URBANDALE COMMUNITY SCHOOL DISTRICT

Course Title:	**College AP Biology**

Description: College AP Biology will cover a full range of biology concepts from microbiology to macro-biology. This is a college level biology course. A fundamental understanding of chemistry concepts is important to a student's success in this class. First semester will focus on microbiology, such as biochemistry, cell biology, biochemical pathways, genetics, and heredity. Second semester will emphasize macro-biology, such as evolution, taxonomy and classification of species, and the structure and physiology of plants and animals. **Qualifies for DMACC credit BIO 112 and BIO 113.**

Reporting Topic	Course Level Standards	Competency Statement
Chemistry of Life	• Define atoms, molecules, chemical bonds, and chemical reactions (3.1) • Describe the unique physical and chemical characteristics of water that support life. (3.2) • Identify structural characteristics of carbohydrates, lipids, proteins, and nucleic acids, and explain their modes of synthesis and degradation. (3.3) • Investigate features of biological macromolecules in the laboratory. (3.4) • Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function (SYI-1.A) • Describe the composition of macromolecules required by living organisms. (ENE-1.A) • Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules (SYI-1.B) • Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecules. (SYI-1.C)	Students will be able to explain the basic structure, composition, and chemical reactions that occur in living things.
Cell Structure and Function	• Identify the structural and functional similarities and differences that exist between prokaryotic and eukaryotic cells (4.1) • Correlate the structure of each eukaryotic cell component to its biological function. (4.2) • Understand how compositional and organizational aspects of membrane structure underlie cellular functions (5.1) • Compare and contrast passive and active modes of membrane transport in terms of energetic requirements and existing gradients of concentration or electrical potential (5.2) • Describe the structure and/or function of subcellular components and organelles. (SYI-1.D) • Explain how subcellular components and organelles contribute to the function of the cell (SYI-1.E) • Describe the structural features of a cell that allow organisms to capture, store, and use energy. (SYI-1.F) • Describe the roles of each of the components of the cell membrane in maintaining the internal	Students will be able to identify major parts of a cell and membrane structure, explain how structure determines function, and predict responses to cell and membranes in various environments.

	environment of the cell (ENE-2.A) ● Describe the Fluid Mosaic Model of cell membranes (ENE-2.B) ● Explain how the structures of biological membranes influence selective permeability. (ENE-2.C) ● Describe the role of the cell wall in maintaining cell structure and function. (ENE-2.D) ● Describe the membrane-bound structures of the eukaryotic cell. (ENE-2.K) ● Explain how internal membranes and membrane-bound organelles contribute to compartmentalization of eukaryotic cell functions. (ENE-2.L ● Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells. (EVO-1.A) ● Understand the central role of endosymbiosis to eukaryote evolution and diversity. (3.2) ● Observe prokaryotes in the laboratory. (2.6) ● Describe the process of prokaryotic genetic recombination. (2.3) ● Recognize the diverse ecological roles of prokaryotes and understand how roles can be exploited for biotechnology. (2.5)	
Cell Energetics	● Compare and contrast passive and active modes of membrane transport in terms of energetic requirements and existing gradients of concentration or electrical potential.(5.2) ● Understand how compositional and organizational aspects of membrane structure underlie cellular functions. (5.1) ● Distinguish between endergonic and exergonic reactions and anabolism and catabolism (6.1) ● Describe the structure of ATP and how it powers the work of cells (6.2) ● Relate energy of activation to enzyme activity. (6.3) ● Describe enzyme structure/function and its regulation by negative feedback mechanisms (6.4) ● Summarize chemical reactions of aerobic and anaerobic respiration of glucose (7.2) ● Distinguish between oxidation and reduction(7.3) ● Explain the importance of electron carriers in cellular respiration(7.4) ● Specify the cellular sites of the processes of cellular respiration(7.5) ● Explain the necessity of oxygen for cellular respiration (7.8) ● Explain how light absorption leads to electron flow through photosystems I and II (8.6) ● Describe the roles of ATP and NADPH in the Calvin cycle (8.7) ● Describe adaptations for minimizing water loss (8.8) ● Describe the properties of enzymes. (ENE-1.D) ● Explain how enzymes affect the rate of biological reactions. (ENE-1.E) ● Explain how changes to the structure of an enzyme may affect its function. (ENE-1.F) ● Explain how the cellular environment affects enzyme activity. (ENE-1.G) ● Describe the photosynthetic processes that allow organisms to capture and store energy.	Students will be able to explain how energy is used and generated in cells efficiently.

	(ENE-1.I) ● Explain how cells capture energy from light and transfer it to biological molecules for storage and use. (ENE-1.J) ● Describe the processes that allow organisms to use energy stored in biological macromolecules. (ENE-1.K) ● Explain how cells obtain energy from biological macromolecules in order to power cellular functions. (ENE-1.L) ● Classify major types of heterotrophic and autotrophic metabolism. (2.4) ● Investigate enzymes in the lab. (6.5)	
Science Practices	● Distinguish between hypothesis and theories (2.1) ● Gain exposure to primary scientific literature (2.2) ● Engage in scientific writing (2.3)	Students will be able to demonstrate understanding of common lab practices and show competency in lab analysis
Cell Communication and the Cell Cycle	● Describe the ways that cells can communicate with one another (IST-3.A) ● Explain how cells communicate with one another over short and long distances (IST-3.B) ● Describe the components of a signal transduction pathway. (IST-3.C) ● Describe the role of components of a signal transduction pathway in producing a cellular response. (IST-3.D) ● Describe the role of the environment in eliciting a cellular response. (IST-3.E) ● Describe the different types of cellular responses elicited by a signal transduction pathway. (IST-3.F) ● Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway. (IST-3.G) ● Describe positive and/or negative feedback mechanisms. (ENE-3.A) ● Explain how negative feedback helps to maintain homeostasis. (ENE-3.B) ● Explain how positive feedback affects homeostasis. (ENE-3.C) ● Describe the events that occur in the cell cycle. (IST-1.B) ● Explain how mitosis results in the transmission of chromosomes from one generation to the next. (IST-1.C) ● Describe the role of checkpoints in regulating the cell cycle. (IST-1.D) ● Describe the effects of disruptions to the cell cycle on the cell or organism. (IST-1.E) ● Describe chromosomes and their structural forms. (9.2) ● Outline the steps and control of the cell cycle. (9.5)	Students will be able to explain/model how cells communicate with one another using different types of signaling to maintain an organism's homeostasis. Students will be able to explain/model events of the cell cycle including progression, regulation and cell death.

	● Identify characteristics and events of the phases of mitosis. (9.6) ● Describe structures and events required for chromosomal movement in mitosis. (9.7)	
Evolution and Natural Selection	● Describe the scientific evidence that provides support for models of the origin of life on Earth (SYI-3.E) ● Describe the causes of natural selection. (EVO-1.C) ● Explain how natural selection affects populations. (EVO-1.D) ● Describe the importance of phenotypic variation in a population. (EVO-1.E) ● Explain how humans can affect diversity within a population. (EVO-1.F) ● Explain the relationship between changes in the environment and evolutionary changes in the population. (EVO-1.G) ● Explain how random occurrences affect the genetic makeup of a population. (EVO-1.H) ● Describe the role of random processes in the evolution of specific populations. (EVO-1.I) ● Describe the change in the genetic makeup of a population over time. (EVO-1.J) ● Describe the conditions under which allele and genotype frequencies will change in populations. (EVO-1.K) ● Explain the impacts on the population if any of the conditions of Hardy-Weinberg are not met. (EVO-1.L) ● Describe the conditions under which new species may arise. (EVO-3.D) ● Describe the rate of evolution and speciation under different ecological conditions. (EVO-3.E) ● Explain the processes and mechanisms that drive speciation. (EVO-3.F) ● Describe factors that lead to the extinction of a population. (EVO-3.G) ● Explain how the risk of extinction is affected by changes in the environment. (EVO-3.H) ● Explain species diversity in an ecosystem as a function of speciation and extinction rates. (EVO-1.I) ● Explain how extinction can make new environments available for adaptive radiation. (EVO-3.J) ● Explain the impacts on the population if any of the conditions of Hardy-Weinberg are not met. (EVO-1.L) ● Describe the types of data that provide evidence for evolution. (EVO-1.M) ● Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time. (EVO-1.N) ● Describe the fundamental molecular and cellular features shared across all domains of life, which provide evidence of common ancestry. (EVO-2.B) ● Describe structural and functional evidence on cellular and molecular levels that provide evidence for common ancestry of all eukaryotes. (EVO-2.C) ● Explain how evolution is an ongoing process in all living things. (EVO-3.A) ● Describe the types of evidence that can be used to infer an evolutionary relationship. (EVO-3.B)	Students will be able to explain the theory of evolution as it pertains to different fields of modern biology including the theory of natural selection, the evidence for evolution, microevolution, speciation, macroevolution, the origin of life on Earth and major evolutionary trends.

	● Explain how the genetic diversity of a species or population affects its ability to withstand environmental pressures. (SYI-3.D) ● Trace the historical development of the theory of natural selection, including the contributions of Charles Darwin and other scientists. (15.2) ● Use the geologic time scale to sequence major events (extinctions, adaptive radiations) in the evolution of life. (15.4) ● Recognize the role of the population as the unit of evolution.(15.5) ● Distinguish between artificial and natural selection. (15.6) ● Describe other modes of evolution, such as genetic drift and gene flow. (15.8) ● Use the phylogenetic approach to classification. (16.1) ● Contrast the biological species concept with other definitions of species. (16.2) ● Identify prezygotic and postzygotic reproductive isolation mechanisms that underlie allopatric and sympatric speciation. (16.3) ● Distinguish homologous and analogous structures, and provide examples of each. (16.4) ● Summarize how molecular clocks are utilized. (16.6) ● Explore the evolutionary and ecological basis for animal behavior. (10.7) ● Identify the major supergroups within Eukarya. (3.3)	
Heredity	● Explain how meiosis results in the transmission of chromosomes from one generation to the next. (IST-1.F) ● Explain how the process of meiosis generates genetic diversity. (IST-1.H) ● Explain how shared, conserved, fundamental processes and features support the concept of common ancestry for all organisms. (EVO-2.A) ● Explain the inheritance of genes and traits as described by Mendel's laws. (IST-1.J) ● Explain how the phenotype of an organism is determined by its genotype. (IST-1.O) ● Explain the connection between the regulation of gene expression and phenotypic differences in cells and organisms. (IST-2.D) ● Explain how the same genotype can result in multiple phenotypes under different environmental conditions. (SYI-3.B) ● Explain deviations from Mendel's model of the inheritance of traits. (IST-1.J) ● Differentiate between mitosis and meiosis. (9.10) ● Explain how genetic variation in populations allows for natural selection. (9.11) ● Summarize Mendel's laws of segregation and independent assortment. (10.1) ● Use Punnett squares and laws of probability to predict genotype and phenotype ratios. (10.2) ● Differentiate between Mendelian and non-Mendelian inheritance patterns.(10.3)	Students will be able to illustrate the sorting and recombination of genes during sexual reproduction has an effect on variation in offspring, analyze selected patterns of inheritance and describe the effect of gene alteration on an organism.

	● Explain how linkage may affect genotype and phenotype ratios. (10.4) ● Evaluate pedigrees to determine patterns of inheritance. (10.5) ● Explore inheritance in the lab. (10.6)	
Gene Expression and Regulation	● Describe the structures involved in passing hereditary information from one generation to the next. (IST-1.K) ● Describe the characteristics of DNA that allow it to be used as the hereditary material.(IST-1.L) ● Describe the mechanisms by which genetic information is copied for transmission between generations. (IST-1.M) ● Describe the mechanisms by which genetic information flows from DNA to RNA to protein.(IST-1.N) ● Describe the types of interactions that regulate gene expression. (IST-2.A) ● Explain how the location of regulatory sequences relates to their function. (IST-2.B) ● Explain how the binding of transcription factors to promoter regions affects gene expression and/or the phenotype of the organism. (IST-2.C) ● Describe the various types of mutation. (IST-2.E) ● Explain how changes in genotype may result in changes in phenotype. (IST-4.A) ● Explain how alterations in DNA sequence contribute to variation that can be subject to natural selection. (IST-4.B) ● Explain the use of genetic engineering techniques in analyzing or manipulating DNA. (IST-1.P) ● Describe the history of the discovery of DNA. (11.1) ● Describe the structure and function of DNA. (11.2) ● Outline the steps of DNA replication. (11.3) ● Differentiate between RNA and DNA structure and function. (11.5) ● Explain eukaryotic mRNA processing. (11.8) ● Summarize virus structure and function. (12.1) ● Describe processes of viral genome replication. (12.2) ● Discuss virus reproduction and transmission. (12.3) ● Compare genomic organization in eukaryotes and prokaryotes. (13.1) ● Explain how operons function in metabolic control. (13.4) ● Describe functions and uses of restriction enzymes. (14.1) ● Describe various research tools used in biotechnology. (14.2) ● Cite specific advances that have been achieved through biotechnology. (14.3) ● Consider safety and ethical aspects of recombinant DNA research. (14.4) ● Investigate molecular genetics and biotechnology in the laboratory. (11.10)(14.5)	Students will be able to explain the connections among genes, chromosomes, and DNA. Then further explain how a genetic trait is determined by the code in a DNA molecule, and finally describe the role of biotechnology in society.

Ecology	● Discuss the influence of climate and disturbance on the distribution of aquatic and terrestrial biomes. (11.1) ● Examine abiotic and biotic factors that influence the abundance and diversity of living organisms. (11.2) ● Describe the demographic factors that regulate the growth of populations. (12.1) ● Identify the models used to describe population growth. (12.2) ● Explain how the concept of carrying capacity applies to human and other populations. (12.3) ● Classify the types of interspecific interactions within communities. (12.4) ● Examine the components of diversity. (12.5) ● Describe the influence of trophic structure, disturbance, and geography on patterns of diversity. (12.6) ● Explain the flow of energy and matter through ecosystems. (12.7) ● Identify the biogeochemical cycles that move nutrients between the living and nonliving parts of ecosystems. (12.8) ● Explain how human activities can influence diversity at genetic, species, and ecosystem levels. (13.1) ● Discuss the role of humans in global climate change. (13.2) ● Describe scientific approaches to the conservation of populations and landscapes. (13.3) ● Identify the goals of sustainable development. (13.4) ● Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment. (ENE-3.D) ● Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population. (IST-5.A) ● Describe the strategies organisms use to acquire and use energy. (ENE-1.M) ● Explain how changes in energy availability affect populations and ecosystems.(ENE-1.N) ● Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem. (ENE-1.O) ● Describe factors that influence growth dynamics of populations. (SYI-1.G) ● Explain how the density of a population affects and is determined by resource availability in the environment. (SYI-1.H) ● Describe the structure of a community according to its species composition and diversity. (ENE-4.A) ● Describe the relationship between ecosystem diversity and its resilience to changes in the environment. (SYI-3.F) ● Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long-term structure. (SYI-3.G) ● Explain the interaction between the environment and random or preexisting variations in	Students will be able to analyze the relationships among organisms and between organisms and abiotic factors that contribute to the stability of the ecosystem, describe the flow of matter and energy between living systems and the physical environment and explain the impact humans have had on Earth.

	populations. (EVO-1.O) ● Explain how invasive species affect ecosystem dynamics. (SYI-2.A) ● Describe human activities that lead to changes in ecosystem structure and/ or dynamics. (SYI-2.B) ● Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics. (SYI-2.C) ● Discuss how animals interact with the environment. (10.8)	
Plants	● Discuss phylogeny and classification of plants (5.1) ● Describe structural and functional innovations that promote land plant survival (5.2) ● Compare structural and functional features of nonvascular and vascular plants. (5.3) ● Discuss reproductive innovations of seed plants that favored land expansion. (5.4) ● Compare and contrast the alternation of generation life cycle of plants. (5.5) ● Compare and contrast the reproductive strategies of angiosperms and gymnosperms. (5.6) ● Discuss pollination, seed, and fruit development. (5.7) ● Examine plant diversity in the laboratory. (5.8) ● List the major plant organs and explain how they contribute to meeting functional needs of plants (6.1) ● Understand the role of plant meristems in primary and secondary growth. (6.2) ● Describe active and passive mechanisms for local and long distance transport in xylem and phloem. (6.3) ● Understand how water potential and its components govern water transport. (6.4) ● Explain how complex hormone interactions govern plant physiological responses. (6.5) ● Discuss mechanisms that plants use to respond to biotic and abiotic factors. (6.6) ● Study plant anatomy and physiology in the lab. (6.7)	Students will be able to explain plant morphology, physiology and reproduction starting with bryophytes and finishing with angiosperms,discuss similarities/differences between vascular and nonvascular plants transport systems and explain how hormones control response.