Seventh Grade Science: First Trimester
Experimental Design

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which **a) data are organized into tables showing repeated trials and means;** **c) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, and probeware are used to gather data;** **e) sources of experimental error are identified;** **f) dependent variables, independent variables, and constants are identified;** **g) variables are controlled to test hypotheses, and trials are repeated.** The concepts developed in this standard include the following: • The nature of science refers to the foundational concepts that govern the way scientists formulate explanations about the natural world. The nature of science includes the following concepts a) the natural world is understandable; b) science is based on evidence - both observational and experimental; c) science is a blend of logic and innovation; d) scientific ideas are durable yet subject to change as new data are collected; e) science is a complex social endeavor; and f) scientists try to remain objective and engage in peer review to help avoid bias. • Expected results are reflected in the organization of the a data table, which includes areas to record the number of repeated trials, levels of the independent variable, measured results for the dependent variable, and analysis of the results by calculation of the mathematical means.	Standard 7.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated across the other 7th grade science standards. Skills a, c, e, f, and g are placed at the beginning of year as an introductory unit in conducting scientific investigations. **All other 7.1 process skills have been connected to specific content within this curriculum guide, but teachers may also provide instruction in any of the skills throughout the school year.** In order to meet this standard, it is expected that students will: • make connections between the components of the nature of science and their investigations and the greater body of scientific knowledge and research. • design a data table that includes space to organize all components of an investigation in a meaningful way including levels of the independent variable, measured responses of the dependent variable, number of trials, and mathematical means. • develop and use a classification system that uses numerous attributes to organize information and discern patterns. • select and use appropriate tools and techniques for collecting qualitative and in classroom and field investigations. • create and use mental and physical models (including simulations) as ways to visualize explanations of ideas and phenomena. • identify potential sources of error in the design of an experiment. • evaluate the design of an experiment and the events that occur during an investigation to	**Models/Simulations:** Reaction Time: Sound (with Historical Log) The user should click when they hear a sound, and watch for improvement on repeated trials.	**AIMS** Magnificent Microworld Adventures "The Enormous E", The student will prepare a wet mount slide and measure the. field of view at various powers of magnification. "A Pretty Rotten Time", The student will observe structures that produce spores in bread mold and mushrooms. STEM Activity: Greenhouse

• Scientists create and apply classification systems to organize information and discern patterns. • Appropriate tools and techniques are used to gather data during scientific investigations. Measurements are collected using the Investigations will use International System of Units (metric units) of measurement. • Mental and physical models, including computer and other simulations, can be helpful in explaining events or sequences of events that occur. They can be used as part of scientific explanations to support data or represent phenomena, especially those that are not easily seen directly or must be inferred from data. • Potential sources of error in the experimental design must be identified. • To communicate the plan of an experiment accurately, the independent variable, dependent variable, and constants must be explicitly defined. • To establish that the events of an experiment are the result of manipulating the independent variable, the experiment must be controlled by observing the effects without the application of the independent variable. The results can be compared with this standard or control. Not all experiments have a control. • Multiple trials of an experiment must be conducted to verify the results. • Analysis of observed results of systematic investigations includes construction and interpretation of graphs. Such interpretation can be used to make predictions about the behavior of the dependent variable in other situations and to explore potential sources of error in the experiment. This analysis can be used to support conclusions about the results of the investigation. • Investigations can be classified as observational (descriptive) studies (intended to generate hypotheses), or experimental studies (intended to test hypotheses). • Science concepts are applied through observations and connections with everyday life and technology.	determine which factors may affect the results of the experiment. This requires students to examine the experimental procedure and decide where or if they have made mistakes. • identify what is deliberately changed in the experiment and what is to be measured as the dependent variable. • analyze the variables in an experiment and decide which ones must be held constant (not allowed to change) in order for the investigation to represent a fair test. This requires students to comprehend what —variablesll are and to apply that idea in new situations related to the Life Science SOL concepts. • determine the specific component of an experiment to be changed as an independent variable and control the experiment by conducting trials for the experiment in which the independent variable is *not* applied. This requires the student to set up a standard to which the experimental results can be compared. The student must use the results of the controlled trials to determine whether the hypothesized results were indeed due to the independent variable. • construct appropriate graphs, using data sets from investigations. This requires the student to recognize that a line graph is most appropriate for reporting continuous or real-time data. This also requires a student to comprehend that points along the line that are not actual data points can be used to make predictions. Students should be able to interpret and analyze these graphs. • distinguish between observational and experimental investigations. • develop conclusions based on a data set and verify whether the data set truly supports the conclusion. This requires students to cite references to the data that specifically support their conclusions.		

Seventh Grade Science: First Trimester
Cells

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.2 The student will investigate and understand that all living things are composed of cells. Key concepts include **a) cell structure and organelles;** **b) similarities and differences between plant and animal cells;** **c) development of cell theory; and** **d) cell division.** The concepts developed in this standard include the following: • The structure of a cell organelle is suited to the function carried out by that organelle. Division of labor within a cell is essential to the overall successful function of the cell. • Similarities and differences in plants and animals are evident at the cellular level. Plant and animal cells contain some of the same organelles and some that differ. • The original cell theory includes the following components: all living things are composed of cells,; cells are the smallest unit (structure) of living things that can perform the processes (functions) necessary for life,; and living cells come only from other living cells. (Although it is appropriate for students at this level to understand the three points of the original cell theory, an exploration of the revised cell theory should be reserved for high school Biology.) • The development of the original cell theory can be attributed to the major discoveries of many notable scientists. The development of the cell theory has been dependent upon improvements in the microscope and microscopic techniques throughout the last four centuries. • Continuing advances in microscopes and instrumentation have increased the understanding of cell organelles and their functions. Many of these organelles can now be observed with a microscope	In order to meet this standard, it is expected that students will: • distinguish among the following: cell membrane, cytoplasm, nucleus, cell wall, vacuole, mitochondrion, endoplasmic reticulum, and chloroplast. • correlate the structures of cell organelles with their jobs functions and analyze how organelles perform particular jobs. • compare and contrast examples of plant and animal cells, using the light microscope and images obtained from other microscopes. • describe and sequence the major points in the development of the cell theory. • identify the three components of the original cell theory. • sequence the steps in the cell cycle, including the phases of mitosis. • differentiate between the purpose of mitosis and meiosis. • design an investigation from a testable question related to animal and plant cells. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. An example of such a question is: "Do onion cells vary in shape or structure depending on where they are found in the plant?" **Skills** **d) models and simulations are constructed and used to illustrate and explain phenomena**	**Models/Simulations:** Biologica Meiosis Explore meiosis through gamete production and reproduction. Biologica Dragon Genetics Explore meiosis works by choosing different traits for each parent. Tree of Life: Phospholipids Explore a phospholipid, a lipid with a charged end.	**AIMS** Magnificent Microworld Adventures. *"Onion Rings", The student will make a wet mount slide of onion cells and observe cell walls, nucleus cytoplasm, and the cell membrane.* *"The Green Machine", The student will observe chloroplasts in a plant cell.* *"The Cell as A Factory", The student will build a model of a cell to learn its structures and their functions.* *"Dead Centers", The student will make a wet mount slide of cork cells and observe both unstained and stained cork cells.* *"Antony van Leeuwenhoek", a biography of van Leeuwenhoek.*

(light, electron). • Cells go through a life cycle known as the cell cycle. The phases of the cell cycle are interphase, mitosis, and cytokinesis. (Although it is appropriate for students at this level to learn to recognize the stages of the cell cycle and mitosis, an exploration of the individual stages of meiosis may be reserved for high school Biology.) • The purpose of mitosis is to produce new cells for growth and repair that are identical to the parent cell. The purpose of meiosis is to produce reproductive (sex) cells that carry half the genetic material of the parent.			*"Cell Theory" & "Cells: The Basis of Life", [teacher reference pages]* **Enhanced Scope and Sequence Plus** Plant and Animal Cells Cell Division

Seventh Grade Science: First Trimester
Cells

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.3 The student will investigate and understand that living things show patterns of cellular organization. Key concepts include **a) cells, tissues, organs, and systems; and** **b) patterns of cellular organization and their relationship to life processes in living things.** The concepts developed in this standard include the following: • Cells that have the same function group together to form tissues. Tissues that have the same function group together to form organs. Organs with similar functions group to work together in an organ system. • Unicellular organisms are made of only one cell. Multicellular organisms are made of many cells. • Multicellular organisms exhibit a hierarchy of cellular organization. They are complex in that there is a division of labor among the levels of this hierarchy for carrying out necessary life processes. • Cells perform numerous functions and processes including cellular respiration, waste breakdown and removal, growth and division, and cellular transport. • Osmosis is the passive transport of water molecules across a cell membrane. Diffusion is the passive transport of substances other than water across a cell membrane. Cell membranes are selectively permeable to various substances. (A discussion of facilitated diffusion, tonicity, and active transport should be reserved for high school Biology.) • Living things carry out life processes	In order to meet this standard, it is expected that students will: • explain the relationship among cells, tissue, organs, and organs systems. • differentiate between unicellular organisms and multicellular organisms and name common examples of each. • compare and contrast how unicellular and multicellular organisms perform various life functions. This includes the application of knowledge about systems in organisms. • explain the role that each life function serves for an organism: ingestion, digestion and removal of waste, stimulus response, growth and repair, gas exchange, and reproduction. • explain that there is a specific range or continuum of conditions that will meet the needs of organisms. • model how materials move into and out of cells in the processes of osmosis, diffusion, and selective permeability. This includes creating and interpreting three-dimensional models and/or illustrations demonstrating the processes involved. Students should be able to analyze the components of these models and diagrams and communicate their observations and conclusions. • create plausible hypotheses about the effects that changes in available materials might have on particular life processes in plants and in animals. • conduct basic investigations related to understanding cellular organization, with emphasis on observations of cells	**Activities:** **Build a Greenhouse [84]** Build your own greenhouse and explore how to regulate the temperature. (Sensors: Temperature, Light) **Greenhouse Light and Temperature [85]** Build a model greenhouse and explore light and temperature levels over the course of an artificial day. (Sensors: Light, Temperature) **Trees of Life-Animals [94]** Explore biological molecules that are important to animals. (Model) **LS.3b** **Trees of Life – Plants [95]** Explore biological molecules that are important in plants. (Model) **Models/Simulations:** Diffusion and Osmosis 5: Dynamic Equilibrium Diffusion and Osmosis 6: Concentration and Breathing (SAM)	**AIMS** Magnificent Microworld Adventures. *"A Complete Package", The student will observe upper and lower epidermis [skin] of a plant leaf and observe how cell structures carry out specific functions.* *"The Green Machine II", The student will observe when salt water solution is added to an Elodea leaf, the internal structures of each leaf cell changes due to water leaving the cell.* *"The Cell as a Factory", The student will build a model of a cell to learn its structures and their functions.* *"Blood", The student will observe professionally prepared slides of human blood.* *"Making a Hay Infusion", The student will make a hay infusion to observe emergence and growth of protozoa over time.* *"The Pickle Jar Aquarium", The student will observe protozoa and freshwater plants in their own aquarium.* *"Dropping in on Protozoa", The student will observe protozoa in pond water.*

including ingestion, digestion and removal of waste, stimulus response, growth and repair, gas exchange, and reproduction. • Numerous factors can strongly influence the life processes of organisms.	and tissue. This investigation should focus on the skills developed in LS.1.	Diffusion and Osmosis 12: Osmosis Diffusion and Osmosis 2: A Simple Example of Diffusion Sandbox: Diffusion of Particles Diffusion and Osmosis 4: Designing Your Own Model Diffusion and Osmosis 1: Riding An Atom Diffusion Demo with Controls Osmosis: Diffusion through a Membrane - Full Controls Diffusion In and Out of the Cell: Water, Oxygen and CO_2 Osmosis: Keeping an Ion Balance The Butterfly Effect Model Simple Osmosis with One Pore The Butterfly Effect Diffusion and Osmosis 3: Net Flow From High To Low (SAM) Diffusion and Osmosis 7: Evolving Efficient Breathing (SAM) Diffusion and Osmosis 8: The Role Of Surface Area (SAM)	Our Wonderful World *"Transpiration-Why Are Plants So Thirsty", The student will explore why plants require so much water to survive and why they die so quickly when water is not present.* *"Transpiration", The student will observe the transpiration and water movement that occurs in plant leaves.* *"PhotosyntheSiS", The student will observe the production of oxygen through photosynthesis.* **Enhanced Scope and Sequence Plus** Levels of Cellular Organization Osmosis, Diffusion, and Active Transport

		Diffusion and Osmosis 9: The Porous Membrane Diffusion And Osmosis 10: Which Atoms Or Molecules Need Pores? Diffusion and Osmosis 13: Making An Electric Potential Diffusion and Osmosis 11: Exploring An Aquapore All of the above models demonstrate examples of diffusion and let the user manipulate the model to reach equilibrium. Diffusion and Osmosis 14: Active Transport Explore the relationship between ion concentration, ATP concentration, and the formation of electrical energy below. To start, use the pull down menus below the model to select a concentration for ATP and for calcium ions.	

Seventh Grade Science: Second Trimester
Photosynthesis

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.5 The student will investigate and understand the basic physical and chemical processes of photosynthesis and its importance to plant and animal life. Key concepts include: **a) energy transfer between sunlight and chlorophyll;** **b) transformation of water and carbon dioxide into sugar and oxygen; and** **c) photosynthesis as the foundation of virtually all food webs.** The concepts developed in this standard include the following: • Chlorophyll is a chemical in chloroplasts that can absorb or trap light energy. • Photosynthesis is the necessary life process that transforms light energy into chemical energy. It involves a series of chemical reactions in which the light energy is used to change raw materials (carbon dioxide and water) into products (sugar and oxygen). The energy is stored in the chemical bonds of the glucose (sugar) molecules. • Plants perform cellular respiration as well as photosynthesis. • Plants convert the sugars they produce into other raw materials that are used by plants and animals for growth, repair, and energy needs. • Energy is a basic need of all living things. Photosynthesizing organisms obtain their energy from the sun and are often called producers because of their ability to produce glucose (sugar).	In order to meet this standard, it is expected that students will: • describe the process of photosynthesis in terms of raw materials and products generated. • identify and describe the cellular organelles involved in the process of photosynthesis. • explain how organisms utilize the energy stored from the products of photosynthesis. • compare and contrast the processes of photosynthesis and cellular respiration. • relate the importance of photosynthesis to the role of producers as the foundation of food webs. • design an investigation from a testable question related to photosynthesis. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. **Skills** h) **data are organized, communicated through graphical representation, interpreted, and used to make predictions**	**Activities:** Leaf Photosynthesis [41] Explore leaf photosynthesis and the macroscopic outcome of the photosynthetic reaction. (Model: Netlogo) Transpiration [40] Investigate the process of transpiration in living plants. (Sensor: Relative Humidity, Temperature) **Models/Simulations:** Cellular Respiration 6: Exploring the Electron Transport Chain The Electron Transport Chain uses high chemical energy molecules made in the Krebs Cycle. Students can explore how they are used to pump hydrogen ions (protons) to one side of a membrane, where they will later be used to create ATP molecules. Cellular Respiration 7: Disrupting the Electron Transport Chain How do some poisons work? Explore places along the Electron Transport Chain where molecular actions can be blocked. Photosynthesis 1: What is Sunlight? In an introductory model, sunlight is discovered to be made of photons of different wave lengths.	**AIMS** Magnificent Microworld Adventures *"Algae -The Food Factory", The student will study the characteristics of several different types of algae.* The Budding Botanist *"PhotosyntheSiS", The student will study oxygen produced by photosynthesis.* **Enhanced Scope and Sequence Plus** Photosynthesis and Cellular Respiration The Cycles of Nature

• Photosynthesizing organisms are the foundation of virtually all food webs.		Photosynthesis 2: When Light Shines on Leaves Consider how different colored leaves absorb, reflect, and transmit different photons. This model provides a virtual experiment involving a green leaf and a red leaf. A light filter is placed at the right edge of the compartment to control the frequency of light that shines into the compartment. Photosynthesis 3: Meeting Chlorophyll in a Leaf Explore the light-harvesting molecules. The model asks students: Suppose we have separated a leaf into three substances, each of which is known to be composed of one type of molecule. Let's call them Molecule A, B, and C. Our task is to figure out which molecule is responsible for absorbing light. Photosynthesis 4: Photosystems in Chloroplasts Without the light harvesting complex, chlorophyll's ability to capture a photon has no result. Students go beyond the chlorophyll molecule to explore the light-harvesting system that is in turn part of the photosystems inside the chloroplasts. Photosynthesis 6: Designing a Pigment An advanced challenge in which users are encouraged to try to make a specific pigment. The model below shows a molecule	

		that can absorb all frequencies of photons. The task is to modify the energy level diagram so that it will absorb photons of any color but blue. Cellular Respiration 1: Introduction to the ATP Molecule Explore the structure of ATP, a high energy molecule that is made in almost every cell and is the fuel needed by most biological processes. Cellular Respiration 2: Glycolysis and the Production of ATP Explore the steps in the breaking down of glucose, and the use and creation of high energy small molecules that make the reactions "go." Cellular Respiration 3: The Role of Enzymes A model system of glycolysis enzymes have on reaction rates. Cellular Respiration 4: The Krebs Cycle, Forming Molecules to Make ATP After glucose is broken down into two pyruvate molecules in the cytoplasm, those molecules move into the mitochondria, where energy extraction is continued in the Krebs cycle. Model 346: Cellular Respiration 5: The Krebs Cycle and the Electron Transport Chain Discover high energy molecules that will become part of the Electron Transport Chain.	

		Photosynthesis 3a: Photons and the Chlorophyll Molecule Explore the chlorophyll molecule in 3D. Follow the instructions that accompany the chlorophyll molecule. Photosynthesis In A Leaf Observe the process of photosynthesis in a leaf. Here's a movie showing the operation of the model. Photosynthesis In A Leaf Observe photosynthesis in a leaf, showing the specific reactants and products as the chloroplasts are excited by light and then de-excited by making sugar.	

Seventh Grade Science: Second Trimester
DNA

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.12 The student will investigate and understand that organisms reproduce and transmit genetic information to new generations. Key concepts include **a) the structure and role of DNA;** **b) the function of genes and chromosomes;** **c) genotypes and phenotypes;** **d) characteristics that can and cannot be inherited;** **e) genetic engineering and its applications; and** **f) historical contributions and significance of discoveries related to genetics.** The concepts developed in this standard include the following: • DNA is a double helix molecule. • DNA is a molecule that includes different components — sugars, nitrogenous bases, and phosphates. The arrangement of the nitrogenous bases within the double helix forms a chemical code. • Chromosomes are strands of tightly wound DNA. Genes are sections of a chromosome that carry the code for a particular trait. An allele is an alternate form of a gene. • The basic laws of Mendelian genetics explain the transmission of most traits that can be inherited from generation to generation. • A Punnett square is a model used to predict the possible combinations of inherited factors resulting from single trait crosses. (An investigation of dihybrid crosses, multiple alleles, and incomplete dominance should be reserved for high school Biology.)	In order to meet this standard, it is expected that students will: • recognize the appearance of DNA as double helix in shape. • explain that DNA contains coded instructions that store and pass on genetic information from one generation to the next. • explain the necessity of DNA replication for the continuity of life. • explain the relationship among genes, chromosomes, and alleles. • demonstrate variation within a single genetic trait. • distinguish between dominant and recessive traits. • distinguish between genotype and phenotype. • use Punnett squares to predict the possible combinations of inherited factors resulting from single trait crosses. • differentiate between characteristics that can be inherited and those that cannot be inherited. • identify aspects of genetic engineering and supply examples of applications. Evaluate the examples for possible controversial aspects. • describe the contributions of Mendel, Franklin, Watson, and Crick to our basic understanding of genetics. **Skills** j) **current applications are used to reinforce life science concepts.**	**Activities:** Genes and Appearance [93] Change the way a dragon looks by changing its genes. (Model: Biologica) Meiosis [92] Learn how meiosis (the formation of gametes) and fertilization (combining two gametes to form a fertilized zygote) shuffle the alleles that offspring inherit. (Model: Biologica) Trees of Life-Animals [94] Explore biological molecules that are important to animals. (Model) Trees of Life – Plants [95] Explore biological molecules that are important in plants. (Model) **Models/Simulations:** Proteins and Nucleic Acids Introducing DNA An interactive model of DNA in 3D. You can explore both the components and the different modes of visualizing DNA. DNA to Proteins 3: Modeling Transcription Visualize a 2D version of DNA. The container background is blue, indicating that everything happens in the aqueous environment of the cell. DNA to Proteins 5: Modeling Transcription And Translation Control both steps in the pathway	**Enhanced Scope and Sequence Plus** DNA Extraction from Strawberries Building a DNA Model Passing Traits to Offspring

• Dominant traits mask the expression (phenotype) of recessive traits. Genotype is the specific combination of dominant and recessive gene forms. • Traits that are expressed through genes can be inherited. Characteristics that are acquired through environmental influences, such as injuries or practiced skills, cannot be inherited. • In genetic engineering, the genetic code is manipulated to obtain a desired product. • Genetic engineering has numerous practical applications in medicine, agriculture, and biology. • A series of contributions and discoveries led to the current level of genetic science.		from DNA to protein: DNA to Proteins 6: Working As A Ribosome Work as a ribosome and translate DNA into amino acids. DNA to Proteins: Making Mutations Use this model to make a number of mutations: substitution, silent, frame shift, as well as stop codons that stop the replication process. Meiosis Three Manipulate alleles to see an outcome. Biologica Dragon Genetics Manipulate alleles to see an outcome. Tree of Life: DNA and Its Nucleotides A set of visualizations of nucleotides, their chemical formulas and 3D representations, together with 3D DNA for active exploration. Tree of Life: Protein Example - Insulin Visual representations of the protein insulin. It is a dimer, with two interrelated protein chains. Tree of Life Protein Example - Plant Toxin Many plants produce a protein that is toxic to pathogens that might infect it or animals that might eat it. This particular toxin is produced by a cabbage plant.	

		Tree of Life: Phospholipids Explore a phospholipid, a lipid with a charged end. Sheep-Mutation This is a model of a flock of sheep whose survival depends on eating grass. The babies inherit traits from their parents according to Mendelian genetics. One can watch the spread of a mutation and how it depends on selection pressure. Sheep-Selection This is a model of a flock of sheep whose survival depends on eating grass. The babies inherit traits from their parents according to Mendelian genetics. One can study the effect on the population of a trait that changes the energy they get from eating grass. DNA to Proteins 1: 3D Model for Exploration A versatile model for exploring DNA, highlighting chains, nucleotides and hydrogen bonds. Users can also move among ball and stick, space filled and cartoon views of the molecule. DNA to Proteins 2: The Nucleotides A view of DNA emphasizing nucleotides. DNA to Proteins 3: Transcription A model in which users can go step by step through the transcription process. Note: The source of mRNA nucleotides is not shown, but they are usually	

		floating around inside the cell. Protein Structure - Substitution Mutation Replace one nucleotide with another for a substitution mutation. To make a mutation, right-click on a nucleotide. Then choose a mutation from the pop-up menu. (For example, you can change TTT to TCT.) Protein Structure: Silent Mutation Make a single nucleotide mutation in the model above that does not change the sequence of the resulting protein. To make sure the amino acid sequence has not changed, you can synthesize (transcribe and translate) the protein before and after you make the mutation. Protein Structure - Stop Codon Inserting a stop codon into the sequence will cause translation to stop there. PopGen Fish Bowl You can explore the effects of: 1-Small population size (Genetic Drift) 2-Selection 3-Mutation 4-Migration 5-Nonrandom mating Some basic population biology is also demonstrated such as, logistic population growth and the Allee Effect. DNA Polymerase: Making a New DNA Molecule From a Template This is a model of DNA replication.	

		Making a Sickle Cell Sequence Allele Divergence Biologica Pedigree Pedigree - Collect Data 1 Pedigree - Collect Data 3 Pedigree - Further Investigation Pedigree - Collect Data 2	

Seventh Grade Science: Second Trimester
Evolution

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.13 The student will investigate and understand that populations of organisms change over time. Key concepts include **a) the relationships of mutation, adaptation, natural selection, and extinction;** **b) evidence of evolution of different species in the fossil record; and** **c) how environmental influences, as well as genetic variation, can lead to diversity of organisms.** The concepts developed in this standard include the following: • The mechanisms through which evolution takes place are a related set of processes that include mutation, adaptation, natural selection, and extinction. This results in changes in populations of organisms over time. • Mutations are inheritable changes because a mutation is a change in the DNA code. • Adaptations are structures, functions, or behaviors that enable a species to survive. • Natural selection is the survival and reproduction of the individuals in a population that exhibit the traits that best enable them to survive in their environment. • A mutation may result in a favorable change or adaptation in genetic information that improves a species' ability to exist in its environment, or a mutation may result in an unfavorable change that does not improve or impedes a species' ability to exist in its environment. • The evidence for evolution is drawn from a variety of sources of data, including the fossil record, radiometric dating, genetic information, the distribution of organisms, and anatomical and developmental similarities across species.	In order to meet this standard, it is expected that students will: • interpret data from simulations that demonstrate selection for a trait belonging to species in various environments. • describe how changes in the environment can bring about changes in a species (adaptation, extinction) through natural selection. • describe and explain how fossils are records of organisms and events in the Earth's history. • explain the evidence for evolution from a variety of sources of scientific data. • explain how genetic variations in offspring, which lead to variations in successive generations, can result from the same two parents. • analyze and evaluate data from investigations on variations within a local population. • explain how environmental influences, as well as genetic variation, can lead to diversity of organisms. **Skills** i. **patterns are identified in data and are interpreted and evaluated**	**Models/Simulations:** Sheep Mutation Mutation in a flock of sheep. Tree of Life: Hemoglobin Hemoglobin, which transports oxygen in higher animals, is an example of a critical protein. The model allows exploration of the globin component. Bug Hunt Camouflage This is a model of natural/artificial selection that shows how a population hunted by a predator can develop camouflaging. For example, in a forest with green leaves, green bugs may emerge as the predominant bug color.	**Enhanced Scope and Sequence Plus** Owl Family Natural Selection Evidence of Evolution

• Individuals of a population each exhibit a range of variations in a trait as a result of the variations in their genetic codes. These variations may or may not help them survive and reproduce in their environment. • If a species does not include traits that enable it to survive in its environment or to survive changes in the environment, then the species may become extinct.			

Seventh Grade Science: Second Trimester
Classification

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.4 The student will investigate and understand how organisms can be classified. Key concepts include **a) the distinguishing characteristics of domains of organisms;** **b) the distinguishing characteristics of kingdoms of organisms;** **c) the distinguishing characteristics of major animal phyla and plant divisions; and** **d) the characteristics that define a species.** The concepts developed in this standard include the following: • Information about physical features and activities is arranged in a hierarchy of increasing specificity. The levels in the accepted hierarchy include domain, kingdom, phylum, class, order, family, genus and species. • Current classification systems now generally recognize the categorization of organisms into three domains, Archaea, Bacteria and Eukarya. • As living things are constantly being investigated, new attributes (physical and chemical) are revealed that affect how organisms are placed in a standard classification system. This system is the basis for scientific binomial nomenclature.	In order to meet this standard, it is expected that students will: • classify organisms based on a comparison of key physical features and activities. • arrange organisms in a hierarchy according to similarities and differences in features. • categorize examples of organisms as representative of the kingdoms and recognize that the number of kingdoms is subject to change as new data are collected. • categorize examples of organisms as representative of the three domains (Archaea, Bacteria and Eukarya) and recognize that the number of domains is subject to change as new data are collected. • recognize examples of major animal phyla. • recognize examples of major plant (divisions). • recognize scientific names as part of a binomial nomenclature. **Skills** b) **a classification system is developed based on multiple attributes**		**AIMS** Critters *"Animal Antics" The student will sort animals into appropriate classifications in the animal kingdom.* *"Warming Up to Worms", The student will observe and chart worm behavior.* *"Portrait of An Average Snail",* *The student will make quantitative and comparative observations of garden snails.* *"Inside Out", The student will observe the various parts of a snail and measure its height, length and mass.* *"Now You See Them Now You Don't", The student will determine how long it takes earthworms to burrow into the ground.* *"Slime Trail", Critters The student will determine whether big snails or small snails travel faster.* *"The Up or Down Snail", The student will determine rates that snails travel on horizontal and vertical surfaces.* *"What's Your Angle?", The student will determine how the angle of a ramp affects the rate at which a snail pulls a load up a ramp.* *"Snail Olympics", The student will compete their snail In four Olympic style events.* *"Table Manners", The student will simulate food gathering with different "Insect mouths."* Magnificent Microworld Adventures *"Pickle Jar Aquarium", The student will observe freshwater protozoa and plants.*

• Any grouping of organisms into domains or kingdoms is based on several factors, including the presence or absence of cellular structures, such as the nucleus, mitochondria, or a cell wall; whether the organisms exist as single cells or are multicellular; and how the organisms get their food. For example, simple, single-celled organisms that are able to survive in extreme environments are believed to be fundamentally different from other organisms and may be classified in their own domain (Archaea). Four different kingdoms of the Eukarya domain of organisms are generally recognized by scientists today (Protista, Fungi, Plants, and Animals). • Some important animal groups (phyla) are the cnidarians, mollusks, annelids, arthropods, echinoderms, and chordates. • Four important plant groups (divisions) are the mosses, ferns, conifers, and flowering plants. • A group of similar-looking organisms that can interbreed under natural conditions and produce offspring that are capable of reproduction defines a species.			*"Spinning the Tail", The student will make flip books and zoetrops to model the movement of protozoa.* *"Moving in on Protozoa", The student will observe the movement of protozoa.* *"Algae -The Food Factory", The student will study the characteristics of several different types of algae.* **Enhanced Scope and Sequence Plus** Classification of Organisms Animal Phyla and Plant Divisions Discovery Education Video http://app.discoveryeducation.com/player/view/assetGuid/902F8724-B78E-4E18-9D24-A5E6B4D743B4

Seventh Grade Science: Third Trimester
Ecosystems

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.6 The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment. Key concepts include **a) the carbon, water, and nitrogen cycles;** **b) interactions resulting in a flow of energy and matter throughout the system;** **c) complex relationships within terrestrial, freshwater, and marine ecosystems; and** **d) energy flow in food webs and energy pyramids.** The concepts developed in this standard include the following: • Many important elements and compounds cycle through the living and nonliving components of the environment as a chain of events that continuously repeats. • Materials are recycled and made available through the action of decomposers. • In order to understand how an ecosystem functions, one must understand the concept of a system and be able to envision models of systems. • To analyze the interactions resulting in a flow of energy and matter throughout the ecosystem, one must identify the elements of the system and interpret how energy and matter are used by each organism. • Energy enters an ecosystem through the process of photosynthesis and is passed through the system as one organism eats and is, in turn, eaten.	In order to meet this standard, it is expected that students will: • differentiate among key processes in the water, carbon, and nitrogen cycles and relate how organisms, from bacteria and fungi to third-order consumers, function in these cycles. • observe and identify common organisms in ecosystems and collect, record, and chart data concerning the interactions of these organisms (from observations and print and electronic resources). • classify organisms found in local ecosystems as producers or first-, second-, or third-order consumers. Design and construct models of food webs with these organisms. • observe local ecosystems and identify, measure, and classify the living and nonliving components. • identify examples of interdependence in terrestrial, freshwater, and marine ecosystems. • determine the relationship between a population's position in a food web and its size. • apply the concepts of food chains, food webs, and energy pyramids to analyze how energy and matter flow through an ecosystem. • design an investigation from a testable question related to food webs. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. • analyze and critique the experimental design of basic investigations related to food webs.	**Activities:** Trees of Life-Animals [94] Explore biological molecules that are important to animals. (Model) Trees of Life – Plants [95] Explore biological molecules that are important in plants. (Model) **Models/Simulations:** Sheep - Population A Sheep - Population B Sheep - Population C Sheep Selection Sheep Mutation The above models show population dynamics in a herd of sheep. The rancher can remove some sheep each year. Algae Algae moving up and down the water column in response to light and food. Worms Worms-food balance Water Cycle A dynamic display of the water cycle.	**Climate change for Middle School** Inquiry-based labs to investigate the carbon cycle.Assessment Access - Login: eliteacher Password: 87dja92 **AIMS** Magnificent Microworld Adventures *"Life in Glass Houses", The student will establish a protozoan community in a glass eyedropper and observe changes in the community over an extended period of lime.* *"Pickle Jar Aquarium", The student will observe freshwater protozoa and plants in their own aquarium.* Critters *"Brine Shrimp", The student will observe and study brine shrimp as they hatch and grow.* *"Worm Home", The student will observe earthworms in their "home environment".* Our Wonderful World *"On Living Pond", The student will observe types of organisms that might be found in a freshwater pond.* **Enhanced Scope and Sequence Plus** Freshwater Food Chains Go with the Flow

This energy flow can be modeled through relationships expressed in food webs. • The amount of energy available to each successive trophic level (producer, first-order consumer, second-order consumer, third-order consumer) decreases. This can be modeled through an energy pyramid, in which the producers provide the broad base that supports the other interactions in the system.			

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VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.7 The student will investigate and understand that interactions exist among members of a population. Key concepts include **a) competition, cooperation, social hierarchy, territorial imperative; and** **b) influence of behavior on a population.** The concepts developed in this standard include the following: • Individual members of a population interact with each other. These interactions include competing with each other for basic resources, mates, territory, and cooperating with each other to meet basic needs. • The establishment of a social order in a population may ensure that labor and resources are adequately shared. • The establishment of a territory ensures that members of a population have adequate habitat to provide for basic resources. • Individual behaviors and group behaviors can influence a population. • Animals exhibit needs for food, water, gases, shelter and space for which they compete. These needs may often be met in a range of conditions. Too much may be as harmful as too little (e.g., too much food or too little water).	In order to meet this standard, it is expected that students will: • differentiate between the needs of the individual and the needs of a population. • interpret, analyze, and evaluate data from systematic studies and experiments concerning the interactions among members of a population. • determine the relationship between a population's position in a food web and the types of interactions seen among the individuals of the population. • observe and identify populations in ecosystems and collect, record, chart, and interpret data concerning the interactions of these organisms (from observations and print and electronic resources). • categorize behaviors as examples of competition, cooperation, social hierarchy, or territorial imperative.	**Models/Simulations:** Sheep Selection 2 Farmer picks sheep randomly when he removes some each year.	**AIMS** Magnificent Microworld Adventures *"The Hanging Drop", the student will observe protozoa in the same drop of water, over time.*

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VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.8 The student will investigate and understand interactions among populations in a biological community. Key concepts include **a) the relationships among producers, consumers, and decomposers in food webs;** **b) the relationship between predators and prey;** **c) competition and cooperation;** **d) symbiotic relationships; and** **e) niches.** The concepts developed in this standard include the following: • Organisms or populations that rely on each other for basic needs form interdependent communities. • Energy resources of a community are shared through the interactions of producers, consumers, and decomposers. • The interaction between a consumer that hunts for another consumer for food is the predator-prey relationship. • In a community, populations interact with other populations by exhibiting a variety of behaviors that aid in the survival of the population. • Organisms may exist as members of a population; populations interact with other populations in a community. • Populations of one species may compete with populations of other species for resources. Populations of one species may also cooperate with populations of other species for resources. • A symbiotic relationship may exist between two or more organisms of different species when they live and work together. • Symbiotic relationships include mutualism (in which both organisms benefit), commensalism (in which one organism benefits and the other is unaffected), and parasitism (in which one organism benefits and the other is harmed). • Each organism fills a specific role or niche in its community.	In order to meet this standard, it is expected that students will: • identify the populations of producers, consumers, and decomposers and describe the roles they play in their communities. • interpret, analyze, and evaluate data from systematic studies and experiments concerning the interactions of populations in an ecosystem. • predict the effect of population changes on the food web of a community. • generate predictions based on graphically represented data of predator-prey populations. • generate predictions based on graphically represented data of competition and cooperation between populations. • differentiate between the types of symbiosis and explain examples of each. • infer the niche of organisms from their physical characteristics. • design an investigation from a testable question related to interactions among populations. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.	**Models/Simulations:** Rabbits-Grass Rabbits-Grass-Weeds-1 Rabbits-Grass-Weeds-2 Rabbits-Grass-Weeds-3 Hawks and Rabbits (Controllable) Hawks and Rabbits in Changing Environment Open Model, Grass Rabbits and Hawks (With Hypothesis) Open Model, Grass Rabbits, Hawks and Foxes (With Hypothesis) Open Model, Grass Rabbits, Hawks and Foxes The above models demonstrate and allow the user to manipulate environmental situations that help show an understanding of predator/prey relationships.	**AIMS** Critters *"Catch Me If You Can", a food chain game of tag.* **Enhanced Scope and Sequence Plus** A Salt Marsh Ecosystem Predator-Prey Simulation Organisms in Symbosis

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VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.9 The student will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem. Key concepts include **a) differences between ecosystems and biomes;** **b) characteristics of land, marine, and freshwater ecosystems; and** **c) adaptations that enable organisms to survive within a specific ecosystem.** The concepts developed in this standard include the following: • The living organisms within a specific area and their physical environment define an ecosystem. • Characteristics of land, marine, and freshwater ecosystems vary with respect to biotic and abiotic factors. • The major terrestrial ecosystems are classified into units called biomes — large regions characterized by certain conditions, including a range of climate and ecological communities adapted to those conditions. • Organisms have specific structures, functions, and behaviors that enable them to survive the biotic and abiotic conditions of the particular ecosystem in which they live. • Organisms possess adaptations to both biotic and abiotic factors in their ecosystem that increase their chance of survival.	In order to meet this standard, it is expected that students will: • differentiate between ecosystems and biomes. • recognize and give examples of major biomes: desert, forest, grassland, and tundra. • compare and contrast the biotic and abiotic characteristics of land, marine, and freshwater ecosystems. • analyze and describe how specific adaptations enable organisms to survive in a particular ecosystem. • design an investigation from a testable question related to how specific adaptations of organisms allow them to survive in the presence of the biotic and abiotic factors in an ecosystems. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.	**Activities:** Competition [87] Study the effect of a consumer (rabbits) on two species of producers (grasses and weeds). **Models/Simulations:** Bug Hunt Camouflage Peppered Moths The above two models demonstrate specific adaptations that enable organisms to survive. (S) Ant sorting This simulation is based on the ability of ants and termites to sort material and align them to piles. This leads to the known building behavior of termites and the known ability of ants to sort seeds or corpses. One basic principle in these cases is the phenomenon called “stigmergy,” that means that the erected building itself represents the key stimulus that directs further building. This way the building itself is simultaneously its own building plan.	**AIMS** Critters *"Who's Home on the Biome?" The student will organize plants and animals in different biomes.* **Enhanced Scope and Sequence Plus** Biomes of the World Heat Loss from a Fur-Insulated Animal A Designed Organism

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VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.10 The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic, change over time, and respond to daily, seasonal, and long-term changes in their environment. Key concepts include **a) phototropism, hibernation, and dormancy;** **b) factors that increase or decrease population size; and** **c) eutrophication, climate changes, and catastrophic disturbances.** The concepts developed in this standard include the following: • Organisms may exist as members of a population; populations interact with other populations in a community; and communities together with the physical environment form ecosystems. • Changes that affect organisms over time may be daily, seasonal, or long-term. • Plants may respond to light by growing toward it or away from it, a behavior known as phototropism. • Animals may respond to cold conditions with a period of lowered metabolism, a behavior known as hibernation. • Organisms may respond to adverse conditions with a period of lowered or suspended metabolism, a behavior known as dormancy. • A variety of environmental factors may cause the size of a population to increase or decrease. (This requires students to brainstorm examples of factors and predict the possible effects.)	In order to meet this standard, it is expected that students will: • relate the responses of organisms to daily, seasonal, or long-term events. • differentiate between ecosystems, communities, populations, and organisms. • predict the effect of climate change on ecosystems, communities, populations, and organisms. • predict the effect of eutrophication on ecosystems, communities, populations, and organisms. • compare and contrast the factors that increase or decrease population size. • classify the various types of changes that occur over time in ecosystems, communities, populations, and organisms, as long term, short term, or seasonal. • design an investigation from a testable question related to change over time in ecosystems, communities, populations, or organisms. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. • analyze and critique the experimental design of basic investigations related to change over time in ecosystems, communities, populations, and organisms.	**Models/Simulations:** Sheep - Population B Sheep - Population C Sheep Selection The above models show population dynamics in a herd of sheep. The rancher can remove some sheep each year. Climate Change, With Temperature Graph Climate Change Starter, Without Graph Climate Change (TELS) The above models include basic factors in climate change, including greenhouse gases, clouds, incoming sunlight and outgoing infrared. Greenhouse Gases Greenhouse Gases in space model. PopGen Fish Bowl PopGen Fishbowl is an agent-based population genetics simulation. The program contains the tools to conduct virtual experiments violating all the assumptions of Hardy-Weinberg theory.	**AIMS** Magnificent Microworld Adventures *"Life in Glass Houses", The student will establish a protozoan community in a glass eyedropper and observe changes in the community over an extended period of time.* *"The Pickle Jar Aquarium", The student will observe protozoa and freshwater plants in their own aquarium.* Critters *"Missing Moths", The student will hunt for moths, testing the success of their camouflage.* Our Wonderful World *"Predator Versus Prey", The student will investigate the importance of protective coloring.* *"Insect Lawn Jumpers", The student will observe a grasshopper's movement.* *"Now You See It, Now You Don't", The student will study the importance of protective coloring.* Finding Your Bearings *"Country Crush", The student will compare the density of the most populated countries in the world.*

• Long-term changes may affect entire communities and ecosystems. Such large-scale changes include the addition of excess nutrients to the system (eutrophication), which alters environmental balance; dramatic changes in climate; and catastrophic events, such as fire, drought, flood, and earthquakes.		Five Flowerpots, One Plant Five Flowerpots, Three Plants Three Flowerpots with Variation Plant Variation with Mountains Five Flower Pots with Water Field Of Flowers with Water Five Flowerpots, Three Plants with Graph Field with Three Plants, No Variation Field with One Plant, Variation The above models lack description but could be used to manipulate the environment and studying the germination rate of seeds. These models should be used by Teachers! Single Rabbit (Controllable) Rabbit Population (Controllable) Rabbit Variation: Feeding The above models lack description but could be used to manipulate the amount of food and rabbits in an environment.	**Enhanced Scope and Sequence Plus** A-Mazing Plants Changes in Ecosystems

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VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
LS.11 The student will investigate and understand the relationships between ecosystem dynamics and human activity. Key concepts include **a) food production and harvest;** **b) change in habitat size, quality, or structure;** **c) change in species competition;** **d) population disturbances and factors that threaten or enhance species survival; and** **e) environmental issues.** The concepts developed in this standard include the following: • Ecosystems are dynamic systems. Humans are a natural part of the ecosystem. Humans use the ecosystem to meet their basic needs, such as to obtain food. • Human interaction can directly alter habitat size, the quality of available resources in a habitat, and the structure of habitat components. Such interactions can be positive and/or negative. • Human input can disturb the balance of populations that occur in a stable ecosystem. These disturbances may lead to a decrease or increase in a population. Since populations in an ecosystem are interdependent, these disturbances have a ripple effect throughout the ecosystem. • The interaction of humans with the dynamic ecosystem may lead to issues of concern for continued ecosystem health in areas such as water supply, air quality, energy production, and waste management.	In order to meet this standard, it is expected that students will: • identify examples of ecosystem dynamics. • describe the relationship between human food harvest and the ecosystem. • debate the pros and cons of human land use versus ecosystem stability. • compare and contrast population disturbances that threaten and those that enhance species survival. • describe ways that human interaction has altered habitats positively and negatively. • observe the effect of human interaction in local ecosystems and collect, record, chart, and interpret data concerning the effect of interaction (from observations and print and electronic resources). • design an investigation from a testable question related to the relationships between ecosystem dynamics and human activity. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. • analyze and critique the experimental design of basic investigations related to the relationships between ecosystem dynamics and human activity.	**Activities:** Build a Greenhouse [84] Build your own greenhouse and explore how to regulate the temperature. (Sensors: Temperature, Light) Greenhouse Light and Temperature [85] Build a model greenhouse and explore light and temperature levels over the course of an artificial day. (Sensors: Light, Temperature) **Model/Simulations:** Sheep - Population C Model to show population dynamics in a herd of sheep. The rancher can remove some sheep each year. Climate Change, With Temperature Graph A model of energy balance in the atmosphere. It includes data plot. To slow the model, pull the top slider to the left. Climate Change Starter, Without Graph This model includes basic factors in climate change, including greenhouse	**AIMS** Finding Your Bearings *"Economically Speaking", The student will infer and draw conclusions about the economy of a country based on its physical features.* Critters *"Who's Home on the Biome?", The student will compare animals and plants in different biomes* *"Who's Home on the Biome ?", The student will compare plants and animals in different biomes.* Finding Your Bearings *"Global Gains", The student will graph worldwide population changes.* *"Up and Down Towns", The student will gather and graph historical as well as current population data for their own town.* *"People 'Plosion", The student will examine four decades of population data of the world's most populated countries and project their future growth.* *"Global Gains", The student will construct a bar graph along a time line axis showing the increments when the world population has doubled and will predict when it will double again.*

		gases, clouds, incoming sunlight and outgoing infrared. Climate Change This is a basic atmospheric greenhouse effect model, showing the effect of radiation, greenhouse gases (Gases), clouds and albedo on temperature of the earth. Greenhouse Gases Greenhouse Gases in space model. Wolf Sheep Predation (oversized) This model allows the user to manipulate the amount of sheep and wolf population to demonstrate a predator/prey relationship.	Water Precious Water *"Mini Water Treatment Simulation", The student will simulate the steps in the water treatment process.* *"Help Save the Birds", The student will devise a system to filter dirty water.* **Enhanced Scope and Sequence Plus** Ecosystem Dynamics