COPPELL ISD SUBJECT YEAR AT A GLANCE

SUBJECT: AP BIOLOGY

GRADE LEVEL 9-12

Program Transfer Goals

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

PACING

First 9 Weeks	Second 9 Weeks	Third 9 Weeks	Fourth 9 Weeks

Unit 1 4 weeks	Unit 2 5 Weeks	Unit 3 2 Weeks	Unit 4 2.5 Weeks	Unit 5 1.5 Weeks	Unit 6 2.5 Weeks	Unit 7 3 Weeks	Unit 8 5 Weeks	Unit 9 2.5 Weeks

First Semester(16 weeks):

Unit 1: Scientific Process and Animal Responses - 4 weeks
Unit 2: the chemistry of Catabolism in the cell - 5 weeks
Unit 3: Cells and the Immunity - 2 weeks
Unit 4: Plant Processes - 2.5 weeks
Exam week

Second Semester (21 weeks)

Unit 5: Communication - **1.5** weeks
Unit 6: Information - **2.5** weeks
Unit 7: Genes - 3 weeks
Unit 8: Evolution- 5 weeks
Unit 9: Ecology- 2.5 weeks
AP Exam Review and Exam- 2 weeks
Final Exam review and exams- 2 weeks

Assurances for a Guaranteed and Viable Curriculum

Adherence to this scope and sequence affords every member of the learning community clarity on the knowledge and skills on which each learner should demonstrate proficiency. In order to deliver a guaranteed and viable curriculum, our team commits to and ensures the following understandings:

Shared Accountability: Responding to the Needs of All Learners

- High levels of learning for all students.
- The district and course formative assessments aligned to the standards for this course support educators and learners in monitoring academic achievement and leveraging interventions.

Shared Understanding: Curriculum Design

- The district curriculum design weaves together the elements of content, skills and assessments in order to adhere to curriculum design at the macro and micro level, ensuring vertical alignment.
- The district curriculum incorporates standards, scope and sequence, enduring understandings, essential questions, performance assessments, and recommended resources.

Interdependence: Curriculum Units
Members of the learning community utilize the curriculum units, plan collaboratively, and reflect on results for continuous improvement.
The district curriculum units may be found: http://tinyurl.com/Coppell-Curriculum

UNIT 1: Scientific Processes and Animal Response (Behavior and Homeostasis)

TIMELINE: 4 WEEKS , 1ST GRADING PERIOD

Unit Summary:
In this unit, students will review types of investigations, scientific method, and types of graphs. They will set up a scientific investigation to gather data. Students will be exposed to multiple methods of statistical analysis and they will utilize the data gathered from the investigation to practice statistical analysis. This unit also introduces the concept of homeostasis to students, and types of feedback loops: the positive and the negative. Animal Behavior topics for this unit will allow students understand and analyze how organisms respond to changes in the external environment or how individuals act on information and communicate it to others.

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Students will know…
- innate behaviors are inherited.
- learning occurs through interactions with the environment and other organisms.
- cooperative behaviors contribute to the survival of the population.
- organisms respond to changes in their environment through behavioral and physiological mechanisms
- internal changes and environmental cues can change an animal's behavior
- animals use visual, auditory, chemical and tactile signals to communicate
- responses to communication are vital to natural selection
- negative feedback systems maintain homeostasis.
- positive feedback systems amplify responses and processes.
- Processes and behaviors that are common to all organisms or groups of organisms reflect common ancestry and are said to be evolutionarily conserved.

Students will be skilled at…

- designing investigations.
- completing and interpreting a statistical analysis of the data, using t-test and Chi Square.
- analyzing and interpreting experimental results
- graphing data with 2SEM error bars.

- Creating and interpreting models of the feedback systems that maintain homeostasis.

UNIT 2: The Chemistry of Catabolism in the Cell: Biochemistry, Internal and External Cell Transport, Cellular Respiration

TIMELINE: 5 WEEKS, 1ST GRADING PERIOD

Unit Summary:
This unit begins with teaching students about concepts related to the structure of organic molecules (biomolecules): structure of monomers and polymers, functional groups and properties of water. Students will apply their knowledge of enzymes and their properties to design a lab to test the effect of a variable on the rate of an enzyme-catalyzed reaction. In addition, students will examine the structure of cell membrane and explore the mechanisms of transport of molecules across the cell membrane. Further, after a review of basic concept of metabolism: catabolism and anabolism, students will inquire the role of ATP in cellular respiration – Glycolysis, Kreb's cycle and the Electron transport Chain. Towards the end of the unit, students will design a lab to test the effect of a variable on the rate of respiration in crickets.

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Students will know…
- the structure and function of polymers is derived from the way that their monomers are assembled
- the shape of a molecule affects its functioning
- living systems depend on the properties of water that result from its polarity and hydrogen bonds
- carbon and nitrogen move from the environment to organisms where they are used to build carbohydrates, proteins and lipids
- enzymes catalyze reactions by lowering the reaction's activation energy
- cells maintain homeostasis through the functioning of the selectively permeable cell membrane
- cell membranes are phospholipid bilayers with proteins, glycoproteins, and cholesterol embedded
- membrane rigidity can be altered through changing its chemical composition
- the ER and Golgi function together to modify proteins and to package them in vesicles for internal and external transport
- cell size is limited by the surface area: volume ratio
- plant cell walls prevent cell lysis
- increased osmosis into a plant cell causes a positive turgor pressure; plasmolysis creates a negative turgor pressure
- entropy increases over time

Students will be skilled at…
- calculations and interpretations of surface area: volume ratios
- calculating water potential, solute potential and turgor pressure.
- predicting solute and water movement across a membrane based upon water potentials
- calculations of Gibbs Free Energy and determining if a reaction is exergonic or endergonic

UNIT 3: Cells and immunity (Viruses, Bacteria, Cells and the Immune system)

TIMELINE: 2 WEEKS - 2ND GRADING PERIOD

Unit Summary:
In this unit, students will compare structure of viruses to a bacterial cell and a typical animal or plant cell. Students will understand the viral life cycle and make distinctions between a lytic and a lysogenic viral life cycle. Students will extend their basic understanding of structure of subcellular components, their functions and interactions and how these subcellular structures carry out essential cellular processes. In addition, the immune system topics will enhance students' understanding that variations in molecules such as Major Histocompatibility Complex (MHC) and antibodies allow for a wider range in function at the cellular and organismal level. Students will also be exposed to specific immune system disorders and plant immune responses.

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Students will know…

- organelles are specialized for various cellular functions
- the cells that comprise organs are specialized; this affects the overall functioning of the organism.
- variations in molecules such as MHC and antibodies allow for a wider range in function at the cellular and organismal level.
- Viruses, are exceptional beings, that can have either DNA or RNA as heritable genetic information.
- viruses reproduce within a host cell using either lytic or lysogenic cycle

Students will be skilled at…

- creating visual models of the immune response to a pathogen.
- Justifying whether viruses are living or nonliving
- constructing explanations based on scientific evidence as to how interactions of subcellular structures provide for essential functions.
- using models to describe nonspecific immune defenses in plants and animals.
- communicating with logical reasons of how viral replication introduces genetic variation in the viral population.

UNIT 4: Plant Processes

TIMELINE: 2.5 WEEKS, 2ND GR PERIOD

UNIT SUMMARY:

During this unit, students will gain an in-depth understanding of major plant process - Photosynthesis and Transpiration and how these processes work. Application of this knowledge will be used to design a lab to test the effect of a variable on the rate of the light dependent stage of photosynthesis. Students will utilize the data gathered and their statistical analysis skills to calculate chi square and/or 2 SEM error bars. They will present their findings and interpretations of results to the class in a mini poster for peer review. Students will also be conducting mini labs using plants to identify basic plant structures and tissues. In addition, students will also learn about plant responses.

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Students will know…

- energy transfer is a series of reactions. that can be entered at multiple points.
- autotrophs use energy sources from the environment to transfer free energy to chemical energy in processes such as photosynthesis.
- heterotrophs use chemical energy of carbon-based molecules to produce ATP in processes such as cellular respiration.

Students will be skilled at…

- modeling the steps of photosynthesis.
- identifying unknown pigments by Rf.
- Designing investigations and using different variables to determine how organisms store and capture free energy.
- Explaining how variation in cellular structures or molecular units allow the organisms to capture, store or use free energy.
- Analyzing how cooperative interactions within organisms promote for efficiency in the use of energy.

UNIT 5: COMMUNICATION

TIMELINE: 1.5 WEEKS - 2ND GRADING PERIOD

UNIT SUMMARY:

Through this unit students will deepen their understanding of mechanisms of cell communications and be skilled at explaining how cell-to-cell communication occurs by direct contact or from a distance through chemical signaling. Students will subsequently apply this knowledge to understand how nervous and endocrine response pathways work. Students will be able to describe how nerve impulses are created due to difference in distribution of ions across a permeable membrane - action potential. Students will use specific examples like, insulin signaling, or breast feeding to explain how organisms use negative and positive feedback mechanisms to maintain their internal environments.

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Students will know…

- individuals can act on information and communicate it to others
- signal transmission within and between cells mediates gene expression and cell function
- communication involves the transduction of stimulatory or inhibitory signals from other cells, organisms, or the environment.
- signal transduction pathways coordinate activities within the cell that support the functioning of the whole organism.
- cells can communicate directly through plasmodesmata or gap junctions or indirectly using signaling molecules such as hormones or neurotransmitters
- the signal transduction pathway begins with the recognition of the ligand by a receptor protein in the membrane.
- receipt of the signal is relayed through secondary messengers and phosphorylation cascades, resulting in a cellular response.
- the neuron is the basic structure of the nervous system.
- action potentials propagate signals along the neuron.
- transmission of information between neurons occurs across synapses.
- different regions of the vertebrate brain have different functions.
- interactions between unicellular organisms can lead to an increased efficiency and utilization of matter and energy
- negative feedback systems maintain homeostasis.
- positive feedback systems amplify responses and processes.
- alterations in feedback systems can lead to serious consequences as in diabetes mellitus and Graves' disease.
- organisms have various mechanisms for obtaining nutrients and eliminating wastes.
- disruptions at the cellular level impact the health of the organism.
- plants respond to environmental stimuli such as light with intermolecular signals for responses such as phototropism and photoperiodism.
- animals synchronize physiological signals with environmental cycles and cues resulting in responses such as hibernation, circadian rhythms, diurnal/nocturnal cycles.
- bacteria can respond to density dependent signals in quorum sensing.

- interaction and coordination between organs and their systems provide for essential biological activities such as between the nervous and muscular system of animals and the vascular system and leaf in plants.

Students will be skilled at…

- Describing how nerve impulses are created due to difference in distribution of ions across a permeable membrane - action potential.
- Creating visual representation to describe how nervous system transmits information.
- Identify different types of neurotransmitters and their role in human body.
- modeling the action potential
- Justifying a claim made about the effect(s) 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.
- Using representations or models to analyze quantitatively and qualitatively the effects of disruptions to dynamic homeostasis in biological systems.
- describing the role of programmed cell death in development and differentiation, the reuse of molecules, and the maintenance of dynamic homeostasis.

UNIT 6: Information- DNA Structure, Replication, Transcription, Translation, Mitosis, and Meiosis

TIMELINE: 2.5 WEEKS - 2ND GRADING PERIOD

UNIT SUMMARY:

Unit 6 will allow students to construct explanations of how DNA or RNA (in some cases) are sources of heritable information and how this information is translated into polypeptides. Students will use models or visual representations to describe phases of a cell cycle, stages of mitosis and meiosis. Students will understand the significance of meiosis in passing traits from parents to offspring and creating genetic diversity and subsequently, the evolution of organisms. In addition, students will understand connection between genetic variations in organisms and phenotypic variations in populations.

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Students will know…

- information is encoded in the sequence of bases in nucleotides and can be transmitted to the next generation
- DNA and RNA are the carriers of genetic information
- DNA/RNA and a universal genetic code are conserved across all domains of life
- DNA and RNA have similarities and differences that define their functioning
- The RNA World hypothesis proposes that RNA could have been the earliest genetic material.
- Monomers, nucleotides, produce polymers with the ability to replicate, store and transfer information.
- genetic information flows from a sequence of bases in a gene to a sequence of amino acids in a protein
- phenotypes are determined by protein activities
- gene duplication may provide new phenotypes
- environmental factors may affect the phenotypic expression of traits both directly and indirectly
- cell differentiation results from the expression of genes for tissue specific proteins

- induction of transcription factors during development results in sequential gene expression
- mitosis results in two daughter cells with identical genomes
- the cell cycle is regulated at various checkpoints
- meiosis results in haploid gametes which allows for greater variability in offspring
- segregation and independent assortment of chromosomes result in genetic variation
- changes in the DNA code can result in changes in the structure and amount of protein produced, thus, affecting phenotype
- external factors such as radiation and internal errors in replication and repair can lead to DNA mutations and to greater genetic variety
- errors in mitosis and meiosis can lead to chromosomal number disorders
- changes in genotypes can result in changes in phenotypes that are subject to the forces of natural selection
- cells that undergo binary fission can introduce genetic variety through transduction, conjugation, and transformation
- crossing over, random assortment of genes, and random pairing of gametes in fertilization are the greatest source of genetic variation in a species

Students will be skilled at…

- modeling replication, transcription and translation
- determining amino acid sequences from DNA codes
- interpreting genetic code and describing how genetic information is translated into amino acids and eventually polypeptides using representations, models or illustrations
- identifying using representations, models or illustrations the sequence of events in cell division, for example, replication, alignment, separation in Mitosis
- constructing an explanation, using visual representations or narratives, as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization.

UNIT 7: Genes- Genetics, Gene Control, Animal Development, and Gene Technology

TIMELINE: 3 WEEKS - 3RD GRADING PERIOD

UNIT SUMMARY:

This unit deals with teaching students about the Mendelian and the non-mendelian genetics, techniques involved in manipulating DNA through genetic engineering technologies, and gene expression in prokaryotes and eukaryotes. In addition, students will learn to use scientific 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.

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Students will know…

- phenotypes are determined by protein activities
- gene duplication may provide new phenotypes
- environmental factors may affect the phenotypic expression of traits both directly and indirectly

- cell differentiation results from the expression of genes for tissue specific proteins
- induction of transcription factors during development results in sequential gene expression
- segregation and independent assortment of chromosomes result in genetic variation
- the rules of probability can be used to predict phenotypes in offspring
- certain human genetic disorders are due to the inheritance of single genes or to chromosomal changes
- multiple genes can affect one trait
- some traits are inherited of the sex chromosomes
- genes in the chloroplasts and mitochondria affect the phenotype of the organism
- gene expression is regulated by promoters, enhancers, transcriptional factors, and repressors
- genes are expressed through both positive and negative control
- gene regulation accounts for some phenotypic differences between organisms with similar genes.
- changes in the DNA code can result in changes in the structure and amount of protein produced, thus, affecting phenotype
- changes in genotypes can result in changes in phenotypes that are subject to the forces of natural selection

Students will be skilled at…

- predicting offspring genotypes and phenotypes using Punnett Squares and pedigrees
- determining parentage and evolutionary relationships through the examination of DNA fingerprints
- constructing plasmid maps using restriction fragment analysis
- determining chromosomal abnormalities from karyotypes
- Posing questions and presenting scientific arguments about ethical, social or medical issues surrounding human genetic disorders
- Posing questions and presenting scientific arguments about ethical, social or medical issues surrounding genetic engineering techniques involving manipulation of DNA or RNA
- explaining representations of non- mendelian inheritance using specific examples
- Explaining through illustrative examples that signal pathways mediate gene expression
- Describing pathways of gene expression in prokaryotes and eukaryotes

UNIT 8: Evolution

TIMELINE: 5 WEEKS - 3RD GRADING PERIOD

UNIT SUMMARY:

In this unit, students will be able to: understand the role of natural selection in evolution of different organisms; apply the Hardy Weinberg equations to predict allele and genotypic frequencies; use evidence from morphological changes, biochemical analysis and geology to propose evolutionary relationships between organisms in a phylogenetic tree or cladogram; construct phylogenetic trees and cladograms to explain evolutionary relationships and relative age of species; and use the concept of a molecular clock to calculate the approximate date of speciation.

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Students will know…

- Competition for limited resources results in differential survival.
- Evolutionary fitness is measured by reproductive success.
- Genetic variation and mutation produce a diverse gene pool
- Evolutionary rate is affected by environmental stability.
- An adaptation is a trait that is favored by selection and that provides an advantage to the organism.
- Chance and random events, like genetic drift, can affect the evolutionary process, especially in small populations.
- Populations that meet the 5 conditions of the Hardy Weinberg principle are in genetic equilibrium and are not evolving.
- An organism's response to a local environment reflects the variety within its genome.
- Species with little genetic diversity are at risk for extinction.
- Continuity of homeostatic mechanisms reflect common ancestry, while changes are in response to different environmental conditions.
- Some phenotypic variations, such as sickle cell anemia, significantly increase or decrease the fitness of an organism.
- Humans impact variation in other species through mechanisms such as artificial selection and antibiotic overuse.
- Reduction of genetic variation within a given population can increase differences between populations of the same species.
- Scientific evidence of biological evolution uses information from geographical, geological, physical, chemical and mathematical applications.
- Molecular, morphological and genetic information of existing and extinct organisms add to our understanding of evolution.
- Structural and functional evidence supports the relatedness of all domains.
- Structural evidence supports the relatedness of all eukaryotes.
- Phylogenetic trees and cladograms can represent traits that are either derived or lost due to evolution.
- Phylogenetic trees and cladograms illustrate speciation that has occurred, in that relatedness of any two groups on the tree is shown by how recently two groups had a common ancestor.
- Phylogenetic trees and cladograms can be constructed from morphological similarities of living or fossil species, and from DNA and protein sequence similarities.
- Phylogenetic trees and cladograms are dynamic are constantly being revised based on the biological data used, new mathematical and computational ideas, and current and emerging knowledge.
- Speciation rates can vary, especially when new habitats become available.
- Species extinction rates are rapid at times of ecological stress.
- Speciation results in diversity of life forms. Species can be physically separated by a geographic barrier such as an ocean or a mountain range, or various pre- and post-zygotic mechanisms can maintain reproductive isolation and prevent gene flow.
- New species arise from reproductive isolation over time, which can involve scales of hundreds of thousands or even millions of years, or speciation can occur rapidly through mechanisms such as polyploidy in plants.
- Scientific evidence supports the idea that evolution has occurred in all species and continues to occur.
- Geological evidence provides support for models of the origin of life on Earth.
- Molecular and genetic evidence from extant and extinct organisms indicates that all organisms on Earth share a common ancestral origin of life.

Students will be skilled at…

- applying the Hardy Weinberg equations to predict allele and genotypic frequencies.
- determining if population numbers support genotypic frequencies using chi square
- using evidence from morphological changes, biochemical analysis and geology to propose evolutionary relationships between organisms in a phylogenetic tree or cladogram.
- using a computer program such as Clustal X to create a phylogenetic tree from DNA sequences of related species.
- constructing phylogenetic trees and cladograms to explain evolutionary relationships and relative age of species.

- analyzing phylogenetic trees and cladograms to explain evolutionary relationships and relative age of species.
- using real scientific data sets to determine the effect of environment on the evolution of a species.
- using a molecular clock to calculate the approximate date of speciation.
- using mathematical models and simulations to illustrate and support evolutionary concepts
- evaluating evidence by using information from morphology, biochemistry and geology to support the concept of evolution.
- evaluating the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth.

UNIT 9: ECOLOGY

TIMELINE: 2.5 WEEKS - 4TH GRADING PERIOD

UNIT SUMMARY:
The unit will allow students to utilize knowledge of basic concepts of ecology: food chains, food webs, populations, communities and use mathematical models to explain the population growth patterns and interactions. Students will understand the effects of environmental tragedies, geological events, and human activities affect species distribution and abundance. Further, Students will evaluate whether the changes in free energy availability can result in disruptions to the ecosystem.

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Students will know…
- communities are described in terms of species composition and diversity.
- energy flows through living systems
- matter is recycled
- food webs are dependent upon primary productivity
- human activities impact ecosystems on a local and global scale
- interactions between populations affect the distributions and abundance of populations.
- environmental tragedies, geological events, and human activities affect species distribution and abundance.
- ecosystems with little diversity are less resilient to changes in the environment
- cell activities and organisms are affected by both biotic and abiotic factors; this is reflected in the stability of the system
- changes in free energy availability can result in disruptions to the ecosystem

Students will be skilled at…
- using 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.
- using mathematical models to illustrate population interactions within a community and environmental impacts on a community
- using mathematical models to illustrate population growth patterns and interactions
- calculating net and gross primary and secondary productivity
- calculations of population growth rates and carrying capacity
- predicting how changes in free energy availability affect organisms, populations and ecosystems.
- applying mathematical routines to quantities that describe interactions among living systems and their environment, which result in the movement of matter and energy.

- analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities or ecosystems).