AP Biology

Unit 1 (Biochemistry)

Estimated Unit Time Frames	Big Ideas	Essential Questions	Concepts (Essential Knowledge)	Competencies (Learning Objectives)	Lessons/ Suggested Resources	Vocabulary
1 Month (September)	Biological systems use molecular building blocks to grow, reproduce, and maintain homeostasis.	What is the basic biochemistry associated with life?	Organisms must exchange matter with the environment to grow, reproduce, and maintain organization. The sub-components of molecules and their sequence determines the properties of that molecule. Shape and	1. Use calculated surface area-to-volume ratios to predict which cells might eliminate wastes or procure nutrients faster by diffusion. 2. Explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination. 3. Justify the selection of data regarding the types of molecules that an animal, plant or bacterium will take up as necessary building blocks and excrete as waste. 4. Represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth, and reproduction. 5. Explain the connection between the sequence and the subcomponents of a	Labs: 1.Cell size 2.Environmental factors affecting plant growth 3. Molecular modeling.	Monomers Polymers Dehydration Hydrolysis Carbohydrates Lipids Proteins Nucleic acids

			function are related to each other	biological polymer and its properties. 6. Refine representations and models to explain how the subcomponents of a biological polymer and their sequence determine the properties of that polymer. 7. Use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule. 5. Construct explanations based on evidence as to how interactions of subcellular structures, which possess specialized functions, provide essential functions. 6. Use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions provide essential functions.		
Unit 2 Cell Structure						
Estimated Unit Time Frames	**Big Ideas**	**Essential Questions**	**Concepts (Essential Knowledge)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**
1 month (October)	Biological systems interact in complex	What are the structures and	The structure and function of subcellular components	1. Make a prediction about the interactions of subcellular organelles. 2. Construct explanations based on	Labs: 1. microscopic observation	Prokaryotic Eukaryotic Compartmentalization

	ways.	properties of living cells? How are eukaryotic cells different that prokaryotic? How doe cells regulate what passes through their plasma membranes?	and their interactions provide essential cellular processes. Cellular are selectively permeable due to their structure. Growth and homeostasis are maintained by constant movement of molecules across membranes. Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	evidence as to how interactions of subcellular structures, which possess specialized functions, provide essential functions. 3. Use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions provide essential functions. 4. Refine representations to illustrate how interactions between external stimuli and gene expression result in specialization of cells. 5. Evaluate questions concerning organisms that exhibit complex properties due to the interaction of their constituent parts. 6. Predict the effects of change in a component o f a biological system on the functionality of an organism. 7. Refine representations and models to illustrate biocomplexity due to interactions of the constituent parts. 4A54A4 . Analyze data to identify how molecular interactions affect structure and functions. 10. Use representations and models to pose questions about	of prokaryotic and eukaryotic cells. 2. Surface area to volume ratio calculations.	Golgi body Ribosomes Vesicles Endopalsmi reticulum Lysosomes

			Organisms use feedback mechanisms to maintain homeostasis and respond to external environmental changes.	properties of cell membranes and selective permeability based on molecular structure. 11. Construct models that connect the movement of molecules across membranes with membrane structure and function. 2B2 12. Use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes. 2B3 13. Explain how internal membranes and organelles contribute to cell functions. 14. Use representations and models to describe differences in prokaryotic and eukaryotic cells. 2C1		
Unit 3 Cell Communication/ Nervous and Endocrine Systems						
Estimated Unit Time Frames	**Big Ideas**	**Essential Questions**	**Concepts (Essential Knowledge)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**

3 Weeks (December)	Cells communicate via chemical and electrical signals. Cell communication pathways are the same for all species.	How do cells in a multicellular organism communicate with each other? What are necessary steps to cell communication?	Mechanisms of cellular communication are conserved across species. These mechanisms evolve very early in the history of life on earth. Cell communication pathways include a signal, a receptor, transduction across the membrane and a response.	2D4 29. Create representations and models to describe immune responses. 30. Create models to describe nonspecific immune defenses in plants and animals. 2E1 31. Show that timing and coordination of specific events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. 32. Use a graph or diagram to analyze situations or solve problems (quantitatively or qualitatively) that involve timing and coordination of events necessary for normal development in an organism. 33. Justify claims with evidence to show that timing and coordination of several events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. 34. Describe the role of programmed cell death in development and differentiation, the reuses of molecules, and the maintenance of homeostasis. 2E2 35. Design a plan for collecting data		

				to support the claim that the timing and coordination of physiological events involve regulation. 36. Justify claims with evidence to show how timing and coordination of physiological events involve regulation. 37. Connect concepts that describe mechanisms that regulate the timing and coordination of physiological events. 2E3 38. Analyze data to support the claim that responses to information and communication of information affect natural selection. 39. Justify claims using evidence to describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms 40. Predict how environmental factors affect responses to information and change behavior. 3D1 31. Describe the chemical processes for cell communication shared across evolutionary lines of decent. 32. Generate questions involving cell communication as it relates to the process of evolution.		

				33. Use representations and models to describe features of a cell signaling pathway. 3D2 34. Construct explanations of cell communication through cell-to-cell direct contact or through chemical signaling. 35. Create representations that depict how cell-to-cell communication occurs by direct contatct or from a distance through chemical signaling. 3D3 36. Describe a model that expresses the key elements of signal transduction pathways by which a signal is converted to a cellular response. 3D4 37. Justify claims based on evidence that changes in signal transduction pathways can alter cellular response. 38. Describe a model that expresses key elements to show how change in signal transduction can alter cellular response. 39. Explain how certain drugs affect signal reception and consequently, signal transduction pathways.		

				3E1 40. Analyze data that indicate how organisms exchange information in response to internal changes and external cues, and which can change behavior. 41. Describe how organisms exchange information in response to internal changes and external cues, and which can result in changes of behavior. 42. Describe how organisms exchange information in response to internal changes or environmental cues. 3E2 43. Explain how the nervous systems detect external and internal signals, transmit and integrate information, and produce responses. 44. Describe the nervous system detect external and internal signals. 45. Describe how the nervous system transmits information. 46. Describe how the vertebrate brain integrates information to produce a response. 47. Create a visual representation of complex nervous systems to describe/explain how these systems detect external and internal signals,		

				transmit and integrate information and produce a response. 48. Create a visual representation to describe how nervous systems detect external and internal signals. 49. Create a visual representation to describe how nervous systems transmit information. 50. Create a visual representation to describe how the vertebrate brain integrated information to produce a response.		
Unit 4 Cellular Energetics (Enzymes)						
Estimated Unit Time Frames	**Big Ideas**	**Essential Questions**	**Concepts (Essential Knowledge)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**
2 months November, December	Biological systems utilize free energy to grow. Reproduce, and maintain homeostasis,	How and why does life capture, transform, transfer, and use energy?	All living systems require constant input of energy. Organisms capture and store free energy for use in	Analyze data to identify how molecular interactions affect structure and functions Justify a claim made about the effects on a biological system at the molecular, physiological, or organismal level when given a scenario in which one or more components within a negative regulatory system is altered. 16. Connect how organisms use negative feedback to maintain their internal environments.	Required Labs: Environmental factors affecting enzymes Plant pigment chromatography.	ATP Coupling Endergonic Exergonic Entropy Enzyme Active sites Feedback Respiration Photosynthesis Aerobic

			biological processes. Energy coupling is a primary role of ATP Enzymes lower activation energy thus speeding up metabolic pathways.	17. Evaluate data that show the effects of changes in concentrations of key molecules on negative feedback mechanisms. 18. Make predictions about how organisms use negative feedback mechanisms to maintain their internal environments. 19. Make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models. 20. Justify that positive feedback mechanisms amplify responses in organisms. Explain how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, grow and reproduce. 2. Justify a scientific claim that free energy is required for living systems to maintain organization, grow, or to reproduce, but that multiple strategies exist in different living systems. 3. Predict how changes in energy availability affect organisms, populations, and ecosystems.	Environmental factors affecting respiration. Environmental factors affecting photosynthesis. Environmental factors affecting transpiration.	Anaerobic Transpiration

				2A2 4. Use representations to pose scientific questions about what mechanisms and structural features allow organisms to capture, store and use free energy. 5. Construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store, or use energy. 4A6 14. Apply mathematical routines to quantities that describe interactions among living systems and their environment, which result in the movement of matter and energy. 15. Use visual representations to analyze situations or solve problems qualitatively to illustrate how interactions among living systems and with their environment result in the movement of matter and energy. 16. Predict the effects of a change of matter or energy availability on communities		
UNIT 5 Molecular Genetics						

Estimated Unit Time Frames	**Big Ideas**	**Essential Questions**	**(Essential Knowledge) Concepts)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**
1 month (January)	Living systems store, retrieve, transmit, and respond to information essential to life processes.	How is biological information stored, transmitted, and processed?	DNA is the primary source of heritable information. Biological information flows from DNA to RNA to proteins sequences. Humans can modifiy an organisms genome. Genetic information can be turned on and off due to environmental factors.	3A1 1. Construct explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA and, in some cases, that RNA are the primary sources of heritable information. 2. Justify the selection of data from historical investigations that support the claim that DNA is the source of heritable information. 3. Describe with representations and models illustrating how genetic information is copied for transmission between generations. 4. Describe representations and models illustrating how genetic information is translated into polypeptides. 5. Justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies. 6. Predict how a change in a specific DNA or RNA sequence can result in changes in gene expression.	Labs: Restriction Enzyme Cleavage of DNA , Gel Electrophoresis and restriction fragment analysis. Bacterial Transformation using pGlo plasmid.	Nucleotid DNA RNA Transcription Translation Mutation Gel electrophoresis Restriction enzymes Operon

				3B1 18. Describe the connection between the regulation of gene expression and observed differences between different kinds of organisms. 19. Describe the connection between the regulation of gene expression and observed idfferences between individuals in a population. 20. Explain how the regulation of gene expression is essential for the process and structures that support cell function. 21. Use representations to describe how gene regulation influences cell products and function. 3B2 22. Explain how signal pathways mediate gene expression, including how this process can affect protein production. 23. Use representations to describe mechanisms of the regulation of gene expression.		
Unit 6 Cell Reproduction and Inheritance						
Estimated Unit Time Frames	**Big Ideas**	**Essential Questions**	**Concepts (Essential Knowledge)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**

1 month (February)	Heritable information is passed to the next generation via the cell cycle and mitosis or meiosis and fertilization	What factors affect the cell cycle? How are the processes of mitosis and meiosis different in terms of function? How can the laws of inheritance be used to make genetic predictions? How can data be statistically analyzed?	The chromosomal basis of inheritance provides an understanding of the patterns of transmittance of genes from parent to offspring.	3A2 7. Make predictions about natural phenomena occurring during the cell cycle. 8. Describe the events that occur in the cell cycle. 9. Construct explanations, using visual representations or narratives, as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization. 10. Represent the connection between meiosis and increased genetic diversity necessary for evolution. 11. Evaluate evidence provided by data sets to support the claim that heritable information is passed from one generation to another generation through mitosis, or meiosis followed by fertilization. 3A3 12. Construct a representation that connects the process of meiosis to the passage of traits from parent to offspring. 13. Pose questions about ethical, social, or medical issues surrounding human genetic disorders. 14. Apply mathematical routines to determine Mendelian patterns of	Labs: Cell cycle and factors that affect the cell cycle. Modeling meiosis Calculation of cross-over frequencies during meiosis Chi-square analysis of genetic cross predictions and observed values.	Cell cycle Mitosis Meiosis Gamete Haploid Diploid Crossing over

				inheritance provided by data sets. 3A4 15. Explain deviations from Mendel's model of the inheritance of traits. 16. Explain how the inheritance patterns of many traits cannot be accounted for by Mendelian genetics. 17. Describe representations of an appropriate example of inheritance patterns that cannot be explained by Mendel's model of the inheritance of traits.		
UNIT 7 EVOLUTION						
Estimated Unit Time Frames	**Big Ideas**	**Essential Questions**	**Concepts (Essential Knowledge)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**
One Month (March)	The process of evolution drives the diversity and unity of life.	What evidence supports the theory of common ancestry? What mechanisms are responsible	Natural selection is a major mechanism of evolution. Natural selection acts on phenotypic variations in a	1A1 1. Convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the causes and effects of this change. 2. Evaluate evidence provided by data to qualitatively and quantitatively investigate the role of natural selection	Labs: 1. Artificial selection using fast plants. 2. Mathematical modeling using Hardy-	Species Population Natural Selection Mutation Genetic Drift Fitness Reproductive Isolation Temporatl

		for evolution? What patterns of evolution are possible? How can evolution be modeled mathematically? How can cladograms and phylogenetic trees be constructed using DNA and protein sequences? What is the current theory on the origin of life on earth?	population. Evolutionary change is also driven by random processes. Biological evolution is supported by scientific evidence from many disciplines, including mathematics. Organisms are linked by lines of descent from common ancestory. Phylogenetic trees and cladograms are graphical representations (models) of	in evolution 3. Apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future. 1A2 4. Evaluated data-based evidence that describes evolutionary changes in the genetic makeup of a population over time. 5. Connect Evolutionary changes in a population over time to a change in the environment 1A3 6. Use data from mathematical models based on the Hardy Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of small populations. 7. Justify data from mathematical models based on the Hardy Weinberg equilibrium to analyze genetic drift the effects of selection in the evolution of specific populations 8. Make predictions about the effects of genetic drift, migration, and artificial selection on the genetic makeup of a population	Weinberg. 3. Comparing DNA sequences to understand evolutionary relationships with Blast. 4. Antibotic resistance using bacterial cultures	isolation Bottleneck Effect Convergent Divergent Stabilizing Directional Disruptive Phylogenetic Trees Cladograms Speciation

			evolutionary history.	1A4 9. Evaluate evidence provided by data from many scientific disciplines that support biological evolution. 10. Refine evidence based on data from many scientific disciplines that support biological evolution. 11. Design a plan to answer scientific questions regarding how organisms have changed over time using information from morphology, biochemistry, and geology. 12. Connect scientific evidence from many scientific disciplines to support the concept of evolution. 13. Construct and justify mathematical models, diagrams or simulations that represent processes of evolution. 1B1 14. Pose scientific questions that identify essential properties of shared, core life processes that provide insights into the history of life on Earth. 15. Describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and how these shared conserved core processes and features support the concept of		

				common ancestry for all organisms. 16. Justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. 1B2 17. Pose questions about a group of organisms whose relatedness is described by a phylogenic tree or cladogram in order to : 1. Identify shared characteristics, 2. Make inferences about the evolutionary history of the group, 3 identify character data that could extend or improve the phylogenic tree. 18. Evaluate evidence provided by a data set in conjunction with a phylogenetic tree or simple cladogram to determine evolutionary history and speciation. 19. Create a phylogenic tree or simple cladogram that correctly represents evolutionary history and speciation from a provided data set. Phylogenetic trees represent traits that are either derived or lost due to evolution. Number of heart chambers, opposable thumbs, absence of legs in sea		

				mammals 1C1 20. Analyze data related to questions of speciation and extinction throughout Earth's history. 21. Design a plan for collecting data to investigate the claim that speciation and extinction have occurred throughout Earth's history. 1C2 22. Use data from a real or simulated population based on graphs or models of types of selection to predict what will happen to the population in the future. 23. Justify the selection of data that address questions related to reproductive isolation and speciation. 24. Describe speciation in an isolated population and connect it to change in gene frequency, change in environment, natural selection and/or genetic drift. 1C3 25. Describe a model that represents evolution within a population. Haki Crabs 26. Evaluate given data sets that illustrate evolution as an ongoing		

				process. 1D1 27. Describe a scientific hypothesis about the origin of life on Earth. 28. Evaluated questions based on hypothesis about the origin of life on Earth. 29. Describe the reasons for revisions of scientific hypotheses of the origin of life on Earth. 30. Evaluate scientific hypothesis about the origin of life on Earth. 31. Evaluate the accuracy and legitimacy of data to answer questions about the origin of life on Earth. 1D2 32. Justify the selection of geological, physical, and chemical data that reveal early Earth conditions.		
UNIT 8 ECOLOGY						
Estimated Unit Time Frame	**Big Ideas**	**Essential Questions**	**Concepts (Essential Knowledge)**	**Competencies (Learning Objectives)**	**Lessons/ Suggested Resources**	**Vocabulary**
1 month (April)	Biological systems interact and their interactions possess	What type of examples can be used to describe relationships between	Interactions between external stimuli and gene expression	2C2 21. Justify the selection of the kind of data needed to answer questions about the relevant mechanism that organisms use to respond to changes in their external environment.	Labs: Dissolved oxygen measuremen ts and	Individual Population Community Ecosystem Biotic Abiotic

	complex properties.	organisms in the cycling of matter and the flow of energy? What type of ecological relationships exist between members of different species in a community? What types of ecological impacts can be attributed to human activity? What factors affect population dynamics?	result in specialization of cells. Organisms exhibit complex properties due to interactions between their constituent parts. Communities are composed of populations of organisms that interact in complex ways. Interactions among living systems and with their environment result in the movement of matter and	2D1 22. Refine models and questions about the effect of complex biotic and abiotic interactions on all biological systems from cells and organisms to populations, communities, and ecosystems. 23. Design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities, and ecosystems) are affected by complex biotic and abiotic interactions. 24. Analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities, or ecosystems). 2D2 4A5 11. Justify the selection of the kind of data needed to answer questions about the interaction of populations within communities. 12. Apply mathematical routines to quantities that describe communities composed of populations of organisms that interact in complex ways. 13. Predict the effects of change in the communities' populations on the	eutrophication.	Symbiosis Mutualism Commensulism Parasitism Exponential Density dependent Density independent Non-native (introduced species)

			energy. Interactions between and within populations influence patterns of species distribution and abundance. Humans have impacted the distribution of local and global ecosystems over time. The level of variation in a population affects population dynamics. The diversity of species within an	community. 4A6 4B2 18. Use representations and models to analyze how cooperative interactions within organisms promote efficiency in the use of energy and matter. 4B3 19. Use data analysis to refine observations and measurements regarding the effect of population interactions on patterns of species distribution and abundance. 4B4 20. Explain how the distribution of ecosystems changes over time by identifying large-scale events that have resulted in changes in the past. 21. Predict consequences of human actions on both local and global systems. 4C1 22. Construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions. 23. Construct explanations of the influence of environmental factors on the phenotype of an organism. 24. Predict the effects of a change		

			ecosystem may influence the stability of the ecosystem.	in an environmental factor on the genotypic expression of the phenotype. 4C3 25. Use evidence to justify a claim that a variety of phenotypic responses to a single environmental factor can result from different genotypes within the population. 26. Use theories and models to make claims and/or predictions about the effects of variation within populations on survival and fitness. 4C4 27. Make claims and predictions about how species diversity within an ecosystem influences ecosystem stability.		