SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Science 9	**Length of Course:** Half Year
Grade Level(s): 9	**Periods Per Cycle:** 6
Units of Credit: 1	**Length of Period:** 84 Minutes
Classification: Core	**Total Instructional Time:** 126 Hours

Course Description

Science 9 is a freshman survey of science course that will engage students in the seven science and engineering practices to build the foundation for students to apply knowledge and synthesize products through inquiry and discovery-based learning. Topics addressed will include basic principles of physics, chemistry, and biology.

Instructional Strategies, Learning Practices, Activities, and Experiences

Teacher Demonstrations Laboratory Experiments	Formal and Summative Assessments Guided Practice Online Resources	Bell Ringers Direct Instruction Differentiated Instruction

Assessments

Teacher-specific Assessments (Quizzes, Unit Exams, etc.)	Final Exam	

Materials/Resources

CK-12 Online Textbook	Online Resources	Laboratory Resources and Equipment

Adopted: 5/19/14
Revised: 5/22/23

I. Science Skills	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Scientific Method B. Units of Measurement C. Data Organization and Analysis	MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. Objectives: ● Students will be able to use both direct and indirect observations to study the natural world. ● Students will be able to identify questions and concepts that guide scientific investigations. ● Students will be able to demonstrate accurate and precise measurements and data collection. ● Students will be able to translate quantitative data into a visual form, such as a table or graph.

II. Forces and Motion	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Speed and Velocity B. Acceleration C. Newton's Laws of Motion	MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. Objectives: ● Students will be able to differentiate between transitional motion and rotational motion in terms of position, velocity, and acceleration. ● Students will be able to determine and demonstrate distance, displacement, speed, velocity, and acceleration.

III. Electricity and Magnetism	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Electricity B. Magnetism	MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. Objectives: ● Students will be able to describe how electricity and magnetism are related effects. ● Students will be able to distinguish between static and current electricity. ● Students will be able to explain electrical charge and differentiate between attractive and repulsive electrical forces. ● Students will be able to explain the types of currents and differentiate between conductors and insulators. ● Students will be able to discuss factors that affect electrical resistance. ● Students will be able to explain magnetic force and differentiate between magnetic and nonmagnetic materials. ● Students will be able to explain how an electric charge can create a magnetic field.

IV. Classification of Matter	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Mixtures vs. Pure Substances B. Homogenous vs. Heterogenous Mixtures C. Chemical and Physical Properties of Matter D. Forms of Energy (Potential: Chemical, Mechanical, and Kinetic: Radiant, Thermal, and Motion).	MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. Objectives: ● Students will be able to differentiate between pure substances and mixtures. ● Students will be able to differentiate between heterogeneous and homogeneous mixtures. ● Students will be able to differentiate between physical and chemical properties. ● Students will be able to explain differences between physical and chemical changes. ● Students will be able to explain types of potential and kinetic energy as it relates to matter. ● Students will be able to explain the law of conservation of energy.

V. Parts of an Atom and the Periodic Table	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Parts of an Atom: Nucleus (Protons/Neutrons, and Electrons B. The Bohr Model C. Modern Periodic Table Arrangement D. Properties of Groups	HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. Objectives: ● Students will be able to distinguish between the subatomic particles of the atom: the neutron, proton, and electron. ● Students will be able to draw Bohr Models of atoms demonstrating proper location of electrons. ● Students will be able to explain the arrangement of elements on the Periodic Table. ● Students will be able to describe properties of metals, nonmetals, and metalloids. ● Students will be able to determine the number of valence electrons in groups 1A-8A. ● Students will be able to describe the characteristics of the representative elements (groups 1A – 8A) on the Periodic Table. ● Students will be able to describe characteristics of various periodic table groups, alkali metals, alkaline earth metals, transition metals, halogens, and noble gases.

VI. Chemical Bonding	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Ionic Bonding B. Covalent Bonding C. Non-Polar vs Polar Bonding D. Hydrogen Bonding E. Properties of Water	HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. (Patterns) HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (Patterns) HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. * (Structure and Function) HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. Objectives: ● Students will be able to construct models to show the interactions of electrons between atoms. ● Students will be able to identify the different types of bonds, such as ionic, covalent. ● Students will be able to distinguish between polar and nonpolar covalent bonds. ● Students will investigate where these different types of bonds are present on earth. ● Students will be able to differentiate the properties of hydrophobic and hydrophilic substances. ● Students will design a lab to explore the high specific heat of water compared to other liquids. ● Students will explain hydrogen bonding and which atoms participate in the force. ● Students will be able to connect how properties of water, such as adhesion, cohesion, and density, play a role in our environment.

VII. Chemical Reactions and Energy	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Balancing Chemical Equations (Synthesis and Decomposition) B. Types of Reactions (Synthesis and Decomposition) C. Energy Changes in Reactions D. Reaction Rate Factors	HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. (Energy and Matter) HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. (Patterns) HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. * (Stability and Change) HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. Objectives: ● Students will construct models to show the interactions between valence electrons in atoms. ● Students will be able to balance simple synthesis and decomposition reactions. ● Students will be able to differentiate synthesis and decomposition reactions and solve for products of each. ● Students will be able to identify the differences between an endothermic and an exothermic reaction. ● Students will make observations during labs to determine how chemicals interact with one another. ● Students will compare how different temperatures, surface area, concentrations, and catalysts affect a chemical reaction. ● Students will revise chemical equations to support the law of conservation of mass.

VIII. Characteristics of Life and Levels of Organization	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Characteristics of Life B. Biological Levels of Organization	HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. Objectives: ● Students will assess what traits all living organisms have in common. ● Students will design a test to prove that living organisms go through fluctuations to maintain internal conditions. ● Students will analyze models and text to identify how species have changed overtime due to fluctuations in their environment. ● Students will compare different reproductive strategies and how they lead to the growth and development of offspring. ● Students will identify different strategies organisms use to produce or consume energy. ● Students will classify what domain, kingdom, phylum, class, order, family, genus, and species an organism is in.

IX. The Nonliving Environment	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Abiotic Factors B. Transfer of Energy C. Matter Recycling	HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. (Energy and Matter) HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. (Energy and Matter) HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (Systems and System Models) HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Objectives: ● Students will construct models to explain the flow of oxygen and carbon through organisms. ● Students will investigate the impacts of carbon emissions and other greenhouse gasses on the atmosphere and temperature of the earth. ● Students will compare the flow of water in a natural system to a system with impermeable surfaces. ● Students will analyze how the industrial revolution spiked the development of cities and changed the flow of matter and water within an ecosystem. ● Students will interpret models such as food webs and ecological pyramids to understand how nutrients cycles through an ecosystem.

X. The Biosphere	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Environmental Organization B. Biotic Factors C. Biotic Interactions D. Population Dynamics	HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (Systems and System Models) HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem. HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. HS-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce. HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

X. The Biosphere (Continued)	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
	Objectives: ● Students will be able to differentiate between R and K selective species. ● Students will connect how predator-prey interactions cause fluctuation in carrying capacity. ● Students will be able to design a model representing how energy, such as oxygen and carbon, flows through an ecosystem. ● Students will be able to design a model to represent how nutrients flows through organisms. ● Students will compare the different interactions of species, such as parasitism, mutualism, commensalism, and competition. ● Students will assess how intraspecific and interspecific interactions play a role in species survival and adaptation. ● Students will be able to recognize how the flow of genetic information, through concepts such as genetic flow and genetic drift, causes natural selection within a population. ● Students will investigate causes that give rise to different species including allopatric, peripatric, parapatric, and sympatric speciation. ● Students will investigate how humans have altered populations of species through fragmentation, deforestation, and development.