Biology

Course Description:
Students in Biology will experience an introduction to many topics in the field of Life Science. Topics covered are Biochemistry (water, proteins & amino acids, enzymes, lipids, DNA, RNA, Protein Synthesis, Cellular Respiration, Photosynthesis); the Cell, Cell Division, Genetics, Evolution, Bacteria & Viruses and Ecology.
Students will learn through using models, argument-driven inquiry-based experiments, many types of lab experiences, projects & presentations.

Successful students are encouraged to enroll in AP Biology for their junior or senior year for an in-depth experience in Biology.

Learning Targets

Domain: Structure and Function
Priority Standards:
HS-LS1-1: 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.
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

A. Students will be able to describe, model or draw their understanding of the properties of water
    - The students will conduct an inquiry lab which investigates the mysteries of microorganisms found in a local pond water ecosystem.
    - The students can use models of water molecules to demonstrate their understanding of a polar molecule
    - The students can use models to demonstrate the phenomenon of cohesion, adhesion and surface tension.

B. Students will be able to describe, model or draw their understanding of the effect of osmosis on tonicity.
    - The students will conduct an inquiry lab to investigate a model of a semipermeable membrane and how it affects the diffusion of molecules &

the osmosis of water
    - The students will conduct an inquiry lab to investigate the phenomenon of osmosis rates being affected by varying concentrations of solutions, to create hypertonic, hypotonic and isotonic environments

C. Students will be able to describe, model or draw their understanding of the properties of amino acids.
    - The students will use models to build and describe the basic structure of an amino acid
    - The students will use models to describe or draw their understanding of how hydrophobic amino acid side chains affect the folding of a protein.
    - The students will use models to describe or draw their understanding of how hydrophilic amino acid side chains affect the folding of a protein.

D. Students will be able to describe, draw or model their understanding of the structure and function of primary and secondary structures of proteins.
    - The students will use models to demonstrate the primary structure of a protein.
    - The students will use models to demonstrate the two secondary structures of a protein, which are alpha helices and beta pleated sheets.
    - The students will use models to demonstrate how the input of high energy in the form of temperature will denature a protein.

E. Students will be able to describe, draw or model their understanding of the structure and function of an enzyme.
    - The students will conduct an inquiry lab experiment to investigate the phenomenon of effect of the enzyme catalase on a specific substrate.
    - The students will use models to understand the function of an enzyme in a catabolic reaction.
    - The students will use models to understand the function of an enzyme in an anabolic reaction.
    - The students will use models to understand the effects of competitive and noncompetitive inhibitors on an enzyme

F. Students will be able to describe, draw or model their understanding of the processes of transcription and translation, as part of protein synthesis.
    - The students will use models to build a strand of a section of DNA, and use this gene to model how mRNA nucleotides are added in the active site of RNA Polymerase, to build a strand of mRNA.
    - The students will use models to show how a polypeptide is built in a ribosome.

Domain: Matter and Energy in Organisms

Priority Standard:

HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken, and bonds in new chemicals are formed, resulting in a net transfer of energy.

HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and the flow of energy in aerobic and anaerobic conditions.

HS-LS2-4: Use mathematical equations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon biosphere, atmosphere, hydrosphere and geosphere.

A. Students will be able to describe, draw or model how carbon is cycled through an ecosystem using the processes of photosynthesis and cellular respiration.
    - The students will create a model of the photosynthetic and action spectra for photosynthesis, and use that data and their graphs to explain the phenomena occurring around green plants.
    - The students will use chromatography to separate photosynthetic pigments from a leaf.
    - The students will model the Law of Conservation of Matter to prove that all atoms of Carbon, Hydrogen & Oxygen are conserved during the processes of photosynthesis & cellular respiration
    - The students will use yeast to model the phenomenon of anaerobic respiration.
    - The students will use bromothymol blue to demonstrate the CO_2 is a by-product of cellular respiration

Domain: Inheritance and Variation of Traits

Priority Standard:

HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms

HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-2: 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.

HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

A. Students will be able to describe, draw or model the distribution of chromosomes in mitosis vs meiosis.
    - The students will be given the supplies to build and model the processes of mitosis and meiosis.

B. Students will be able to describe, draw or model their understanding of how variations occur in genes of offspring.
    - The students will conduct an experiment to show a hypothetical sled dog, as well as dragon breeding operations of how traits in the parents are selected for, but chance dictates the outcome in the offspring.
    - The students will learn how dominant and recessive traits are expressed in offspring.
    - The students will discover the phenomenon of heterozygote advantage in Kenya, as an evolutionary advantage to malaria prone ecosystems.

Domain: Natural Selection and Evolution

Priority Standard:
HS-LS4-2: Construct an explanation based on evidence that the process of evolution results from four factors: (1) the potential for a species to increase in number, (2) the heritable variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
HS-LS4-3: 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.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5: 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.

A. Students will be able to describe, draw or model their understanding of directional, stabilizing, and disruptive natural selection.

- The students will conduct an experiment using a model population, to investigate the phenomena related to population shifts due to predation.

B. Students will be able to describe, draw or model how environmental changes may lead to the increase in some species, & the decline or extinction of others.
    - The students will conduct an inquiry lab to investigate the effects of various environmental habitats on the population of various species.
    - The students will conduct an experiment to model how various birds' beaks are adaptations to their primary food source

C. Students will be able to describe, draw or model how mutations and changing environments may lead to speciation.
    - The students will use data from the Howard Hughes Medical Institute on Rock Pocket Mouse in New Mexico to see how mutations can be both beneficial or harmful, based on the ecosystem
    - The students will use data from the Howard Hughes Medical Institute on Bottleneck Effect & Founder's Effect, that will show how lack of genetic diversity can lead to speciation

Domain: Interdependent Relationships in Ecosystems

Priority Standards:

HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations of ecosystems of different scales.
HS-LS2-6: Evaluate 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.

A. Students will be able to describe, draw or model their understanding of biodiversity in an ecosystem
    - The students will conduct an experiment using the Quadrat sampling method for plants, to show the diversity of plants in an ash grove.
    - The students will conduct an experiment to investigate the biodiversity of animal life in the school pond.

B. Students will be able to describe, draw or model their understanding of the effects of invasive species on native flora and fauna in an ecosystem
    - The students will investigate the behaviors of the rusty crayfish from a local river.

These standards and learning targets will be reported on at the end of each grading period. If you have questions regarding any standards or learning target, please contact the building principal.