DINWIDDIE COUNTY Public Schools

Physical Science

Grade 8

Science Curriculum Guide

Dinwiddie County Public Schools provides each student the opportunity to become a productive citizen, engaging the entire community in the educational needs of our children.

Physical Science Curriculum Guide

- The DCPS Curriculum Guide contains key concepts and SOL numbers for each week. These skill areas must be cross referenced with the DOE Enhanced Scope and Sequence and DOE Curriculum Framework.
- Grade Level(s): 8
- Prerequisite: Science 6 and Life Science
- Course Description: Physical Science is a laboratory-oriented program that provides students with a foundation in the physical sciences. Laboratory investigations and activities are the primary means for developing problem-solving skills and for developing the major concepts and principles of the fields of science which make up the eighth-grade program. Students also develop experimental research and design skills in a problem area of their choice. Research and decision-making skills are further developed through the investigation of local or national issues and concerns that result from the interaction of science, technology, and society.

Virginia Department of Education Curriculum Frameworks

Virginia Department of Education Curriculum Guides

Unit	Approximate Number of Days Taught	Topic	Targeted SOL
Science Process Skills (Unit 1 Plans) (Unit 1 Checklist)	10	**<u>Scientific Investigation, Reasoning, and Logic</u>** ● Data analysis ● Data collection tools ● Data tables used to communicate data ● Graphic representations of data ● Valid conclusions about data ● Models and simulations ● Laboratory safety ● Accurate measurements and conversions ○ Length, Mass, Volume, Density ● Scientific notation ● Identification of variables, controls, and constants ● Current applications of science skills ***FYI:*** *Infused throughout the year with content-specific objectives. Skills are reinforced with hands-on activities.*	**PS.1 a-n PS.2 f**
Nature of Matter	5	**<u>Force, Motion, Energy and Matter</u>** ● States of Matter	**PS.2 a,c,f**
Changes in Matter	5	**<u>Force, Motion, Energy and Matter</u>** ● Acids, bases, salts ● Elements ● Compounds ● Mixtures ● Physical properties and changes	**PS.2 b,d,e,f PS.5 a,b**

<table>
<tr><td></td><td></td><td>Chemical properties and changes
Law of Conservation of Matter and Energy</td><td></td></tr>
<tr><td>Transfer of Thermal Energy</td><td>5</td><td><u>Force, Motion, Energy and Matter</u>
Temperature Scales
Freezing and Melting Points
Conduction
Radiation
Convection
Absolute Zero
Thermal Energy Transfer</td><td>PS.7 a-d</td></tr>
<tr><td>Models of Atomic Structure</td><td>3</td><td><u>Force, Motion, Energy and Matter</u>
Notable scientific contributions to the atomic model
Modern model of atomic structure
Proton, electron, neutron</td><td>PS.3 a,b</td></tr>
<tr><td>Atoms and Periodic Table</td><td>11</td><td><u>Force, Motion, Energy and Matter</u>
Organization: symbols, atomic number, atomic number, atomic mass, groups, periods
Uses: Classification of elements, metals, nonmetals, and metalloids
Ionic Bonding
Covalent Bonding
Chemical Ratios
Writing and Naming Chemical Formulas
Balancing Chemical Equations</td><td>PS.4 a-c
PS.5 a,b</td></tr>
<tr><td>Chemical Reactions</td><td>3</td><td><u>Force, Motion, Energy and Matter</u>
Physical properties & changes
Chemical properties & changes</td><td>PS.5 a,b</td></tr>
<tr><td>Energy</td><td>5</td><td><u>Force, Motion, Energy and Matter</u>
Potential Energy
Kinetic Energy
Mechanical Energy
Electrical Energy</td><td>PS.5 c
PS.6 a,b</td></tr>
</table>

		● Radiant Energy (Electromagnetic) ● Chemical Energy ● Thermal Energy ● Nuclear Energy ○ Fusion and Fission ● Energy Conversions	
Principles of Work, Force, and Motion	4	**<u>Force, Motion, Energy and Matter</u>** ● Speed ● Velocity ● Acceleration	**PS.10 a, d**
Principles of Work, Force, and Motion	6	**<u>Force, Motion, Energy and Matter</u>** ● Forces ● Newton's Laws of Motion ● Friction ● Gravity ● Centripetal Force	**PS.10 b, d**
Principles of Work, Force, and Motion	5	**<u>Force, Motion, Energy and Matter</u>** ● Work ● Power ● Simple Machines ● Mechanical Advantage ● Efficiency	**PS.10 c,d**
Nature of Sound and its Applications	2	**<u>Force, Motion, Energy and Matter</u>** ● Properties of Waves ○ wavelength, frequency, speed, amplitude, rarefaction, and compression ● Mechanics of Waves ● Resonance ● Applications of Sound	**PS.8 a-d**
Nature of Light and its Applications	2	**<u>Force, Motion, Energy and Matter</u>** ● Transverse Waves ○ wavelength, amplitude, frequency, crest, and trough.	**PS.9 a-e**

		- Behavior of Waves - refraction, reflection, diffraction, and interference - Lenses and Mirrors - Electromagnetic Spectrum - Technological Applications of Light	
Electricity and Magnetism	2	**<u>Force, Motion, Energy and Matter</u>** - Nature of Magnetisms - Magnetic Field - Electromagnets - Motors - Generators - Circuits - Parallel and Series - Voltage, Resistance, Current - Current - Static Electricity - Conductors, Semiconductors, Insulators - Diodes and Transistors	**PS.11 a-d**
SOL Review	10	**6th & 7th grade SOL review**	

Dinwiddie County Public Schools
Science Curriculum

PS.1

PS.1The student will demonstrate an understanding of scientific reasoning, logic and the nature of science by planning and conducting investigations in which

a) chemicals and equipment are used safely;
b) length, mass, volume, density, temperature, weight, and force are accurately measured;
c) conversions are made among metric units, applying appropriate prefixes;
d) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, probeware, and spring scales are used to gather data;
e) numbers are expressed in scientific notation where appropriate;
f) independent and dependent variables, constants, controls, and repeated trials are identified;
g) data tables showing the independent and dependent variables, derived quantities, and the number of trials are constructed and interpreted;
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;
i) frequency distributions, scatterplots, line plots, and histograms are constructed and interpreted;
j) valid conclusions are made after analyzing data;
k) research methods are used to investigate practical problems and questions;
l) experimental results are presented in appropriate written form;
m) models and simulations are constructed and used to illustrate and explain phenomena; and
n) current applications of physical science concepts are used.

Blueprint Categories	Grade 8 SOL	Number of Items
Scientific Investigation	**PS.1**	**10**

Prior Knowledge

LS.1The 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;
b) a classification system is developed based on multiple attributes;
c) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, and probeware are used to gather data;
d) models and simulations are constructed and used to illustrate and explain phenomena;
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;
h) data are organized, communicated through graphical representation, interpreted, and used to make predictions;
i) patterns are identified in data and are interpreted and evaluated; and
j) current applications are used to reinforce life science concepts.

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific 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 of 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. • 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, 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 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. • 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.	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. • 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 or kilometer to meter). • 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.

• 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, and semiconductors). • 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).	• 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.

Vocabulary	Lessons and TEI Items	Trade Books
Conclusion -is drawn by making judgments based on details and facts. **Constant-** is an item that remains the same throughout the experiment **Control-** is the thing that is purposefully not changed and remains the same throughout the experiment **Dependent variable-** is the factor that changes as a result of the changes to the independent variable in an experiment **Dichotomous key-** is a guide used to identify organisms/based on like or unlike characteristics **Experiment-** is a fair test driven by a hypothesis. A fair test is one in which only one variable is compared **Graduated Cylinder-** is an instrument used to measure	PS. 1 Google Documents	**Book Room List** *Lessons In Science Safety with Max Axiom, Super Scientist* (by Donald Lemke)

liquid in milliliters (ml) **Hypothesis**- is an educated guess/prediction about what will happen. It must be worded as a question. **Independent variable**- is the one factor that a scientist changes during an experiment **Inference** -is a tentative explanation based on background knowledge and available data. **Investigation**- is an experiment designed to test a hypothesis. **Meniscus**- is the curved upper surface of a liquid in a column of liquid. **Observations**- happen when we use all five senses to generate a hypothesis. **Prediction**- is making an inference about a future event based on current evidence or past experience. **Probe ware-** is a learning tool that connects probes and sensors to a computer running suitable software and allows students to view real-time data in a variety of formats. **Purpose**- is the reason for doing the experiment/activity. **Qualitative data-** deals with descriptions and data that can be observed, but not measured. **Quantitative data**- is data that can be counted or measured and the results can be recorded using numbers, graphs and charts. **Triple Beam Balance (Scale)-** is an instrument used to measure mass of an object. **Validity**- is when our data is based on fact		

Student Links	Destiny	Instructional Resources
Dismount *(teaching the scientific method (I have a worksheet that goes with this activity)* **Science 360** (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12 Jefferson Lab Kahoot PS.1 Review Practice Test Items Released SOL Test	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools
Science Curriculum

PS.3	Blueprint Categories	Grade 8 SOL	Number of Items
PS.3The student will investigate and understand the modern and historical models of atomic structure. Key concepts include a) the contributions of Dalton, Thomson, Rutherford, and Bohr in understanding the atom; and b) the modern model of atomic structure.	**Force, Motion, Energy, Matter**	**PS.3**	**15**
	Prior Knowledge		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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, 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.	In order to meet this standard, it is expected that students will • 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.

Vocabulary	Lessons and TEI Items	Trade Books
Atom-The smallest particle into which an element can be divided and still be the same substance. **Proton**-The positively charged particle of the nucleus **Neutron**-The particles of the that have no charge **Electron**-The negatively charged particles found in all atoms **Quantum mechanics**- A theory of the mechanics of atoms, molecules, and other physical systems that are subject to the uncertainty principle **Electron cloud-** The regions inside an atom where electrons are likely to be found	Historical Models of Atoms The Modern Model of Atomic Structure PS. 3 Google Documents	**Book Room List** *The Powerful World of Chemical Reactions with Max Axiom, Super Scientist* (by Agnieszke Biskup) *Atoms and Molecules* (by Molly Aloian) *Investigating the Chemistry of Atoms* (by Elizabeth Cregan)

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app)	Destiny Atoms	Brain POP Science activities Science Net Links

SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test		Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools
Science Curriculum

PS.4	Blueprint Categories	Grade 8 SOL	Number of Items
PS.4The student will investigate and understand the organization and use of the periodic table of elements to obtain information. Key concepts include a) symbols, atomic number, atomic mass, chemical families (groups), and periods; b) classification of elements as metals, metalloids, and nonmetals; and c) formation of compounds through ionic and covalent bonding.	**Force, Motion, Energy, Matter**	**PS.4**	**15**

Prior Knowledge

6.4The student will investigate and understand that all matter is made up of atoms. Key concepts include

a) atoms consist of particles, including electrons, protons, and neutrons;
b) atoms of a particular element are alike but are different from atoms of other elements;
c) elements may be represented by chemical symbols;
d) two or more atoms interact to form new substances, which are held together by electrical forces (bonds);
e) compounds may be represented by chemical formulas;
f) chemical equations can be used to model chemical changes; and
g) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere.

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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	In order to meet this standard, it is expected that students will • use the periodic table to obtain the following information about the atom of an element: - symbol - atomic number - atomic mass - state of matter at room temperature - number of outer energy level (valence) electrons.

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 pattern of properties such as boiling point across periods on the table. • 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.	• describe the organization of the periodic table in terms of - 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.

Vocabulary	Lessons and TEI Items	Trade Books
Atom-The smallest particle into which an element can be divided and still be the same substance. **Proton**-The positively charged particle of the nucleus **Neutron**-The particles of the that have no charge **Electron**-The negatively charged particles found in all atoms **Quantum mechanics**-A theory of the mechanics of atoms, molecules, and other physical systems that are subject to the uncertainty principle **Electron cloud**-The regions inside an atom where electrons are likely to be found **Periodic table of elements**-A table of elements arranged by atomic number that shows patterns in their properties **Periods**-a row of elements on the periodic table Ion **Charged particles**- that form during chemical changes Isotope **Atoms**- that have the same number of protons but have different numbers of neutrons **Metals**-Elements that are shiny and good conductors of heat and electricity **Nonmetals**-Elements that are dull and poor conductors of heat and electricity **Compound-**A pure substance composed of two or more elements that are chemically combined **Atomic number**-The number of protons in the nucleus of	Metals, Nonmetals, Metalloids Chemical Bonds PS. 4 Google Documents	**Book Room List** *Chemistry: Getting a Big Reaction* (by Dan Green)

an atom **Atomic mass**-The weighted average of the masses of all the naturally occurring isotopes of an element **Ionic bond**-The force of attraction between oppositely charged ions **Covalent bond**-The force of attraction between the nuclei of atoms and the electrons shared by the atoms **Metalloids**-Elements that have properties of both metals and nonmetals **Element-**A pure substance that cannot separated or broken down into simpler substances by physical or chemical means **Valence electrons**-The electrons in the outermost energy level of an atom **Family**-A column of elements on the periodic table		

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye

Jefferson Lab Practice Test Items Released SOL Test		CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools
Science Curriculum

PS. 2	Blueprint Categories	Grade 8 SOL	Number of Items
PS.2The student will investigate and understand the nature of matter. Key concepts include 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.	**Force, Motion, Energy, Matter**	**PS.2**	**15**
	Prior Knowledge		
	6.4The student will investigate and understand that all matter is made up of atoms. Key concepts include h) atoms consist of particles, including electrons, protons, and neutrons; i) atoms of a particular element are alike but are different from atoms of other elements; j) elements may be represented by chemical symbols; k) two or more atoms interact to form new substances, which are held together by electrical forces (bonds); l) compounds may be represented by chemical formulas; m) chemical equations can be used to model chemical changes; and n) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere.		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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, 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:	In order to meet this standard, it is expected that students will • 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.

- 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 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. • 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.	• describe the properties of solids, liquids, 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 compose a clear hypothesis, create an organized data table, identify variables and constants, record data correctly, construct appropriate graphs, analyze data, and draw reasonable conclusions.)

Vocabulary	**Lessons and TEI Items**	**Trade Books**
Acid- is a compound with a ph less than 7 and neutralizes **Atomic number**- is the number found on the periodic table of elements that determines the number of protons . **Base-** is a compound with a ph higher than 7 **Chemical bond**- is the force of attraction that holds two atoms together.	The Particle Theory of Matter PS. 2 Google Documents	**Book Room List**

Chemical symbol -is a one or two letter representation of an element. **Compound**- is a substance made up of two or more elements that are chemically joined. **Covalent bond**- is a chemical bond formed when two atoms share electrons. **Element-** is a pure substance that cannot be broken down into other substances by chemical or physical means. **Matter**- is anything that has mass and takes up space. Mixture forms when two or more substances are combined such that each substance retains its own chemical identity **Molecule-** is a neutral group of two or more atoms held together by covalent bonds. **Nucleus** -is the center of an atom that is made up of protons and neutrons. **Neutron** -is a small sub atomic particle in the nucleus of the atom, with no electrical charge. **Particle Theory of Matter**- state that all **matter** consists of many, very small **particles**which are constantly moving or in a continual state of motion. **Periodic table-** is an arrangement of the elements showing the repeating pattern of their properties. **Proton**- is a small, positively charged, sub atomic particle that are found in the nucleus of an atom **Salts** -are any chemical compound formed from the reaction of an acid with a base, with all or part of the hydrogen of the acid replaced by a metal or other cation . **Sub-atomic particle-** a particle smaller than an atom (i.e. neutron, proton)		

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools
Science Curriculum

PS.5	Blueprint Categories	Grade 8 SOL	Number of Items
PS.5The 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 a) physical changes; b) chemical changes; and c) nuclear reactions.	**Force, Motion, Energy, Matter**	**PS.5**	**15**
	Prior Knowledge		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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 (endothermic). (The study of synthesis, decomposition, and replacement reactions can be reserved for high school chemistry.)	In order to meet this standard, it is expected that students will • 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

• 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.	summarize and compare and contrast these two types of nuclear energy. • evaluate the positive and negative effects of using nuclear energy.

Vocabulary	Lessons and TEI Items	Trade Books
Chemical change- occurs when atoms of the same or different elements rearrange themselves to form a new substance. **Law of Conservation of Matter and Energy**- states that the total amount of energy and matter in a system remains constant **Nuclear Change**- involves a change in the characteristics of an atomic nucleus **Physical change**- occurs when matter changes forms but one substance is not transformed into another (No chemical reaction takes place) Physical changes are usually reversible.	The Law of Conservation of Matter PS. 5 Google Documents	**Book Room List** *Once a Wolf: How Wildlife Biologists Fought to Bring Back the Gray Wolf* (by Stephen Swinburne) *Many Biomes: One Earth Sneed Collard* *Environmental Engineer (by* Geoffry Horn) *Planet Under Pressure: Too Many People on Earth (by* Laurie Halse Anderson)

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools Science Curriculum			
PS.6	**Blueprint Categories**	**Grade 8 SOL**	**Number of Items**
PS.6The student will investigate and understand forms of energy and how energy is transferred and transformed. Key concepts include a) potential and kinetic energy; and b) mechanical, chemical, electrical, thermal, radiant and nuclear energy.	**Force, Motion, Energy, Matter**	**PS.6**	**15**
	Prior Knowledge		
	6.2The student will investigate and understand basic sources of energy, their origins, transformations, and uses. Key concepts include a) potential and kinetic energy; b) the role of the sun in the formation of most energy sources on Earth; c) nonrenewable energy sources; d) renewable energy sources; and e) energy transformations		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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 sound 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.	In order to meet this standard, it is expected that students will • 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.

Vocabulary	Lessons and TEI Items	Trade Books
Potential energy- The energy of position or shape. **Kinetic energy**-The energy of motion. **Mechanical energy**-The total energy of motion and position of an object. **Chemical energy**-The energy of a compound that changes as its atoms are rearranged to form a new compound. **Electrical energy**-The energy of electric charges. **Light energy**-The energy produced by the vibrations of electrically charged particles. **Heat energy**-The heat energy of a substance is determined by how active its atoms and molecules are.	States and Forms of Energy PS. 6 Google Documents	**Book Room List** *Forms of Energy* (by Anna Claiborne) *The Powerful World of Energy with Max Axiom, Super Scientist* (by Agnieszke Biskup) *Energy in the Real World* (by Christin Zuhora-Walske)

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app)	Destiny	Brain POP Science activities Science Net Links

SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test		Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools
Science Curriculum

PS.10	Blueprint Categories	Grade 8 SOL	Number of Items
PS.10The student will investigate and understand the scientific principles of work, force, and motion. Key concepts include 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.	**Force, Motion, Energy, Matter**	**PS.10**	**15**
	Prior Knowledge		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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.	In order to meet this standard, it is expected that students will • 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.

• 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.	• make measurements to calculate the power of an object. • solve basic problems given the following formulas: Speed = distance/time ($s = d/t$) Force = mass × acceleration ($F = ma$) Work = force × 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.

Vocabulary	Lessons and TEI Items	Trade Books
Energy transformation-The process of changing one form of energy into another. **Fusion**-The process by which multiple atomic particles join together to form a heavier nucleus. **Law of Conservation of Matter (mass)-**The law that states that mass is neither created nor destroyed in ordinary chemical and physical changes. **Fission-**The process where a large atomic nucleus splits into two smaller nuclei **Law of Conservation of Energy**-The law that states that energy is neither created nor destroyed. **Speed-**The rate at which an object moves.	The Rate of Motion Work and Power PS. 10 Google Documents	**Book Room List** *A Crash Course in Forces and Motion with Max Axiom, Super Scientist* (by Emily Sohn)

Velocity-The speed of an object in a particular direction. **Acceleration**-The rate at which velocity changes. **Newton's Law of Motion**-Three physical laws which provide relationships between the forces acting on an object and the motion of an object. **Work**-The action that results when a force causes an object to move in the direction of the force. **Force**-A push or pull. **Mechanical advantage**-A number that tells how many times a machine multiplies force. **Efficiency**-The percentage of the input work done on a machine that the machine can return in output work. **Power**-The rate at which work is done. **Mass**-The amount of matter that something is made of. **Weight-**A measure of the gravitational force exerted on an object, usually by the Earth. **Simple machines**-The six machines from which all other machines are constructed-(lever, an inclined plane, wedge, screw, wheel and axle, pulley). **Compound machine**-A machine that is made of two or more simple machines.		

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools
Science Curriculum

PS.7	Blueprint Categories	Grade 8 SOL	Number of Items
PS.7The student will investigate and understand temperature scales, heat, and thermal energy transfer. Key concepts include 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.	**Force, Motion, Energy, Matter**	**PS.7**	**15**
	Prior Knowledge		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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 (–273°C/0 K) 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	In order to meet this standard, it is expected that students will • 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 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).

radiation. • 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, evaporating, boiling, and vaporizing) as this energy is being used to make or break bonds between molecules.	• 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 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.

Vocabulary	Lessons and TEI Items	Trade Books
Celsius temperature scale -the temperature scale used by most scientist **Kelvin temperature scale**-The SI unit for temperature **Absolute zero**-Lowest temperature on the Kelvin scale **Heat-**The transfer of energy between objects that are at different temperatures **Temperature**-Measure of the average kinetic energy of the particles in an object **Phase change**-The conversion of a substance from one physical form to another	Heat and Thermal Energy Transfer PS. 7 Google Documents	**Book Room List** *Same Sun Here* (by Melaina Foranda) *Deep Freeze* (by Diane Muldrow)

Freezing point-The change of state from a solid to a liquid **Melting point**-The temperature at which the substance changes from a solid to a liquid **Boiling point**-The temperature at which a liquid boils **Vaporization**-The change of state from a liquid to a gas **Condensation**-The change of state from a gas to a liquid **Conduction**-The transfer of thermal energy through direct contact **Convection**-The transfer of thermal energy by the movement of a liquid or a gas **Radiation**-The transfer of energy through matter or space as an electromagnetic wave **Heat transfer**-The process whereby heat moves from one body or substance to another by radiation, conduction, or convection		

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye

Jefferson Lab Practice Test Items Released SOL Test		CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

Dinwiddie County Public Schools Science Curriculum			
PS.11	**Blueprint Categories**	**Grade 8 SOL**	**Number of Items**
PS.11The student will investigate and understand basic principles of electricity and magnetism. Key concepts include a) static electricity, current electricity, and circuits; b) relationship between a magnetic field and an electric current; c) electromagnets, motors, and generators and their uses; and d) conductors, semiconductors, and insulators.	**Force, Motion, Energy, Matter**	**PS.11**	**15**
	Prior Knowledge		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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 of wire that creates another magnetic field. • 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	In order to meet this standard, it is expected that students will • 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,

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.	semiconductors, and insulators. • identify current applications of semiconductors and their uses (e.g., diodes and transistors).

Vocabulary	Lessons and TEI Items	Trade Books
Static electricity-The build up of electric charges on an object. **Current electricity**-A constant flow of electrons. series circuit-A circuit in which all parts are connected in a single loop. **Parallel circuit**-A circuit in which different loads are on separate branches. **Magnetic field**-The region around a magnet in which magnetic forces can act. **Electric current**-A continuous flow of electric charge motor-A device that changes electrical energy into kinetic energy. **Generator**-A device that uses electromagnetic induction	Electricity and Circuits Electricity and Magnetism PS. 11 Google Documents	**Book Room List**

to convert kinetic energy into electrical energy. **Voltage-**The difference in energy per unit charge as a charge moves between two points in an electric circuit. **Resistance**-The opposition to the flow of electric charge. **Current-**A continuous flow of charge caused by the motion of electrons. The rate at which a charge passes a given point. **Direct current**-Electric current in which the charges always flow in the same direction. **Electromagnet**-A magnet that consists of a solenoid wrapped around an iron core. **Conductor**-A material in which charges can move easily. **Alternating current-**Electric current in which the charges continually switch from flowing in one direction to flowing in the reverse direction. **Insulator**-A material in which charges cannot easily move.		

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

PS.9	Blueprint Categories	Grade 8 SOL	Number of Items
PS.9The student will investigate and understand the characteristics of transverse waves. Key concepts include a) wavelength, frequency, speed, amplitude, crest, and tr b) the wave behavior of light; c) images formed by lenses and mirrors; d) the electromagnetic spectrum; and e) technological applications of light.	**Force, Motion, Energy, Matter**	**PS.9**	**15**
	Prior Knowledge		
	5.3The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include a) transverse waves; b) the visible spectrum; c) opaque, transparent, and translucent; d) reflection of light from reflective surfaces; and e) refraction of light through water and prisms.		

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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	In order to meet this standard, it is expected that students will • 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.

highest frequency. Visible light lies in between and makes up only a small portion of the electromagnetic spectrum. • 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.	

Vocabulary	Lessons and TEI Items	Trade Books
Light energy-The energy produced by the vibrations of electrically charged particles. **Reflection**-the bouncing back of a wave after it strikes a barrier **Refraction**-the bending of a wave as it passes at an angle form one medium to another **Diffraction**-the bending of waves around a barrier or through an opening **Interference**-A wave interaction that occurs when two or more waves overlap **Electromagnetic spectrum**-The entire range of electromagnetic waves **electromagnetic radiation**-Radiation consisting of electromagnetic waves **Transverse**-A wave in which the particles of the waves medium vibrate perpendicular to the direction the wave is	Light and the Electromagnetic Spectrum PS. 9 Google Documents	**Book Room List**

traveling **Gamma waves**-Electromagnetic waves with no mass and high energy **X-rays-**Electromagnetic waves with high energy that are between ultraviolet and gamma rays **Ultraviolet**-Electromagnetic waves that are between visible light and x-rays on the spectrum **visible light**- The narrow range of wavelengths and frequencies on the spectrum that humans can see I**nfrared**-Electromagnetic waves that are between microwaves and visible light on the spectrum **radio waves**-Electromagnetic waves with long wavelengths and low frequencies **Microwaves**-Electromagnetic waves between radio waves and infrared waves on the spectrum		

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities	Destiny	Brain POP Science activities Science Net Links Newsela

CK-12 Jefferson Lab Practice Test Items Released SOL Test		Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

<table>
<tr><th>PS. 8</th><th>Blueprint Categories</th><th>Grade 8 SOL</th><th>Number of Items</th></tr>
<tr><td rowspan="3">PS.8The student will investigate and understand the characteristics of sound waves. Key concepts include
a) wavelength, frequency, speed, amplitude, rarefaction, and compression;
b) resonance;
c) the nature of compression waves; and
d) technological applications of sound.</td><td>Force, Motion, Energy, Matter</td><td>PS.8</td><td>15</td></tr>
<tr><th colspan="3">Prior Knowledge</th></tr>
<tr><td colspan="3">5.2The student will investigate and understand how sound is created and transmitted, and how it is used. Key concepts include
a) compression waves;
b) vibration, compression, wavelength, frequency, amplitude;
c) the ability of different media (solids, liquids, and gases) to transmit sound; and
d) uses and applications of sound waves.</td></tr>
</table>

Understanding the Standard	Essential Knowledge, Skills, and Procedures
The critical scientific concepts developed in this standard include the following: • 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.	In order to meet this standard, it is expected that students will • 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.

• 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.	• 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.

Vocabulary	Lessons and TEI Items	Trade Books
Sound-The energy caused by an object's vibrations. **Wavelength-**The distance between one point on a wave and the corresponding point on an adjacent wave in a series of waves. **Frequency-**The number of waves produced in a given amount of time. **Speed-**The rate at which an object moves. **Amplitude-**The maximum distance a wave vibrates from its rest position **Resonance-**What occurs when an object vibrating at or near a resonant frequency of a second object causes the second object to vibrate. **Longitudinal wave-**A wave in which the particles of the medium vibrate back and forth along the path that the wave travels. **Medium-**A substance through which a wave can travel. **Compression-**A region of higher density or pressure in a wave.	Sound PS.8 Google Documents	**Book Room List**

Student Links	Destiny	Instructional Resources
Science 360 (app) **Science House** (app) SOL Pass Suffolk City Activities CK-12 Jefferson Lab Practice Test Items Released SOL Test	Destiny	Brain POP Science activities Science Net Links Newsela Bill Nye CK-12 Virginia Interactive Science Textbook E-Media Super Teacher Worksheets PBS Kids PBS Design Squad National Science Teachers Association

PS. 1 Overview

The skills described in standard PS.1 are intended to define the "investigate" component of all of the other Physical Science standards (PS.2 – PS.11). The intent of standard PS.1 is that students will continue to develop a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed in the Physical Science curriculum. **Standard PS.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other Physical Science standards.** It is also intended that by developing these skills, students will achieve greater understanding of scientific inquiry and the nature of science, as well as more fully grasp the content-related Standards of Learning concepts. Models, simulations, and current applications are used throughout the course in order to learn and reinforce science concepts.

Across the grade levels, kindergarten through high school, the skills in the first standards form a nearly continuous sequence. It is very important that the Physical Science teacher be familiar with the skills in the sequence leading up to standard PS.1 (LS.1, 6.1, 5.1, 4.1).

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
Unit Science Process Skills **SOL Reporting Category** Scientific Investigation **Virginia SOL PS.1** The student will demonstrate an understanding of scientific reasoning, logic and the nature of science by planning and conducting investigations in which a) chemicals and equipment are used safely; b) length, mass, volume, density, temperature, weight, and force are accurately measured; c) conversions are made among metric units, applying appropriate prefixes; d) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, probeware, and spring	**The student will** • 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 newton's. • recognize metric prefix units and make common metric conversions between the same base metric unit (for example,	**Essential Questions** • What are the rules and procedures you should follow to ensure a safe laboratory experience? • Why do scientists use metric measurement to collect quantitative data from investigations? • What tools are useful to investigate and quantify phenomena in physical science? • What important information should be included on data tables? • What are some powerful tools that can be used for interpreting data? • What does scientific methodology, regardless of whether it is experimental or not, begin with? • Why is it important to utilize appropriate research methods to answer questions? **Essential Understandings** • 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 of 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

scales are used to gather data; e) numbers are expressed in scientific notation where appropriate; f) independent and dependent variables, constants, controls, and repeated trials are identified; g) data tables showing the independent and dependent variables, derived quantities, and the number of trials are constructed and interpreted; 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; i) frequency distributions, scatter plots, line plots, and histograms are constructed and interpreted; j) valid conclusions are made after analyzing data; k) research methods are used to investigate practical problems and questions;	nanogram to milligram or kilometer to meter). • 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	f) scientists try to remain objective and engage in peer review to help avoid bias. • 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. Teacher Notes and Elaborations ***<u>Resources</u>*** *<u>Brain Pop</u>* *<u>UVA Physical Science Activities</u>* *<u>Science Links</u>* *VDOE Enhanced Scope and Sequence Lessons* *<u>SOL Pass</u>* *Jefferson Lab activities* Pearson Physical Science Interactive Science Textbook pages ***<u>Supplies</u>***

l) experimental results are presented in appropriate written form; m) models and simulations are constructed and used to illustrate and explain phenomena; and n) current applications of physical science concepts are used. **Foundational Standards** 4.1 5.4 6.1 LS.1	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. **Key Vocabulary** ● constant ● control ● dependent variable ● experiment hypothesis ● independent variable ● inference ● investigation ● meniscus ● observations ● nanotechnology ● prediction ● qualitative data ● quantitative data ● validity	

PS. 2 Overview

The concepts in PS.2 build upon several science standards from previous grades, including K.4, 1.3, 2.3, 3.3, 5.4, and 6.4. These standards introduce and develop basic ideas about the characteristics and structure of matter. In PS.2, the ideas and terminology continue to be expanded and treated in greater depth, including more mathematical application. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
Unit Characteristics and Structure of Matter **SOL Reporting Category** Force, Motion, Energy, and Matter **Virginia SOL PS.2** The student will investigate and understand the nature of matter. Key concepts include 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. K.4 **Foundational Standards** The student will investigate and understand that the position, motion, and physical properties of an object can be described. 1.3	The student will • 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 solids, liquids, 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,	**Essential Questions** • 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. **Teacher Notes and Elaborations** ***Resources*** NASA Website Solids, Liquids and Gases (Sun-Earth Connection see phases of matter-stucture of an atom) University of Colorado Interactive Simulations *UVA Physical Science Activities*

The student will investigate and understand how different common materials interact with water. **<u>Foundational Standards</u>** The student will investigate and understand basic properties of solids, liquids, and gases. 3.3 The student will investigate and understand that objects are made of materials that can be described by their physical properties. 5.4 The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. 6.4 The student will investigate and understand that all matter is made up of atoms.	measurement, and/or data collection and analysis. (Students should be able to use the inquiry skills represented in PS.1 and LS.1 to compose a clear hypothesis, create an organized data table, identify variables and constants, record data correctly, construct appropriate graphs, analyze data, and draw reasonable conclusions.) **Key Vocabulary** ● acid ● acidity ● atom ● base ● basicity ● buoyancy ● combustibility ● compound ● conductivity ● density ● ductile ● element ● hydrogen ● ions ● hydroxide ● ions ● inorganic ● matter ● malleability ● mixtures ● organic	*<u>Brain Pop</u>* *VDOE Enhanced Scope and Sequence Lessons* *<u>SOL Practice Items</u>* *Jefferson Lab activities* *<u>Simulations</u>* *<u>SOL Pass</u>* Pearson Physical Science Interactive Science Textbook pages

	• pH • plasma • reactivity • salt • solubility	

PS.3 Overview

PS.3 builds upon science standards 3.3, 5.4, and 6.4, which introduce basic concepts and terminology related to the atom. PS.3 focuses more specifically on the basic structure of the atom and how models have been and are used to explain atomic structure. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
<u>Unit</u> Atoms and Atomic Models **<u>SOL Reporting Category</u>** Force, Motion, Energy, and Matter **<u>Virginia SOL PS.3</u>** The student will investigate and understand the modern and historical models of atomic structure. Key concepts include a) the contributions of Dalton, Thomson, Rutherford, and Bohr in understanding the atom; and b) the modern model of atomic structure. **<u>Foundational Standards</u>** 3.3 The student will investigate and understand that objects are made of materials that can be described by their physical properties. 5.4 The student will investigate and understand that matter is anything that has mass and takes up space; and	The student will • 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. **Key Vocabulary** ● atom ● electron ● neutron ● particle ● proton ● quark	**<u>Essential Questions</u>** • What information can be obtained about an atom's properties from the periodic table? • What are some properties that can be related to position on the periodic table? • What are the three main classes of elements in the periodic table? • How does a chemical formula represent the composition of a compound? • How are covalent and ionic bonds similar and different? • 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

occurs as a solid, liquid, or gas. 6.4 The student will investigate and understand that all matter is made up of atoms.		basis of periodicity — the repetitive pattern of properties such as boiling point across periods on the table. • 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. **Teacher Notes and Elaborations** ***Resources***

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
Unit The Periodic Table **SOL Reporting Category** ________________________ Force, Motion, Energy, and Matter **Virginia SOL PS.4** The student will investigate and understand the organization and use of the periodic table of elements to obtain information. Key concepts include a) symbols, atomic number, atomic mass, chemical families (groups), and periods; b) classification of elements as metals, metalloids, and nonmetals; and c) formation of compounds through ionic and covalent bonding. **Foundational Standards** None	The student will • use the periodic table to obtain the following information about the atom of an element: - 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 - 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.	**Essential Questions** • What are the major events that led us to agree on the basic structure of atoms? • How can we describe what we currently accept to be the model of atomic structure? • What are the similarities and differences between the properties and locations of subatomic particles in an atom? • 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, 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. **Teacher Notes and Elaborations**

	• predict what kind of bond (ionic or covalent) will likely form when metals and nonmetals are chemically combined. **Key Vocabulary** ● atomic number ● atomic mass ● chemical bonds ● chemical formulas ● chemical symbol ● compounds ● covalent bonds ● family ● group ● ion ● ionic bonds ● isotope metals ● metalloids ● nonmetals ● periods ● valence electrons	***Resources***

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
Unit Changes in Matter and Energy **SOL Reporting Category** Force, Motion, Energy, and Matter **Virginia SOL 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 a) physical changes; b) chemical changes; and c) nuclear reactions. **Foundational Standards** None	The student will • 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. **Key Vocabulary** ● chemical equations ● endothermic ● exothermic ● fission	**Essential Questions** **Teacher Notes and Elaborations** ***Resources*** *UVA Physical Science Activities* *Brain Pop* VDOE Enhanced Scope and Sequence:lessons SOL Practice Items SOL Pass Jefferson Lab activities Simulations Pearson Physical Science Interactive Science Textbook pages

	• fusion • mass • reactants • products	

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
<u>Unit</u> States and Forms of Energy **<u>SOL Reporting Category</u>** Force, Motion, Energy, and Matter **<u>Virginia SOL PS.6</u>** The student will investigate and understand forms of energy and how energy is transferred and transformed. Key concepts include a) potential and kinetic energy; and b) mechanical, chemical, electrical, thermal, radiant and nuclear energy. **<u>Foundational Standards</u>** 4.2 The student will investigate and understand characteristics and interactions of moving objects. 4.3 The student will investigate and understand the characteristics of electricity. 6.2 The student will investigate and understand basic sources of energy,	**Key Vocabulary** ● chemical energy ● conductor ● electrical energy ● energy ● kinetic energy ● mechanical energy ● nuclear energy ● potential energy ● radiant energy ● speed ● thermal energy ● transformation ● velocity	**<u>Essential Questions</u>** • What does energy enable us to do? • What two general states of energy exist in the world? • What are common forms of energy and examples of each? • How do nuclear changes demonstrate the Law of Conservation of Mass and Energy? • What everyday examples of energy transformations can we see and describe? • 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 sound 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. **<u>Teacher Notes and Elaborations</u>** ***<u>Resources</u>***

their origins, transformations, and uses. 6.4 The student will investigate and understand that all matter is made up of atoms.		

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
Unit Transfer of Thermal Energy **SOL Reporting Category** Force, Motion, Energy, and Matter **Virginia SOL PS.7** The student will investigate and understand temperature scales, heat, and thermal energy transfer. Key concepts include 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. **Foundational Standards** 2.3 The student will investigate and understand basic properties of solids, liquids, and gases. 5.4 The student will investigate and understand	The student will • 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. **Key Vocabulary** ● absolute zero ● boiling ● condensing ● conduction ● Convection ● evaporating (evaporate) ● freezing (freeze) ● heat melting (melt) ● phase change ● radiation ● sublimation ● temperature ● thermal energy ● vaporizing (vaporization)	**Essential Questions** • What is the difference between heat and temperature? • How does temperature change when kinetic energy increases? • How is temperature measured? • How do changes in temperature affect matter? • How is energy transferred through heat? • What are some everyday applications of the use of heat transfer? • 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/0K) 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. • 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, evaporating, boiling, and vaporizing) as this energy is being used to make or break bonds between molecules.

that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas.		**Teacher Notes and Elaborations** ***Resources*** *UVA Physical Science Activities* *Brain Pop* Enhanced Scope and Sequence lessons SOL Practice Items SOL Pass Jefferson Lab activities Simulations

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
<u>Unit</u> Nature of Sound and its Applications **<u>SOL Reporting Category</u>** Force, Motion, Energy, and Matter **<u>Virginia SOL PS.8</u>** The student will investigate and understand the characteristics of sound waves. Key concepts include a) wavelength, frequency, speed, amplitude, rarefaction, and compression; b) resonance; c) the nature of compression waves; and d) technological applications of sound. **<u>Foundational Standards 5.2</u>** The student will investigate and understand how sound is created and transmitted, and how it is used.	The student will • 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 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 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	**<u>Essential Questions</u>** **<u>Teacher Notes and Elaborations</u>** • What is a wave? • What are the measurable properties of mechanical waves? • How are wavelength, frequency, speed, and amplitude of mechanical waves calculated? • How are sound waves produced and detected? • What is resonance? • What are some useful applications of sound technology? • 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.

	Key Vocabulary ● amplitude ● amplify ● compression ● frequency ● mechanical wave ● medium ● radar ● rarefaction ● resonance ● sonar ● sound ● vibration ● wavelength	• Reflection and interference patterns are used in ultrasonic technology, including sonar and medical diagnosis. ***<u>Resources</u>***

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
<u>Unit</u> Nature of Light and its Applications **SOL Reporting Category** __________________________ Force, Motion, Energy, and Matter **<u>Virginia SOL PS.9</u>** The student will investigate and understand the characteristics of transverse waves. Key concepts include 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. **<u>Foundational Standards</u>** 5.3 The student will investigate and understand basic characteristics of visible light and how it behaves.	The student will • 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. **Key Vocabulary** ● absorption (absorb) ● amplitude ● convex lens	**<u>Essential Questions</u>** • In what type of waves does light travel? • What are the two ways light interacts with materials as it travels in straight lines? • How does the curve in a lens cause it to refract light differently than a mirror? • What does the electromagnetic spectrum represent? • What are the parts of the electromagnetic spectrum? • What are everyday applications of each form of electromagnetic energy? • 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

	• concave lens • crest diffraction • electromagnetic waves • frequency	the highest frequency. Visible light lies in between and makes up only a small portion of the electromagnetic spectrum. • 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. **Teacher Notes and Elaborations** ***Resources***

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
<u>Unit</u> Principles of Work, Force, and Motion **SOL Reporting Category** ______________________ Force, Motion, Energy, and Matter **<u>Virginia SOL PS.10</u>** The student will investigate and understand the scientific principles of work, force, and motion. Key concepts include 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. **<u>Foundational Standards</u>** 3.2 The student will investigate and understand simple machines and their uses. 4.2	The student will • 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 × acceleration (F = ma) Work = force × 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.	**<u>Essential Questions</u>** • How can motion be described and predicted? • How are speed, velocity, and acceleration calculated? • How does Newton's first law allow us to predict motion? • What does Newton's second law predict will happen to an object's acceleration if the force acting upon it is increased? • What does Newton's third law tell us about action/reaction pairs of forces? • How are force, work, and power calculated? • What does mechanical advantage tell us about a machine? • What are some notable historical and current applications of work, force, and motion? • 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

The student will investigate and understand characteristics and interactions of moving objects.	**Key Vocabulary** • acceleration • deceleration • force • mass • mechanical advantage • momentum • power • speed • velocity • weight • work	negative value depending on the direction of the change in position, whereas speed always has a positive value and is non directional. • Work is done when an object is moved through a distance in the direction of the applied force. **Teacher Notes and Elaborations** ***Resources***

Curriculum Information	Essential Knowledge and Skills Key Vocabulary	Essential Questions and Understandings Teacher Notes and Elaborations
Unit Electricity and Magnetism **SOL Reporting Category** Force, Motion, Energy, and Matter **Virginia SOL PS.11** The student will investigate and understand basic principles of electricity and magnetism. Key concepts include a) static electricity, current electricity, and circuits; b) relationship between a magnetic field and an electric current; c) electromagnets, motors, and generators and their uses.; and d) conductors, semiconductors, and insulators, **Foundational Standards** 4.3 The student will investigate and understand the characteristics of electricity.	The student will • 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). **Key Vocabulary** ● alternating current ● circuit ● conductor ● current ● diode	**Essential Questions** • What is electrical energy? • How do we distinguish between direct current and alternating current? • How do we distinguish between conductors and insulators? • What are the required components for a complete electrical circuit? • What is the difference between a series and a parallel circuit? • How are electricity and magnetism related? • What is the role of electricity and magnetism in the function of motors and generators? • 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 of wire that creates another magnetic field. • A generator is a device that converts mechanical energy into electrical energy. Most of the electrical energy we use comes

	• direct current • electromagnets • generator • insulators • magnetic field • magnetism • parallel circuit • resistance • semiconductor • series circuit • solar cell • static electricity • transistors • voltage	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. **<u>Teacher Notes and Elaborations</u>** ***<u>Resources</u>***