macromolecules 1.6 Nucleic Acids	1.1 Structure of Water and Hydrogen Bonding Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function. 1.2 Elements of Life Describe the composition of macromolecules required by living organisms. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. (NGSS Standard HS-LS1-6) 1.3 Introduction to Biological Macromolecules Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules. 1.4 Properties of Biological Macromolecules Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules. 1.5 Structure and Function of Biological Macromolecules Explain how a change in the subunits of a polymer may lead to changes in the structure or function of the macromolecule. 1.6 Nucleic Acids Describe the structural similarities and differences between DNA and RNA.

2. Cell Structure and Function	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
2.1 Cell Structure: Subcellular Components 2.2 Cell Structure and Function 2.3 Cell Size 2.4 Plasma Membranes 2.5 Membrane Permeability 2.6 Membrane Transport	2.1 Cell Structure: Subcellular Components Describe the structure and/or function of subcellular components and organelles. 2.2 Cell Structure and Function Explain how subcellular components and organelles contribute to the function of the cell. Describe the structural features of a cell that allow organisms to capture, store, and use energy. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. (NGSS Standard HS-LS1-2) 2.3 Cell Size Explain the effect of surface area to volume ratios on the exchange of materials between cells or organisms and the environment. Explain how specialized structures and strategies are used for the efficient exchange of molecules to the environment. 2.4 Plasma Membranes 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. 2.5 Membrane Permeability Explain how the structure of biological membranes influences selective permeability. Describe the role of the cell wall in maintaining cell structure and function. 2.6 Membrane Transport 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.

2. Cell Structure and Function Continued	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
2.7 Facilitated Diffusion 2.8 Tonicity and Osmoregulation 2.9 Mechanisms of Transport 2.10 Cell Compartmentalization 2.11 Origins of Cell Compartmentalization	2.7 Facilitated Diffusion Explain how the structure of a molecule affects its ability to pass through the plasma membrane. 2.8 Tonicity and Osmoregulation Explain how concentration gradients affect the movement of molecules across membranes. Explain how osmoregulatory mechanisms contribute to the health and survival of organisms. 2.9 Mechanisms of Transport Describe the processes that allow ions and other molecules to move across membranes. 2.10 Compartmentalization Describe the membrane-bound structures of the eukaryotic cell. Explain how internal membranes and membrane-bound organelles contribute to the compartmentalization of eukaryotic cell functions. 2.11 Origins of Cell Compartmentalization 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.

3. Cellular Energetics	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
3.1 Enzyme Structure 3.2 Enzyme Catalysis 3.3 Environmental Impacts on Enzyme Function 3.4 Cellular Energy 3.5 Photosynthesis 3.6 Cellular Respiration 3.7 Fitness	3.1 Enzyme Structure Describe the properties of enzymes. 3.2 Enzyme Catalysis Explain how enzymes affect the rate of biological reactions. 3.3 Environmental Impacts on Enzyme Function Explain how changes to the structure of an enzyme may affect its function. Explain how the cellular environment affects enzyme activity. 3.4 Cellular Energy Describe the role of energy in living organisms. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. (NGSS Standard HS-LS2-3) Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (NGSS Standard HS-LS2-5) 3.5 Photosynthesis 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. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (NGSS Standard HS-LS1-5) 3.6 Cellular Respiration 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. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. (NGSS Standard HS-LS1-7) 3.7 Fitness 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.

4. Cell Communication and Cell Cycle	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
4.1 Cell Communication 4.2 Introduction to Signal Transduction 4.3 Signal Transduction 4.4 Changes in Signal Transduction Pathways 4.5 Feedback 4.6 Cell Cycle 4.7 Regulation of Cell Cycle	4.1 Cell Communication Describe the ways that cells can communicate with one another. Explain how cells communicate with one another over short and long distances. 4.2 Introduction to Signal Transduction Describe the components of a signal transduction pathway. Describe the role of components of a signal transduction pathway in producing a cellular response. 4.3 Signal Transduction Describe the role of the environment in eliciting a cellular response. Describe the different types of cellular responses elicited by a signal transduction pathway. 4.4 Changes in Signal Transduction Pathways Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway. 4.5 Feedback Describe positive and/or negative feedback mechanisms. Explain how negative feedback helps to maintain homeostasis. Explain how positive feedback affects homeostasis. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. (NGSS Standard HS-LS1-3) 4.6 Cell Cycle Describe the events that occur in the cell cycle. Explain how mitosis results in the transmission of chromosomes from one generation to the next. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. (NGSS Standard HS-LS1-4) 4.7 Regulation of Cell Cycle Describe the role of checkpoints in regulating the cell cycle. Describe the effects of disruptions to the cell cycle on the cell or organism.

5. Heredity	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
5.1 Meiosis 5.2 Meiosis and Genetic Diversity 5.3 Mendelian Genetics 5.4 Non-Mendelian Genetics 5.5 Environmental Effects on Phenotype 5.6 Chromosomal Inheritance	5.1 Meiosis 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. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. (NGSS Standard HS-LS3-2) 5.2 Meiosis and Genetic Diversity Explain how the process of meiosis generates genetic diversity. 5.3 Mendelian Genetics 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. 5.4 Non-Mendelian Genetics Explain deviations from Mendel's model of the inheritance of traits. 5.5 Environmental Effects on Phenotype Explain how the same genotype can result in multiple phenotypes under different environmental conditions. 5.6 Chromosomal Inheritance Explain how chromosomal inheritance generates genetic variation in sexual reproduction. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. (NGSS Standard HS-LS3-3)

6. Gene Expression and Regulation	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
6.1 DNA and RNA Structure 6.2 Replication 6.3 Transcription and RNA Processing 6.4 Translation 6.5 Regulation of Gene Expression 6.6 Gene Expression and Cell Specialization 6.7 Mutations 6.8 Biotechnology	6.1 DNA and RNA Structure 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. 6.2 Replication Describe the mechanisms by which genetic information is copied for transmission between generations. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. (NGSS Standard HS-LS3-1) 6.3 Transcription and RNA Processing Describe the mechanisms by which genetic information flows from DNA to RNA to protein. 6.4 Translation Explain how the phenotype of an organism is determined by its genotype. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. (NGSS Standard HS-LS1-1) 6.5 Regulation of Gene Expression Describe the types of interactions that regulate gene expression. Explain how the location of regulatory sequences relates to their function. 6.6 Gene Expression and Cell Specialization 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. 6.7 Mutations Describe the various types of mutations. Explain how changes in genotype may result in changes in phenotype. Explain how alterations in DNA sequences contribute to the variation that can be subject to natural selection. 6.8 Biotechnology Explain the use of genetic engineering techniques in analyzing or manipulating DNA.

7. Natural Selection	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
7.1 Introduction to Natural Selection 7.2 Natural Selection 7.3 Artificial Selection 7.4 Population Genetics 7.5 Hardy-Weinberg Equilibrium 7.6 Evidence of Evolution	7.1 Introduction to Natural Selection Describe the causes of natural selection. Explain how natural selection affects populations. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. (NGSS Standard HS-LS2-8) 7.2 Natural Selection Describe the importance of phenotypic variation in a population. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. (NGSS Standard HS-LS4-3) 7.3 Artificial Selection Explain how humans can affect diversity within a population. Explain the relationship between changes in the environment and evolutionary changes in the population. 7.4 Population Genetics 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. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. (NGSS Standard HS-LS4-4) 7.5 Hardy-Weinberg Equilibrium 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 Hardy-Weinberg are not met. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. (NGSS Standard HS-LS3-3) 7.6 Evidence of Evolution 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.

7. Natural Selection Continued	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
7.7 Common Ancestry 7.8 Continuing Evolution 7.9 Phylogeny 7.10 Speciation 7.11 Extinction 7.12 Variations in Populations 7.13 Origins of Life on Earth	7.7 Common Ancestry Describe structural and functional evidence on cellular and molecular levels that provide evidence for the common ancestry of all eukaryotes. 7.8 Continuing Evolution Explain how evolution is an ongoing process in all living organisms. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. (NGSS Standard HS-LS4-1) Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. (NGSS Standard HS-LS2-8) 7.9 Phylogeny 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. 7.10 Speciation 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. 7.11 Extinction 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. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. (NGSS Standard HS-LS4-5) 7.12 Variations in Populations Explain how the genetic diversity of a species or population affects its ability to withstand environmental pressures. 7.13 Origins of Life on Earth Describe the scientific evidence that provides support for models of the origin of life on Earth.

8. Ecology	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
8.1 Responses to the Environment 8.2 Energy Flow Through Ecosystems 8.3 Population Ecology 8.4 Effect of Density of Populations	8.1 Responses to the Environment Explain how the behavioral and/or physiological response of an organism is related to changes in the internal or external environment. Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population. 8.2 Energy Flow Through Ecosystems 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. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. (NGSS Standard HS-LS2-4) 8.3 Population Ecology Describe factors that influence the growth dynamics of populations. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. (NGSS Standard HS-LS2-2) 8.4 Effect of Density of Populations Explain how the density of a population affects and is determined by resource availability in the environment.

8. Ecology Continued	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
8.5 Community Ecology 8.6 Biodiversity 8.7 Disruptions to Ecosystems	8.5 Community Ecology 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. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (NGSS Standard HS-LS2-1) 8.6 Biodiversity 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. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. * (NGSS Standard HS-LS2-7) Create or revise a simulation to test a solution to mitigate the adverse impacts of human activity on biodiversity. * (NGSS Standard HS-LS4-6) 8.7 Disruptions to Ecosystems 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. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem. (NGSS Standard HS-LS2-6)