

**Eighth Grade Science: First Trimester
Experimental Design**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which</p> <p>d) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, probeware, and spring scales are used to gather data;</p> <p>f) independent and dependent variables, constants, controls, and repeated trials are identified;</p> <p>g) data tables showing the independent and dependent variables, derived quantities, and the number of trials are constructed and interpreted;</p> <p>h) data tables for descriptive statistics showing specific measures of central tendency, the range of the data set, and the number of repeated trials are constructed and interpreted;</p> <p>j) valid conclusions are made after analyzing data;</p> <p>l) experimental results are presented in appropriate written form</p> <ul style="list-style-type: none"> • Systematic investigations require standard measures and consistent and reliable tools. International System of Units (SI or metric) measures, recognized around the world, are a standard way to make measurements. • Systematic investigations require organized reporting of data. The way the data are displayed can make it easier to see important patterns, trends, and relationships. Frequency distributions, scattergrams, scatterplots, line plots, and histograms are powerful tools for displaying and interpreting data. • Investigation not only involves the careful application of systematic (scientific) methodology, but also includes the review and analysis of prior research related to the 	<p>Standard 8.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated across the other 8th grade science standards.</p> <p>Skills d, f, g, h, j, and l are placed at the beginning of year as an introductory unit in conducting scientific investigations.</p> <p>All other 8.1 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.</p> <p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • make connections between the components of the nature of science and their investigations and the greater body of scientific knowledge and research. • select appropriate equipment (probeware, triple beam balances, thermometers, metric rulers, graduated cylinders, electronic balances, or spring scales) and utilize correct techniques to measure length, mass, density, weight, volume, temperature, and force. • 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. • record measurements, using the following metric (SI) units: liter, milliliter (cubic centimeters), meter, centimeter, millimeter, grams, degrees Celsius, and newtons. • recognize metric prefix units and make common metric conversions between the same base metric unit (for example, nanogram to milligram to gram or kilometer to meter). 		<p>UVA Physical Science Activities Experimental Design Graphing Metric Measurement</p> <p>STEM Activity: Boat Design Challenge</p>

<p>topic. Numerous sources of information are available from print and electronic sources, and the researcher needs to judge the authority and credibility of the sources.</p> <ul style="list-style-type: none"> • To communicate the plan of an experiment accurately, the independent variable, dependent variable, and constants must be explicitly defined. • The number of repeated trials needs to be considered in the context of the investigation. Often —controls are used to establish a standard for comparing the results of manipulating the independent variable. Controls receive no experimental treatment. Not all experiments have a control, however. • The analysis of data from a systematic investigation may provide the researcher with a basis to reach a reasonable conclusion. Conclusions should not go beyond the evidence that supports them. Additional scientific research may yield new information that affects previous conclusions. • Different kinds of problems and questions require differing approaches and research. Scientific methodology almost always begins with a question, is based on observation and evidence, and requires logic and reasoning. Not all systematic investigations are experimental. • It is important to communicate systematically the design and results of an investigation so that questions, procedures, tools, results, and conclusions can be understood and replicated. • Some useful applications of physical science concepts are in the area of materials science (e.g., metals, ceramics, semi-conductors). • Nanotechnology is the study of materials at the molecular (atomic) scale. Items at this scale are so small they are no longer visible with the naked eye. Nanotechnology has shown that the behavior and properties of some substances at the nanoscale (a nanometer is one-billionth of a meter) contradict how they behave and what their properties are at the visible scale. • New discoveries based on nanoscience investigations have allowed the production of superior new materials with improved properties (e.g., computers, cell phones). 	<ul style="list-style-type: none"> • use a variety of graphical methods to display data; create an appropriate graph for a given set of data; and select the proper type of graph for a given set of data, identify and label the axes, and plot the data points. • gather, evaluate, and summarize information, using multiple and variable resources, and detect bias from a given source. • identify the key components of controlled experiments: hypotheses, independent and dependent variables, constants, controls, and repeated trials. • formulate conclusions that are supported by the gathered data. • apply the methodology of scientific inquiry: begin with a question, design an investigation, gather evidence, formulate an answer to the original question, communicate the investigative process and results, and realize this methodology does not always follow a prescribed sequence. • communicate in written form the following information about investigations: the purpose/problem of the investigation, procedures, materials, data and/or observations, graphs, and an interpretation of the results • describe how creativity comes into play during various stages of scientific investigations. • use current technologies to model and simulate experimental conditions. • recognize examples of the use of nanotechnology and its applications. 		
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**Eighth Grade Science: First Trimester
Properties of Matter**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.5 The student will investigate and understand changes in matter and the relationship of these changes to the Law of Conservation of Matter and Energy. Key concepts include</p> <p>a) physical changes; b) chemical changes; and c) nuclear reactions.</p> <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> Matter can undergo physical and chemical changes. In physical changes, the chemical composition of the substances does not change. In chemical changes, different substances are formed. Chemical changes are often affected by the surface area/volume ratio of the materials involved in the change. The Law of Conservation of Matter (Mass) states that regardless of how substances within a closed system are changed, the total mass remains the same. The Law of Conservation of Energy states that energy cannot be created or destroyed but only changed from one form to another. A chemical equation represents the changes that take place in a chemical reaction. The chemical formulas of the reactants are written on the left, an arrow indicates a change to new substances, and the chemical formulas of the products are written on the right. Chemical reactions are classified into two broad types: ones in which energy is released (exothermic) and ones in which energy is absorbed 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> compare and contrast physical, chemical, and nuclear changes. identify the reactants and products in a given chemical equation formula. design an investigation that illustrates physical and chemical changes. given chemical formulas, write and balance simple chemical equations. analyze experimental data to determine whether it supports the Law of Conservation of Mass. recognize that some types of chemical reactions require continuous input of energy (endothermic) and others release energy (exothermic). describe, in simple terms, the processes that release nuclear energy (i.e., nuclear fission and nuclear fusion). Create a simple diagram to summarize and compare and contrast these two types of nuclear energy. evaluate the positive and negative effects of using nuclear energy. <p>Skills</p> <p>a) chemicals and equipment are used safely</p>	<p>Activities:</p> <p>Baggie Chemistry [54] Investigate the dramatic results produced by household chemicals mixed in a baggie. (Sensor: Temperature)</p> <p>Making Heat [53] Monitor the temperature of reactions with different concentrations of reactants. (Sensor: Temperature)</p> <p>Stoichiometric Calculations [64] Associate a balanced chemical equation with a balance in mass. (It is designed for high school chemistry.)</p> <p>(Model: Molecular Workbench—Ammonia)</p> <p>Models/Simulations:</p> <p>From Stoichiometry: Constructing Water Molecules Using molecules of hydrogen and oxygen to construct water</p>	<p>UVA Physical Science Activities</p> <p>Observing a Chemical Change with Mixed Solutions Finding Radiation More on Chemical Changes Growing Balloons Temperature Effects on Solubility More on Temperature and Solubility Physical and Chemical Changes Mass of Dissolved Salt Properties of Mixtures and Solutions Conservation of Matter and Balancing Chemical Equations Nuclear Fission and Nuclear Fusion Nuclear Reactions Personal Exposure to Radiation Protection from Radiation Crystallizing Borax Chemiluminescence Decomposition of Hydrogen Peroxide Electrolysis Tasty Phase Change - The Ice Cream Lab Chemical Switch Chromatography</p> <p>American Chemical Society</p> <p>What is a Chemical Reaction? Controlling the Amount of Products in a Chemical Reaction Forming a Precipitate Temperature and Rate of a Chemical Reaction A Catalyst and the Rate of Reaction Using Chemical Change to Identify an</p>

<p>(endothermic). (The study of synthesis, decomposition, and replacement reactions can be reserved for high school chemistry.)</p> <ul style="list-style-type: none"> Another type of change occurs in nuclear reactions. Nuclear energy is the energy stored in the nucleus of an atom. This energy can be released by joining nuclei together (fusion) or by splitting nuclei (fission), resulting in the conversion of minute amounts of matter into energy. In nuclear reactions, a small amount of matter produces a large amount of energy. However, there are potential negative effects of using nuclear energy, including radioactive nuclear waste storage and disposal. 		<p>molecules— illustrates balanced equations.</p> <p>From Stoichiometry: Constructing a Larger Number of Water Molecules Using molecules of hydrogen and oxygen to construct water molecules— illustrates balanced equations.</p> <p>From Stoichiometry: Most Ammonia Molecules This model uses molecules of nitrogen and hydrogen to construct ammonia molecules.</p> <p>Atomic Structure 5: Isotopes and Radioactivity (SAM)</p> <p>Add or subtract subatomic particles to create atoms of elements and identify whether they are radioactive or have an electric charge.</p>	<p>Unknown Energy Changes in Chemical Reactions pH and Color Change Neutralizing Acids and Bases Carbon Dioxide Can Make a Solution Acidic</p> <p>Enhanced Scope and Sequence Plus The Law of Conservation of Matter</p>
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**Eighth Grade Science: First Trimester
Properties of Matter**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.2 The student will investigate and understand the nature of matter. Key concepts include</p> <ul style="list-style-type: none"> a) the particle theory of matter; b) elements, compounds, mixtures, acids, bases, and salts; c) solids, liquids, and gases; d) physical properties; e) chemical properties; and f) characteristics of types of matter based on physical and chemical properties. <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Matter is anything that has mass and occupies space. All matter is made up of small particles called atoms. Matter can exist as a solid, a liquid, or a gas, or plasma. • Matter can be classified as elements, compounds, and mixtures. The atoms of any element are alike but are different from atoms of other elements. Compounds consist of two or more elements that are chemically combined in a fixed ratio. Mixtures also consist of two or more substances, but the substances are not chemically combined. • Compounds can be classified in several ways, including: <ul style="list-style-type: none"> - acids, bases, salts - inorganic and organic compounds. • Acids make up an important group of compounds that contain hydrogen ions. When acids dissolve in water, hydrogen ions (H+) are released into the resulting solution. A base is a substance that releases hydroxide ions (OH-) into 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • describe the particle theory of matter. • describe how to determine whether a substance is an element, compound, or mixture. • define compounds as inorganic or organic. (All organic compounds contain carbon). • describe what a salt is and explain how salts form. • describe the properties of the states of matter (solids, liquids, and gases, and plasma). • distinguish between physical properties (i.e., shape, density, solubility, odor, melting point, boiling point, and color) and chemical properties (i.e., acidity, basicity, combustibility, and reactivity). • find the mass and volume of substances and calculate and compare their densities. • analyze the pH of a solution and classify it as acidic, basic, or neutral. • determine the identity of an unknown substance by comparing its properties to those of known substances. • design an investigation from a testable question related to physical and chemical properties of matter. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. (Students should be able to use the inquiry skills represented in PS.1 and LS.1 to 	<p>Activities:</p> <p>Diffusion [100] Investigate how the random motion and collisions of particles result in diffusion. Also shows how temperature change affects particle motion. (Model: Molecular workbench – Diffusion)</p> <p>Melting Ice [109] Investigate the temperature of a melting ice cube. (Sensor: Temperature; Model: Molecular Workbench – Phase Change)</p> <p>States of Matter [107] Investigate forces and attractions present in the three primary states of matter. (Model: Molecular Workbench – Phase Change)</p> <p>Pool pH [398] Explore acids, bases, and pH levels. (Sensor: pH; Simulation: PhET PH Scale)</p> <p>Determining the pH of Diluted Solutions - Eimers (351) Determine whether diluting changes the pH of an acidic or basic solution. (Sensor – pH)</p>	<p>UVA Physical Science Activities</p> <p>Investigating Density Density of Liquids Properties of Mixtures and Solutions Particle Theory of Matter with Popcorn Acid-Base Tea Party Acid-Base Reactions in Photography Flower Indicators Gases Are Real Growing Balloons Properties of Gases Chemical Switch Trapped Inside The Effect of Temperature on a Bouncing Ball Tasty Phase Change - The Ice Cream Lab Soda Science Air Density Chromatography Layering Density Where Does My pH Rank?</p> <p>American Chemical Society</p> <p>Molecules Matter Molecules in Motion The Ups and Downs of Thermometers Moving Molecules in a Solid Air, It's Really There What is density? Finding Volume—The Water</p>

<p>solution. pH is a measure of the hydrogen ion concentration in a solution. The pH scale ranges from 0–14. Solutions with a pH lower than 7 are acidic; solutions with a pH greater than 7 are basic. A pH of 7 is neutral. When an acid reacts with a base, a salt is formed, along with water.</p> <ul style="list-style-type: none"> • Matter can be described by its physical properties, which include shape, density, solubility, odor, melting point, boiling point, and color. Some physical properties, such as density, boiling point, and solubility, are characteristic of a specific substance and do not depend on the size of the sample. Characteristic properties can be used to identify unknown substances. • Equal volumes of different substances usually have different masses. • Matter can also be described by its chemical properties, which include acidity, basicity, combustibility, and reactivity. A chemical property indicates whether a substance can undergo a chemical change. 	<p>compose a clear hypothesis, create an organized data table, identify variables and constants, record data correctly, construct appropriate graphs, <i>analyze data</i>, and draw reasonable conclusions.)</p> <p>Skills</p> <ul style="list-style-type: none"> b) length, mass, volume, density, temperature, weight, and force are accurately measured; m) models and simulations are constructed and used to illustrate and explain phenomena 	<p><u>Models/Simulations:</u> <u>Phase Change 5: Phase Changes Caused by Energy Input</u> Demonstrate changes in phase by removing a barrier between molecules that have high kinetic energy (hot liquid) and low kinetic energy (cold solid).</p> <p><u>Phase Change 9: Testing Your Understanding</u> Investigate energy as it is added or removed from matter to represent solid, gas and liquid states and take a snapshot of each.</p>	<p><u>Displacement Method Density of Water</u> <u>Density—Sink and Float for Solids</u> <u>Density—Sink and Float for Liquids</u> <u>Temperature and Density</u></p> <p><u>STEM Activity: Underwater Camera</u></p> <p><u>STEM Activity: Recycle my Stuff</u></p> <p><u>STEM Activity: Engineered Fabrics</u></p> <p><u>STEM Activity: Phase Change</u></p> <p><u>Enhanced Scope and Sequence Plus</u> The Particle Theory of Matter</p>
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**Eighth Grade Science: First Trimester
Properties of Matter**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.7 The student will investigate and understand temperature scales, heat, and thermal energy transfer. Key concepts include</p> <ul style="list-style-type: none"> a) Celsius and Kelvin temperature scales and absolute zero; b) phase change, freezing point, melting point, boiling point, vaporization, and condensation; c) conduction, convection, and radiation; and d) applications of thermal energy transfer. <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Heat and temperature are not the same thing. Heat is the transfer of thermal energy between substances of different temperature. As thermal energy is added, the temperature of a substance increases. • Temperature is a measure of the average kinetic energy of the molecules of a substance. Increased temperature means greater average kinetic energy of the molecules in the substance being measured, and most substances expand when heated. The temperature of absolute zero (-273oC/0oK) is the theoretical point at which molecular motion stops. • Atoms and molecules are perpetually in motion. • The transfer of thermal energy occurs in three ways: by conduction, by convection, and by radiation. 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • distinguish between heat and temperature. • compare and contrast Celsius and Kelvin temperature scales and describe absolute zero. • illustrate and explain the effect of the addition or subtraction of heat thermal energy on the motion of molecules. • analyze a time/temperature graph of a phase change experiment to determine the temperature at which the phase change occurs (freezing point, melting point, or boiling point). • compare and contrast methods of thermal energy transfer (conduction, convection, and radiation) and provide and explain common examples. • explain, in simple terms, how the principle of thermal energy transfer applies to heat engines, thermostats, refrigerators, heat pumps, and geothermal systems. • design an investigation from a testable question related to heat thermal energy transfer. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. <p>Skills</p> <ul style="list-style-type: none"> c) conversions are made among metric units, applying appropriate prefixes 	<p>Activities:</p> <p>Diffusion [100] In this activity, the student will investigate how the random motion and collisions of particles result in diffusion. Also shows how temperature change affects particle motion. (Model)</p> <p>States of Matter [107] In this activity you will investigate forces and attractions present in the three primary states of matter. (Model: Molecular Workbench – Phase Change)</p> <p>Heat and Light from Electricity [96] - Monitor temperature changes as energy is moved from batteries to holiday bulbs & resistors. (Sensor: Temperature)</p> <p>Pressure and Temperature [97] Use molecule models to explore the relationship between temperature and pressure when a gas is held at a constant volume. (Sensor: Temperature; Model: Pressure-Temperature Relationship)</p> <p>Models/Simulations:</p> <p>Model 30: The Pressure-Temperature Relationship (Gay-Lussac) (bar graph) Change the temperature of a gas and observe changes in pressure</p>	<p>UVA Physical Science Activities</p> <p>Heat Transfer Condensation Determining Absolute Zero Heat Conduction Change of State Heat of Fusion Evaporation and Heat Engines Thermometers How Does a Thermostat Work? Transfer of Heat by Radiation Mixing Cold and Warm Water Energy Content of Fuels Tasty Phase Change - The Ice Cream Lab Convection Currents and Density</p> <p>American Chemical Society</p> <p>Heat, Temperature, and Conduction Changing State—Evaporation Changing State—Condensation Changing State—Freezing Changing State—Melting</p> <p>Enhanced Scope and Sequence Plus</p> <p>Heat and Thermal Energy Transfer</p>

<ul style="list-style-type: none"> As thermal energy is added to or taken away from a system, the temperature does not always change. There is no change in temperature during a phase change (freezing, melting, condensing, evaporation, boiling, and vaporizing) as this energy is being used to make or break bonds between molecules. 		<p>Model 140: Phase Change 5: Phase Changes Caused by Energy Input (SAM) This model demonstrates changes in phase by removing a barrier between molecules that have high kinetic energy (hot liquid) and low kinetic energy (cold solid).</p> <p>Model 413: Phase Change 9: Testing Your Understanding (SAM) This model allows energy to be added or removed from matter to represent solid, gas and liquid states and take a snapshot of each.</p> <p>Model 471: Heat Transfer: Comparing Heat Capacities (Enhanced Engineering) Observe heat flow between two materials with different heat capacities.</p> <p>Model 470: Heat Transfer: Comparing Thermal Conductivities (Enhanced Engineering) Demonstrate heat flow through two materials with different thermal conductivities.</p> <p>Model 315: Atoms and Energy 6: When Energy is Not Conserved - heating and cooling Use graphs and color to investigate what happens to the energy of a system as heat is added or removed.</p>	
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**Eighth Grade Science: Second Trimester
Periodic Table**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.3 The student will investigate and understand the modern and historical models of atomic structure. Key concepts include</p> <p>a) the contributions of Dalton, Thomson, Rutherford, and Bohr in understanding the atom; and</p> <p>b) the modern model of atomic structure.</p> <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Many scientists have contributed to our understanding of atomic structure. • The atom is the basic building block of matter and consists of subatomic particles (proton, neutron, and electron, and quark) that differ in their location, charge, and relative mass. Protons and neutrons are made up of smaller particles called quarks. • Size at the atomic level is measured on the nanoscale. • Scientists use models to help explain the structure of the atom. Their understanding of the structure of the atom continues to evolve. Two models commonly used are the Bohr and the “electron cloud” (Quantum Mechanics) models. The Bohr model does not depict the three-dimensional aspect of an atom, and it implies that electrons are in static orbits. The “electron cloud” model better represents our current understanding of the structure of the atom. 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • describe the historical development of the concept of the atom and the contributions of Dalton, Thomson, Rutherford, Bohr and other scientists (Schrödinger). • differentiate among the three basic particles in the atom (proton, neutron, and electron) and their charges, relative masses, and locations. • compare the Bohr atomic model to the electron cloud model with respect to its ability to represent accurately the three-dimensional structure of the atom. <p>Skills</p> <ul style="list-style-type: none"> • research methods are used to investigate practical problems and questions 	<p><u>Models/Simulations:</u></p> <p><u>Atomic Structure 8: The Periodic Table</u></p> <p>This model shows electron configurations, including suborbitals.</p>	<p><u>UVA Physical Science Activities</u></p> <p>Atomic Model Construction Demonstrating Quanta Making Atoms Come to Life Not So Bohring Atoms Indirect Measurement Indirect Measurement II Cloud Model of the Atom I Cloud Model of the Atom II</p> <p><u>Enhanced Scope and Sequence Plus</u></p> <p>Historical Models of Atoms The Modern Model of Atomic Structure</p>

**Eighth Grade Science: Second Trimester
Periodic Table**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.4 The student will investigate and understand the organization and use of the periodic table of elements to obtain information. Key concepts include</p> <p>a) symbols, atomic numbers, atomic mass, chemical families (groups), and periods;</p> <p>b) classification of elements as metals, metalloids, and nonmetals; and</p> <p>c) formation of compounds through ionic and covalent bonding.</p> <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • There are more than 110 known elements. No element with an atomic number greater than 92 is found naturally in measurable quantities on Earth. The remaining elements are artificially produced in a laboratory setting. Elements combine in many ways to produce compounds that make up all other substances on Earth. • The periodic table of elements is a tool used to organize information about the elements. Each box in the periodic table contains information about the structure of an element. • An atom's identity is directly related to the number of protons in its nucleus. This is the basis for the arrangement of atoms on the periodic table of elements. • The vertical columns in the table are called groups or families. The horizontal rows are called periods. • Elements in the same column (family) of the periodic table contain the same number of electrons in their outer energy levels. This gives rise to their similar properties and is the basis of periodicity — the repetitive 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • use the periodic table to obtain the following information about the atom of an element: <ul style="list-style-type: none"> - symbol - atomic number - atomic mass - state of matter at room temperature - number of outer energy level (valence) electrons. • describe the organization of the periodic table in terms of <ul style="list-style-type: none"> - atomic number - metals, metalloids, and nonmetals - groups/families vs. periods. • recognize that an atom's identity is related to the number of protons in its nucleus. • categorize a given element as metal, nonmetal, or metalloid. • given a chemical formula of a compound, identify the elements and the number of atoms of each that comprise the compound. • recognize that the number of electrons in the outermost energy level determines an element's chemical properties or chemical reactivity. • describe the difference between ionic and covalent bonding. • predict what kind of bond (ionic or covalent) will likely form when metals and nonmetals are chemically combined. 	<p><u>Models/Simulations:</u></p> <p><u>Atomic Structure 8: The Periodic Table</u> This model shows electron configurations, including suborbitals.</p> <p><u>Atomic Structure 3: The Elements</u> Add electrons, protons and neutrons to an atom of hydrogen to see the changes in element isotopes.</p> <p><u>Atomic Structure 5: Isotopes and Radioactivity (SAM)</u> Add or subtract subatomic particles to create atoms of elements and identify whether they are radioactive or have an electric charge (isotopes and ions).</p>	<p><u>UVA Physical Science Activities</u></p> <p>Atomic Mass Metals, Non-Metals, Metalloids I Names and Symbols of Elements Candy Half-Life Atomic Number and Mass Atomic Model Construction Making Atoms Come to Life Not So Bohring Atoms Bonding Mapping Out the Periodic Table Cloud Model of the Atom I Cloud Model of the Atom II Chemical Switch The Universal Periodic Table</p> <p><u>American Chemical Society</u></p> <p>Protons, Neutrons, and Electrons The Periodic Table The Periodic Table & Energy Level Models Energy Levels, Electrons, and Covalent Bonding Energy Levels, Electrons, and Ionic Bonding Represent Bonding with Lewis Dot Diagrams</p> <p><u>Enhanced Scope and Sequence Plus</u></p> <p>Metals, Nonmetals, and Metalloids Chemical Bonds</p>

<p>pattern of properties such as boiling point across periods on the table.</p> <ul style="list-style-type: none">• The periodic table of elements is an arrangement of elements according to atomic number and properties. The information can be used to predict chemical reactivity. The boxes for all of the elements are arranged in increasing order of atomic number. The elements have an increasing nonmetallic character as one reads from left to right across the table. Along the stair-step line are the metalloids, which have properties of both metals and nonmetals.• The nonmetals are located to the right of the stair-step line on the periodic table.• Metals tend to lose electrons in chemical reactions, forming positive ions. Nonmetals tend to gain electrons in chemical reactions, forming negative ions.• Gaining or losing electrons makes an atom an ion.• Gaining or losing neutrons makes an atom an isotope. However, gaining or losing a proton makes an atom into a completely different element.• Atoms react to form chemically stable substances that are held together by chemical bonds and are represented by chemical formulas. To become chemically stable, atoms gain, lose, or share electrons.• Compounds are formed when elements react chemically. When a metallic element reacts with a nonmetallic element, their atoms gain and lose electrons respectively, forming ionic bonds. Generally, when two nonmetals react, atoms share electrons, forming covalent (molecular) bonds.			
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**Eighth Grade Science: Third Trimester
Energy**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.6 The student will investigate and understand forms of energy and how energy is transferred and transformed. Key concepts include</p> <p>a) potential and kinetic energy; and</p> <p>a) mechanical, chemical, electrical, thermal, radiant, and nuclear energy.</p> <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Energy is the ability to do work. • Energy exists in two states. Potential energy is stored energy based on position or chemical composition. Kinetic energy is energy of motion. Students should know that the amount of potential energy associated with an object depends on its position. The amount of kinetic energy depends on the mass and velocity of the moving object. • Important forms of energy include radiant, thermal, chemical, electrical, mechanical, and nuclear energy. Visible light is a form of radiant energy and Ssound is a form of mechanical energy. • Energy can be transformed from one type to another. In any energy conversion, some of the energy is lost to the environment as thermal energy. 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • differentiate between potential and kinetic energy. • use diagrams or concrete examples to compare relative amounts of potential and kinetic energy. • identify and give examples of common forms of energy. • design an investigation or create a diagram to illustrate energy transformations. <p>Skills</p> <ul style="list-style-type: none"> • current applications of physical science concepts are used 	<p>Activities:</p> <p>Renewable Energy Generator Construction [1560] Use a computer model and voltage probe to investigate and construct working models of wind turbines and hydroelectric generators. (Sensor: Voltage)</p> <p>Capacitors: How They Store Energy [98] You will charge a capacitor and light a bulb or run a motor with it, while measuring the voltage. Compare energy storage in a capacitor to energy storage in a battery. (Sensor: Voltage)</p> <p>Heat and Light from Electricity [96] Monitor temperature changes as energy is moved from batteries to holiday bulbs & resistors. (Sensor: Temperature)</p> <p>Model 155: Climate Change Starter Explore what happens to the Sun's energy when it strikes Earth.</p> <p>Models/Simulations:</p> <p>Atoms and Energy 1: The Energy of Motion Explore the changes in kinetic energy by changing the speed of an object as seen when it collides with a second, more massive object.</p> <p>Atoms and Energy 2: The Energy of a Pendulum Change the starting position of a pendulum and observe the changes in kinetic and potential energy.</p>	<p>UVA Physical Science Activities</p> <p>Growing Balloons</p> <p>The Energy of A Bouncing Ball</p> <p>Observing the Transfer of Energy</p> <p>Energy of a Pendulum</p> <p>Energy of Sound</p> <p>Energy of a Cart on a Ramp (Version A)</p> <p>Energy of a Cart on a Ramp (Version B)</p> <p>Transfer of Heat by Radiation</p> <p>Energy Content of Fuels</p> <p>The Effect of Temperature on a Bouncing Ball</p> <p>STEM Activity: The United Gear Force</p> <p>STEM Activity: Design a Roller Coaster</p> <p>Enhanced Scope and Sequence Plus States and Forms of Energy</p>

		<p>PhET Energy Skate Park Manipulate a skater on a half-pipe to investigate the relationships between PE, KE, friction and heat.</p> <p>Climate Change Starter Explore the effects of clouds and greenhouse gases on sunlight, infrared energy and heat energy in the earth.</p> <p>Introduction to Modeling 3a: Extended Visualization to See Kinetic Energy Observe the kinetic energy (shown both on a graph and by color) of a bouncing ball.</p>	
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**Eighth Grade Science: Third Trimester
Energy**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.11 The student will investigate and understand basic principles of electricity and magnetism. Key concepts include</p> <p>a) static electricity, current electricity, and circuits;</p> <p>b) relationship between a magnetic field and an electric current;</p> <p>c) electromagnets, motors, and generators and their uses; and</p> <p>d) conductors, semiconductors, and insulators.</p> <ul style="list-style-type: none"> • Several factors affect how much electricity can flow through a system. Resistance is a property of matter that affects the flow of electricity. Some substances have more resistance than others. • Friction can cause electrons to be transferred from one object to another. These static electrical charges can build up on an object and be discharged slowly or rapidly. This is often called static electricity. • Electricity is related to magnetism. Magnetic fields can produce electrical current in conductors. Electricity can produce a magnetic field and cause iron and steel objects to act like magnets. • Electromagnets are temporary magnets that lose their magnetism when the electric current is removed. Both a motor and a generator have magnets (or electromagnets) and a coil 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • design an investigation to illustrate the effects of static electricity. • construct and compare series and parallel circuits. • create an electromagnet and explain how it works. • explain the relationship between a magnetic field and an electric current. • construct simple circuits to determine the relationship between voltage, resistance, and current. • compare and contrast generators and motors and how they function. • identify situations in everyday life in which motors and generators are used. • provide examples of materials that are good conductors, semiconductors, and insulators. • identify current applications of semiconductors and their uses (e.g., diodes and transistors). 	<p>Activities:</p> <p>Capacitors: How They Store Energy [98] Charge a capacitor and then light a bulb or run a motor with it, while measuring the voltage. Compare energy storage in a capacitor to energy storage in a battery. (Sensor: Voltage)</p> <p>Heat and Light from Electricity [96] Monitor temperature changes as energy is moved from batteries to holiday bulbs and resistors. (Sensor: Temperature)</p> <p>Motors and Generators [146] Explore motors and generators. (Sensor: Voltage)</p> <p>Light Bulbs [137] Compare the efficiency of various kinds of light bulbs. (Sensors: Temperature and Light)</p> <p>Solar Cell [138] Measure the voltage from a solar cell and explore what factors influence its output (Sensor: Voltage)</p> <p>Voltage in a Simple Circuit [77] Investigate voltage in various parts of a simple circuit, using a circuit-building computer model. (Simulation: Phet Circuit Construction Kit DC)</p> <p>Current in a Simple Circuit [79] Investigate current in various parts of a simple circuit, using a circuit-building computer model. (Simulation: Phet Circuit Construction Kit DC)</p>	<p>UVA Physical Science Activities</p> <p>Conductor or Insulator? Electromagnet Parallel and Series Balloon Electroscope Static Electricity Static Electricity Salt and Pepper Neon Bulbs and Motion of Charge Magnetic Field Introduction to Static Electricity Chemical Switch Investigating Magnetic Fields</p> <p>PBS DESIGN SQUAD Teacher's Guide Unit 1: Electrifying Games</p> <p>PBS Resources: Electricity</p> <p>STEM Activity: Agricultural Robot</p> <p>Enhanced Scope and Sequence Plus Electricity and Circuits Electricity and Magnetism</p>

<p>of wire that creates another magnetic field.</p> <ul style="list-style-type: none"> • A generator is a device that converts mechanical energy into electrical energy. Most of the electrical energy we use comes from generators. Electric motors convert electrical energy into mechanical energy that is used to do work. Examples of motors include those in many household appliances, such as blenders and washing machines. • A conductor is a material that transfers an electric current well. An insulator is material that does not transfer an electric current. A semiconductor is in-between a conductor and an insulator. • The diode is a semiconductor device that acts like a one way valve to control the flow of electricity in electrical circuits. Solar cells are made of semiconductor diodes that produce direct current (DC) when visible light, infrared light (IR), or ultraviolet (UV) energy strikes them. Light emitting diodes (LED) emit visible light or infrared radiation when current passes through them. An example is the transmitter in an infrared TV remote or the lighting course behind the screen in an LED TV or notebook computer screen. • Transistors are semiconductor devices made from silicon, and other semiconductors. They are used to amplify electrical signals (in stereos, radios, etc.) or to act like a light switch turning the flow of electricity on and off. 		<p>Electrostatics [78] Discover the phenomenon called electrostatics, which is the study of the interactions among objects that carry charges. (Models: Electrostatics 6: Polarization (SAM) and Electrostatics: Lab applications (SAM))</p> <p>Magnetic Fields [67] Study how the movement of magnetic fields creates electric current. (Model: Model 84: PhET Faraday Model)</p> <p>Models/Simulations: Phet Circuit Construction Kit DC Build circuits with resistors, light bulbs, batteries, and switches.</p> <p>Electrostatics 6: Polarization Investigate static charge on a balloon.</p> <p>Electrostatics: Lab Applications Investigate an electroscope.</p> <p>Electrostatics 4: The Distance Between Charges Matters Move the (+) charge to hit a target with an electron.</p> <p>Electrostatics 5 +: A Charge Game Navigate through a maze using like and opposite charges.</p> <p>PhET Faraday Model Investigate magnetic fields using a bar magnet and compass.</p> <p>Electricity 6: Parallel Circuit Follow electrons in a simple parallel circuit.</p> <p>Electricity 4: Ohm's Law Pt2: Current and Resistance Change the resistivity of a material and observe the current on an ammeter.</p>	
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**Eighth Grade Science: Third Trimester
Waves**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.9 The student will investigate and understand the characteristics of transverse waves. Key concepts include</p> <ul style="list-style-type: none"> a) wavelength, frequency, speed, amplitude, crest, and trough; b) the wave behavior of light; c) images formed by lenses and mirrors; d) the electromagnetic spectrum; and e) technological applications of light. <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Visible light is a form of radiant energy that moves in transverse waves. • All transverse waves exhibit certain characteristics: wavelength, crest, trough, frequency, and amplitude. As wavelength increases, frequency decreases. There is an inverse relationship between frequency and wavelength. • Radiant energy travels in straight lines until it strikes an object where it can be reflected, absorbed, or transmitted. As visible light travels through different media, it undergoes a change in speed that may result in refraction. • Electromagnetic waves are arranged on the electromagnetic spectrum by wavelength. All types of electromagnetic radiation travel at the speed of light, but differ in wavelength. The electromagnetic spectrum includes gamma rays, X-rays, ultraviolet, visible light, infrared, and radio and microwaves. • Radio waves are the lowest energy waves and have the longest wavelength and the lowest frequency. Gamma rays are the highest energy waves and have the shortest wavelength and the highest frequency. Visible light lies in between and makes up only a small portion of 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • model a transverse wave and draw and label the basic components. Explain wavelength, amplitude, frequency, crest, and trough. • describe the wave behavior of visible light (refraction, reflection, diffraction, and interference). • design an investigation to illustrate the behavior of visible light – reflection and refraction. Describe how reflection and refraction occur. • identify the images formed by lenses and mirrors. • compare the various types of electromagnetic waves in terms of wavelength, frequency, and energy. • describe an everyday application of each of the major forms of electromagnetic energy. <p>Skills</p> <ul style="list-style-type: none"> e) numbers are expressed in scientific notation where appropriate 	<p>Activities:</p> <p>Interference with Light [72] Explore a model of light interference patterns. (Model: PhET Wave Interference Model)</p> <p>Color Absorption and Reflection (70) Investigate how absorbing and reflecting different wavelengths of light affect the color of a material. (Model: Light Reflection and Light Absorption)</p> <p>Measuring Light [6] Explore the brightness of light in different parts of the classroom and from different sources, such as light bulbs, flashlights, and the Sun. (Sensor: Light)</p> <p>Colors of Light (7) Explore the colors that are in light and experiment with mixing colors together. (Model: RGB Colors)</p> <p>Reflection and Transmission of Light (8) Explore the reflection, scattering, and transmission of white light. (Sensor: Light)</p>	<p>UVA Physical Science Activities</p> <p>Refraction Reflection Convex Lenses Curved Mirrors Electromagnetic Spectrum Polarized Light Neon Bulbs and Motion of Charge Total Internal Reflection Waves and Particles Visible Spectrum Polarized Filters</p> <p>Enhanced Scope and Sequence Plus</p> <p>Light and the Electromagnetic Spectrum</p>

<p>the electromagnetic spectrum.</p> <ul style="list-style-type: none"> • Plane, concave, and convex mirrors all reflect light. Convex mirrors diverge light and produce a smaller, upright image. Concave mirrors converge light and produce an upright, magnified image if close and an inverted, smaller image if far away. • Concave and convex lenses refract light. Convex lenses converge light. Concave lenses diverge light. • Diffraction is when light waves strike an obstacle and new waves are produced. • Interference takes place when two or more waves overlap and combine as a result of diffraction. 		<p>Models/Simulations:</p> <p>Light Reflection Explore how surface color perception depends on light absorption and reflection.</p> <p>Light Absorption Explore light absorption by filters.</p> <p>PhET Wave Interference Model Investigate wave properties and interference in sound, light and water waves.</p> <p>HSB and RGB Display Use sliders to create HSB and RGB colors.</p>	
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**Eighth Grade Science: Third Trimester
Waves**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.8 The student will investigate and understand the characteristics of sound waves. Key concepts include</p> <p>a) wavelength, frequency, speed, amplitude, rarefaction, and compression;</p> <p>b) resonance;</p> <p>c) the nature of compression waves; and</p> <p>d) technological applications of sound.</p> <p>The critical scientific concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Sound is produced by vibrations and is a type of mechanical energy. Sound travels in compression waves and at a speed much slower than light. It needs a medium (solid, liquid, or gas) in which to travel. In a compression wave, matter vibrates in the same direction in which the wave travels. • All waves exhibit certain characteristics: wavelength, frequency, and amplitude. As wavelength increases, frequency decreases. • The speed of sound depends on two things: the medium through which the waves travel and the temperature of the medium. • Resonance is the tendency of a system to vibrate at maximum amplitude at certain frequencies. • A compression (longitudinal) wave consists of a repeating pattern of compressions and rarefactions. Wavelength is measured as the distance from one compression to the next compression or the distance from one rarefaction to the next rarefaction. • Reflection and interference patterns are used in ultrasonic technology, including sonar and medical diagnosis. 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> • determine the relationship between frequency and wavelength. • analyze factors that determine the speed of sound through various materials and interpret graphs and charts that display this information. • identify examples illustrating resonance (e.g., musical instruments, Tacoma Narrows Bridge, crystal stemware). • model a compression (longitudinal) wave and diagram, label, and describe the basic components: wavelength, compression, rarefaction, and frequency. • describe technological applications of sound waves and generally how each application functions. • design an investigation from a testable question related to sound. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. 	<p>Activities:</p> <p>Complex Sounds and Instruments [106] Explore the complex characteristics of common sounds and conclude with building and testing an instrument. (Model: Sound Grapher; Sensor: Microphone)</p> <p>How Loud, How High? [105] Explore the frequency, wavelength, amplitude, and velocity of sound waves. (Model: Sound Grapher; Sensor: Microphone)</p> <p>The Shape of Sound Waves [73] Use a Sound Grapher to display and analyze sound waves. (Model: Sound Grapher; Sensor: Microphone)</p> <p>Models/Simulations:</p> <p>Sound Grapher Record sounds and compare graphs of the sound frequencies.</p> <p>Wave Interference Model Investigate wave properties and interference in sound, light and water waves.</p>	<p>UVA Physical Science Activities</p> <p>Energy of Sound</p> <p>Terminology of Waves</p> <p>Wavelength and Frequency of Vibration</p> <p>Wavelength and Pitch</p> <p>Interference</p> <p>Fetal Ultrasound</p> <p>Mathematics of Music</p> <p>Sonar</p> <p>The Frequency of Sound</p> <p>Sound Stations</p> <p>PBS Design Squad Teacher's Guide</p> <p>Unit 2: Sounds Good (sound)</p> <p>Enhanced Scope and Sequence Plus</p> <p>Sound</p>

**Eighth Grade Science: Third Trimester
Work, Force, & Motion**

VA Standards of Learning (SOL) Essential Understandings	Content Knowledge and Skills	State and MCPS Adopted Materials	Supporting Materials
<p>PS.10 The student will investigate and understand the scientific principles of work, force, and motion. Key concepts include</p> <p>a) speed, velocity, and acceleration; b) Newton’s laws of motion; c) work, force, mechanical advantage, efficiency, and power; and d) technological applications of work, force, and motion.</p> <ul style="list-style-type: none"> Acceleration is the change in velocity per unit of time. An object moving with constant velocity has no acceleration. A decrease in velocity is negative acceleration or deceleration. A distance-time graph for acceleration is always a curve. Objects moving with circular motion are constantly accelerating because direction (and hence velocity) is constantly changing. Newton’s three laws of motion describe the motion of all common objects. Mass and weight are not equivalent. Mass is the amount of matter in a given substance. Weight is a measure of the force due to gravity acting on a mass. Weight is measured in newtons. A force is a push or pull. Force is measured in newtons. Force can cause objects to move, stop moving, change speed, or change direction. Speed is the change in position of an object per unit of time. Velocity may have a positive or a negative value depending on the direction of the change in position, whereas speed always has a positive value and is nondirectional. 	<p>In order to meet this standard, it is expected that students will:</p> <ul style="list-style-type: none"> make measurements to calculate the speed of a moving object. apply the concepts of speed, velocity, and acceleration when describing motion. differentiate between mass and weight. identify situations that illustrate each Law of Motion. explain how force, mass, and acceleration are related. apply the concept of mechanical advantage to test and explain how a machine makes work easier. make measurements to calculate the work done on an object. make measurements to calculate the power of an object. solve basic problems given the following formulas: Speed = distance/time ($s = d/t$) Force = mass \times acceleration ($F = ma$) Work = force \times distance ($W = Fd$) Power = work/time ($P = W/t$) explain how the concepts of work, force, and motion apply to everyday uses and current technologies. <p>Skills</p> <p>i) frequency distributions, scatterplots, line plots, and histograms are constructed and interpreted</p>	<p>Activities:</p> <p>Seeing Motion [104] Investigate simple, straight-line motion. Use position-time graphs to describe motion. (Sensor: Motion)</p> <p>Inclined Planes [215] Use a force sensor to investigate the advantages and disadvantages of using an inclined plane to lift an object. (Sensor: Force)</p> <p>Accelerating Bodies [221] Use a position sensor to study the acceleration of a toy car down a ramp. (Sensor: Motion)</p> <p>Levers [139] Use a force sensor to investigate the mechanical advantage of a lever. (Sensor: Force)</p> <p>Forces - Equal and Opposite [83] Use two force sensors to see if Newton's Third Law is really true! (Sensor: Force)</p>	<p>UVA Physical Science Activities</p> <p>Galileo's Gravitational Experiment</p> <p>Levers</p> <p>Newton's First Law</p> <p>Newton's Second Law</p> <p>Newton's Second Law of Motion</p> <p>Newton's Third Law</p> <p>Pulleys</p> <p>Compound Machines</p> <p>Human Motion</p> <p>Styrofoam Helicopters</p> <p>The Effect of Temperature on a Bouncing Ball</p> <p>Flying High</p> <p>PBS DESIGN SQUAD Teacher's Guide Unit 3: Breezy Blimps (force)</p> <p>PBS Resources: Force</p> <p>Enhanced Scope and Sequence Plus</p> <p>The Rate of Motion</p> <p>Work and Power</p>

<ul style="list-style-type: none"> • Work is done when an object is moved through a distance in the direction of the applied force. • A simple machine is a device that makes work easier. Simple machines have different purposes: to change the effort needed (mechanical advantage), to change the direction or distance through which the force is applied, to change the speed at which the resistance moves, or a combination of these. Due to friction, the work put into a machine is always greater than the work output. The ratio of work output to work input is called efficiency. • Mathematical formulas are used to calculate speed, force, work, and power. 		<p>Models/Simulations:</p> <p>Model 104: Elastic Collision 3: Newton's Cradle With Red Atoms Transmitting Energy Use models of atoms to create a Newton's Cradle and observe the energy changes—shown by color coding (uses pair of atoms).</p> <p>Elastic Collision 4: Newton's Cradle With Single Atom Transmitting Energy Use models of atoms to create a Newton's Cradle and observe the energy changes—shown by color coding (uses single atom).</p> <p>Newton's Cannon with Plots Launch a cannonball, manipulate launch heading and speed to observe effects on cannonball trajectory and velocity.</p> <p>Pulley 1: Weight Balance on a Pulley Simulate a pulley wheel with different weights on each end of the rope.</p>	
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