SMMUSD Curriculum Map- Biology

Semester 1:

Topic	Scientific Method (2 weeks)
Learning Objectives	▪ Identify steps of the scientific method and apply them using an experiment ▪ Differentiate between independent (manipulated) and dependent (responding) variables ▪ Set up an experiment with controlled variables ▪ Interpret, understand and construct different graphs (line, bar, circle) ▪ Introduce key Latin and Greek prefixes/suffixes ▪ Contrast fact with inference
Key Standards	**Investigation and Experimentation Standard**s 1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will: c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled contions f. Distinguish between hypothesis and theory as scientific terms
Common Labs	▪ Lab: Seed Growth Lab Students set up an experiment that tests the effects of pH on seed growth. During the experiment, they identify the independent variable (pH) and the dependent variable (number of seeds that grow). Results are graphed and analyzed ▪ Lab: Mouthwash Lab Students set up an experiment that tests the effects of mouthwash on bacterial growth in their mouths. Bacterial cultures are taken from their mouths, incubated and analyzed for inhibited growth.
Lesson notes/resources and ideas	▪ Lecture Notes on the scientific method (Powerpoint presentations) ▪ List of Latin/ Greek Roots as reference ▪ Practice problems in which variables and controls are identified (Simpsons Scientific Method) ▪ Designing an experiment that tests claims made by ads ▪ Worksheets designed to practice different graphical forms (line, bar, circle)
Text Resources	▪ Chapter 1: The Science of Biology
Enrichment Opportunities	▪ Designing individual experiments with specified variables and conducting them ▪ Discussing statistical analysis ▪ Discussing the role of science in society ▪ Discussing variability among data values and the implications for statistical comparisons ▪ report sums, differences, products, and quotients to the correct number of significant figures ▪ Contrasting precision and accuracy ▪ Collecting real data to be graphed ▪ Contrast qualitative with quantitative date ▪ Contrast objective with subjective data

Topic	Cell Organelles and Cell Processes
Learning Objectives	▪ identify key organelles and their functions ▪ contrast animal cells with plant cells ▪ identify the parts of the cell theory ▪ contrast prokaryotes with eukaryotes ▪ contrast passive transport with active transport ▪ identify types of passive transport (diffusion, osmosis, facilitated diffusion) ▪ identify isotonic, hypertonic and hypotonic solutions ▪ identify types of active transport (exocytosis, endocytosis, protein pumps) ▪ describe the process of cell specialization and describe stem cells

Key Standards	Cell Biology **1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organisms' cells** a. *Students know cells are enclosed within a semi-permeable membrane that regulates their interactions with their surroundings.* *c. Students know how prokaryotic cells and eukaryotic cells (including those of plants and animals) and viruses differ in complexity and general structure.* *e. Students know the role of the endoplasmic reticulum and Golgi bodies in the secretion of proteins.*
Common Labs	Lab: Looking the Microscope Students learn how to use key features of the microscope including the objectives, fine and course adjustments, the stage and the diaphragm. Lab: Looking At Cells Students compare plant cells with animal cells and distinguish contrasting structures. Students prepare a wet mount to be examined using the microscope. Lab: Egg Osmosis Lab Students place de-shelled eggs in syrup and water to test the change in masses. Data is graphed and analyzed. Lab: Analysis of Marine Cells Students look at single-celled protists and examine cell structure.
Lesson notes/resources and ideas	▪ Brain pop animations ▪ Prentice Hall DVD on animations ▪ Lectures on Powerpoint ▪ Graphic organizers ▪ Build A Cell Cake (or other models) project ▪ Cell Analogy project ▪ Foldables and Venn diagrams contrasting Animal/Plant cells and Prokaryotic/Eukaryotic cells ▪ Two-faced Cell
Text Resources	▪ Chapter 7: Cell Structure and Function
Enrichment Opportunities	▪ Cell Analogy using alternative presentations (besides posters) e.g. skits, songs, models, movies etc ▪ Descriptions of the cytoskeleton and its function ▪ Inquiry-based Lab Extension: students design an isotonic solution with a given solute concentration in which the mass of a de-shelled egg stays constant over time and the solution and the internal environment of the egg are in equilibrium

Topic	**Physiology**
Learning Objectives	• define homeostasis and the general role of major body system in maintaining it • describe the role of body systems in providing oxygen and nutrients to cells and removing wastes **Immune System** • discuss the function of the immune system and the three lines of defense (nonspecific vs. specific) • differentiate between active and passive immunity • discuss the role of vaccines • identify the steps of the virus lytic cycle • describe how HIV compromises the immune system **Nervous** • describe feedback loops and its role in maintaining homeostasis • structure and function of neurons • identify the three types of neurons and their electrical path **Digestive** • describe the path of food through the digestive system • learn about the four organic compounds and their monomers • identify the role of enzymes in digestion • define a substrate, active site, and activation energy •
Key Standards	1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organisms' cells ***b.*** *Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and activities of enzymes depend on the temperature, ionic conditions and pH of the surroundings* *h. Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and*

	organisms are synthesized from a small collection of simple precursors **9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.** *a. Students know how the complementary activity of major body systems provide cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.* *b. Students know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.* *c. Students know feedback loops in the nervous and endocrine systems regulate conditions in the body.* *d. Students know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses* *e. Students know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response* *f. * Students know the individual functions and sites of secretion of digestive enzymes (amylases, proteases, lipases), stomach acid, and bile salts.* *g. *Students know the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance* *h. *Students know the cellular and molecular basis of muscle contraction including the roles of actin, myosin, calcium and ATP* *i. *Students know how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at a cellular level and in whole organisms* **10. Organisms have a variety of mechanisms to combat disease.** *a. Students know the role of the skin in providing nonspecific defenses against infection.* *b. Students know the role of antibodies in the body's response to infection.* *c. Students know how vaccination protects an individual from infectious diseases.* *d. Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of this infections.* *e. Students know why an individual with a compromised immune system (for example a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.* *f. *Students know the roles of phagocytes, B-lymphocytes and T-lymphocytes in the immune system*
Common Labs	Lab: Rat Dissection • Identify and diagram key mammalian body systems in a rat specimen using dissecting tools Lab: Liver Catalase lab • Students test the ability of the enzyme catalase in different pH's and temperature to break down hydrogen peroxide into oxygen and water Lab: Effect of Pepsin on Protein Digestion • Students study the ability of pepsin to digest proteins given different pH's Lab: Disease Transmission Lab • Students study how infectious diseases have the ability to reach epidemic proportions.
Lesson notes/resources and ideas	▪ Graphic Organizers, Foldables, Neuron Models ▪ Meet the Pathogens Powerpoints ▪ Virus Lytic Cycle Cut and Paste ▪ Making a Neuron Model with Pipecleaners ▪ "Outbreak" movie ▪ Physiology movies and animations ▪ "Super Size Me" movie ▪ Enzymes cut and paste showing catabolic and anabolic reactions ▪ Worksheet on Path of Food Through Digestive System
Text Resources	▪ Unit 10: The Human Body ▪ Chapter 2: The Chemistry of Life
Enrichment Opportunities	▪ Finding body mass index using body weight and height ▪ Sheep Brain Lab: identify and examine the key parts of the brain ▪ Testing Foods for Organic Compounds Lab ▪ Fish and Squid Dissections ▪ Identify the steps of the virus lytic cycle

Topic	Energy
Learning Objectives	• Contrast the reactants and products of photosynthesis and cellular respiration ▪ Know the role of chloroplasts and mitochondria in photosynthesis and cellular respiration ▪ Identify the steps of aerobic respiration (glycolysis, Krebs Cycle, electron transport chain)
Key Standards	**1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organisms' cells. As a basis for understanding this concept,** *f. Students know usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.* *g. Students know the role of the mitochondria in making stored chemical bond energy available to cells by completing the breakdown of glucose to carbon dioxide.* *i. * Students know how chemosmotic gradients in the mitochondria and chloroplast store energy for APT production*
Common Labs	▪ Lab: Measuring the amount of carbon dioxide in exhaled air
Lesson notes/resources and ideas	▪ Energy Cycle Cut and Paste ▪ Foldables, Lecture Notes, Powerpoints
Text Resources	▪ Chapter 8: Photosynthesis ▪ Chapter 9: Cellular Respiration
Enrichment Opportunities	▪ Students do a chromatography lab in which they separate pigments on a drop of chlorophyll. ▪ Students do an experiment in which they grow plants in different wavelengths and measure plant growth.

Second Semester

Topic	Central Dogma (DNA, RNA and Protein Synthesis) (3 weeks)
Learning Objectives	▪ Describe the structure of DNA and its components ▪ Describe steps of DNA replication ▪ Describe the structure of RNA and its components ▪ Describe the steps of protein synthesis (transcription and translation) ▪ Identify the different types of mutations (point vs. frameshift) and give examples
Key Standards	1d. Students know the central dogma of molecular biology outlines the flow of information from transcription of RNA in the nucleus to translation of proteins on ribosomes in the cytoplasm. 2e. Students know why approximately half or each DNA sequence comes from each parent. 4a. Students know the general pathway of which ribosomes synthesize proteins using tRNA to translate genetic information in mRNA. 4b. Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA. 4c. Students know how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in a coded protein. 4d. Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves. 4e. Students know proteins can differ from one another in the number and sequence of amino acids. 5a. Students know the general structures and functions of DNA, RNA and protein. 5b. Students know how to apply base-pairing rules to explain precise copying of DNA during semi-conservative replication and transcription of information from DNA into mRNA. 5c. Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products
Common Labs	▪ Lab: "Whodunnit?" Dry Lab ▪ DNA Extraction Lab using wheat germ, banana, strawberries ▪ Making a DNA Model Lab using molecular or paper models

	▪ Modeling DNA Replication Lab
Lesson notes/resources and ideas	▪ DNA Structure Web Animations ▪ Protein Synthesis Web Animations ▪ Brain Pop Animations ▪ Notes ▪ GATTACA ▪ DNA and Protein Synthesis foldable
Text Resources	▪ Chapter 12: DNA and RNA
Enrichment Opportunities	* Gel Electrophoresis to sequence DNA and do DNA fingerprinting. * Making your own model of DNA with different materials.

Topic	**Cell Division and Sexual Reproduction (4 weeks)**
Learning Objectives	▪ Know the steps of the cell cycle ▪ Know why cells have to divide ▪ Contrast surface area with volume and relate to why cells have to be small ▪ Identify how mistakes in cell cycle cause cancer ▪ Know the steps of meiosis and the end results of each phase (Meiosis I and Meiosis II) ▪ Contrast mitosis and meiosis ▪ Know the importance of crossing over and its role in genetic recombination ▪ Describe what happens in fertilization ▪ Know the definition of gametes, zygote, haploid, diploid, somatic, segregation ▪ How to read karyotypes and identify sex, monosomies and trisomies
Key Standards	2a. Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type. 2b. Students know only certain cells in a multicellular organism undergo meiosis. 2c. Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete. 2d. Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes. 2f. Students know the role of chromosomes in determining individual sex. 3b. Students know the genetic basis for Mendel's law of segregation and independent assortment. 4c. Students know how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.
Common Labs	Lab: Measuring Surface Area and Volume Ratios (using agar cubes and phenolphthalein) Lab: Identifying Stages of Mitosis Using Microscopes Lab: Reading Karyotypes to diagnose conditions such as Down Syndrome, Turner Syndrome, etc.
Lesson notes/resources and ideas	▪ Life's Greatest Miracle movies ▪ Film Strip of Mitosis/Meiosis ▪ Cell Cycle Foldable ▪ Yarn Demonstration showing different steps of mitosis ▪ Internet Animations on Cell Cycle and Cancer ▪ Cancer article ▪ Cell Cycle diagram identification worksheets ▪ Graphic organizers/Venn diagrams contrasting mitosis and meiosis
Text Resources	▪ Chapter 10: Cell Growth and Division ▪ Chapter 11: Introduction to Genetics (1^{st} half)
Enrichment Opportunities	▪ Sea Urchin Lab showing fertilization

Topic	Genetics (5 weeks)
Learning Objectives	▪ Contrast genotype with phenotype ▪ Contrast dominant and recessive traits ▪ Contrast homozygous with heterozygous genotypes ▪ Construct Punnett squares to predict offspring genotypes and phenotypes ▪ Describe other patterns of heredity (sex-linked, codominant, multiple alleles, incomplete dominance, polygenic traits) ▪ Construct and interpret pedigrees ▪ Identify Mendel's laws of inheritance ▪ Identify's Mendel's generations of pea plants ▪
Key Standards	2g. Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents. 3a. Students know how to predict the probably outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance. 3b. Students know the genetic basis for Mendel's law of segregation and independent assortment.
Common Labs	▪ Lab: "Making a Baby Lab' with coin flips, applying the laws of probability ▪ Lab: Using Genetic Corn Ears to identify Mendel's phenotypic and genotypic ratios ▪ Lab: Using Blood Type to Determine Familial Relationships ▪ Lab: Identifying Genotypes and Phenotypes (PTC paper, widow's peak, Hitchhiker's thumbs) ▪ Lab: Sickle Cell Anemia Inheritance Using Probability
Lesson notes/resources and ideas	▪ Punnett Square Practice Problems ▪ "The Island" movie ▪ Genetic Disorders Poster/Powerpoint Project ▪ Graphic organizers showing Mendel's laws and generations ▪ Web animations showing Mendelian experiments ▪ Pedigree Practice Problems ▪ Foldable
Text Resources	▪ Chapter 11: Introduction to Genetics ▪ Chapter 14: The Human Genome
Enrichment Opportunities	Solving Dihybrid Crosses

Topic	Evolution (3 weeks)
Learning Objectives	▪ Know principles in Darwin's theory of evolution by natural selection ▪ Know how natural selection acts on phenotypes, not genotypes ▪ Know how genetic variation is created within a gene pool ▪ Describe how genetic drift, bottleneck effect and Founder effect leads to changes in a population's gene pool ▪ Identify that factors that lead to speciation (geographic isolation, reproductive isolation, adaptive radiation) ▪ Know different examples of evidence for evolution (fossils, radiometric dating)
Key Standards	7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. a. Students know why natural selection acts on phenotypes rather than the genotype of an organism. b. Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool. c. Students know new mutations are constantly being generated in a gene pool. d. Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental condtions. 8. Evolution is the result of genetic changes that occur in constantly changing environments. a. Students know how natural selection determines the differential survival of groups of organisms. b. Students know a great diversity of species increases the change that at least some organisms survive major changes in the environment. c. Students know the effects of genetic drift on the diversity of organisms in a population. d. Students know reproductive or geographic isolation affect speciation. e. Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.
Common Labs	Lab: Simulating Bird Beaks and Candy Lab to Model Natural Selection Lab: Simulating Natural Selection Using Toothpicks/Jelly Beans/ Candy Web Simulation Using Peppered Moth
Lesson notes/resources and ideas	▪ Voyage to Galapagos Videos ▪ Geologic Time Scale worksheets ▪ Darwin's Voyage Map ▪ Beaks of Finches worksheets ▪ Walking with Cavemen DVD ▪ Patterns in the Grass DVD
Text Resources	▪ Chapter 15: Darwin's Theory of Evolution ▪ Chapter 16: Evolution of Populations ▪ Chapter 17: History of Life
Enrichment Opportunities	▪ Geologic Time Scale (eras and period) ▪ Human Evolution ▪ Hardy Weinberg Equilibrium

Topic	Ecology (2 weeks)
Learning Objectives	▪ Construct and analyze food chains and food webs ▪ Contrast producers, primary, secondary and tertiary consumers ▪ Contrast autotrophs and heterotrophs ▪ Contrast carnivores, herbivores and omnivores ▪ Interpret energy pyramids ▪ Contrast biotic and abiotic factors ▪ Describe biogeochemical cycles (water, carbon, nitrogen) ▪ Know the role of birth rates, death rates, immigration and emigration in population changes ▪ Know the role that humans play in environment changes (global warming and introduction of invasive species)

Key Standards	6. Stability in an ecosystem is a balance between competing effects. a. Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats. b. Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of non-native species, or changes in population size. c. Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration and death. d. Students know how water, carbon and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration. e. Students know a vital part of an ecosystem is the stability of its producers and decomposers. f. Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.
Common Labs	Lab: Plankton Lab. Students look at zooplankton and phytoplankton to contrast food chain dynamics. Lab: Tragedy of the Commons. Students are given a plot with M&M's to show how humans affect population size through overconsumption. Lab: Chocolate Chip Cookie Lab to simulate mining for nonrenewable resources
Lesson notes/resources and ideas	▪ Foldable on Biogeochemical Cycles ▪ Create Your Own Food Web Project ▪ Ecological Pyramids Worksheet ▪ Lions and Hyena ▪ Simpsons video clip
Text Resources	▪ Chapter 3: The Biosphere ▪ Chapter 4: Ecosystems and Communities ▪ Chapter 5: Populations ▪ Chapter 6: Humans in the Biosphere
Enrichment Opportunities	▪ Biomes Project