Grade 6

Science Curriculum Guide

SY 2012-13 through SY 2018-19

Prince William County
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Introduction

The Prince William County Public Schools Science Curriculum is based on the *Science Standards of Learning for Virginia Public Schools* and is further defined by the *Science Standards of Learning* Curriculum Framework. The Science Curriculum provides guidance to teachers as they develop instruction appropriate for their students. It assists teachers as they plan their lessons by identifying essential understandings, skills, and processes students need to master. The curriculum specifically outlines the minimum content that all teachers should teach and all students should learn.

Teachers should use the science curriculum as a resource for developing instruction without limiting the scope of instruction. Additional knowledge and skills that can enrich and enhance students' understanding of the content identified in the curriculum should be included as a part of quality learning experiences.

The Prince William County Science Curriculum reflects the knowledge and skills that students are accountable for on the Science Standards of Learning assessments that are administered in the spring of each school year. Assessment items are not a verbatim reflection of the information presented in the Science Curriculum. Students are expected to continue to apply knowledge and skills from curriculum presented in previous grades as they build scientific expertise.

The design of the Science Curriculum requires that teachers prepare students to demonstrate achievement of the standards for elementary and middle school by the time they complete the grade levels tested. The high school end-of-course assessments are administered at the end of the year in which instruction takes place. (Students may earn verified units of credit upon successfully meeting expectations on the Standards of Learning assessment and course material.)

Each topic in the Science Curriculum is derived from the Science Standards of Learning. The format of the Science Curriculum facilitates teacher planning by identifying the key questions, concepts, knowledge and skills that should be the focus of instruction for each standard. The curriculum document is divided into three columns: *Curriculum Information, Essential Knowledge, Skills, and Processes/Key Vocabulary,* and *Essential Questions and Understandings*. The purpose of each column is explained below.

Curriculum Information
Each standard reflects what students know and should be able to do. In this column, the unit, SOL Reporting Category and standard is listed. Additionally, because the *Science Standard of Learning for Virginia Public Schools* is scaffolded, foundational Standards that support the SOL from previous grades are listed.

Essential Knowledge, Skills and Processes; Key Vocabulary
This section delineates the key concepts, ideas and scientific relationships that all students should grasp to demonstrate an understanding of the Standards. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. This section is helpful to teachers when planning classroom assessments as it is a guide to the knowledge and skills that define the objective. This section also identifies vocabulary that is critical to mastering the objective of that standard and many times is the first introduction for the student to new concepts and skills. The vocabulary identified is not an exhaustive list of terms that a student will encounter in addressing each standard.

Essential Questions and Understandings
This section includes background information for the teacher. It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. It may also contain definitions of key vocabulary to help facilitate student learning.

Investigate and Understand

Many of the standards in the *Science Standards of Learning* begin with the phrase "Students will investigate and understand." This phrase was chosen to communicate the range of rigorous science skills and knowledge levels embedded in each standard. Limiting a standard to one observable behavior, such as "describe" or "explain," would have narrowed the interpretation of what was intended to be a rich, highly rigorous, and inclusive content standard.

"Investigate" refers to scientific methodology and implies systematic use of the following inquiry skills:

- observing;
- classifying and sequencing;
- communicating;
- measuring;
- predicting;
- hypothesizing;
- inferring;
- defining, controlling, and manipulating variables in experimentation;
- designing, constructing, and interpreting models; and
- interpreting, analyzing, and evaluating data.

"Understand" refers to various levels of knowledge application. In the *Science Standards of Learning*, these knowledge levels include the ability to:

- recall or recognize important information, key definitions, terminology, and facts;
- explain the information in one's own words, comprehend how the information is related to other key facts, and suggest additional interpretations of its meaning or importance;
- apply the facts and principles to new problems or situations, recognizing what information is required for a particular situation, using the information to explain new phenomena, and determining when there are exceptions;
- analyze the underlying details of important facts and principles, recognizing the key relations and patterns that are not always readily visible;
- arrange and combine important facts, principles, and other information to produce a new idea, plan, procedure, or product; and
- make judgments about information in terms of its accuracy, precision, consistency, or effectiveness.

Therefore, the use of "investigate and understand" allows each content standard to become the basis for a broad range of teaching objectives, which the school division will develop and refine to meet the intent of the *Science Standards of Learning*.

Planning Guide for Grade 6

Unit	VA SOL Reporting Category	Objectives	Suggested Time Allocation
Science Process Skills	Scientific Investigation, Reasoning, and Logic	**6.1/ Infused** Observations of similar objects/organisms Data analysis Data collection tools Models and simulations Validity test Scale models Variables and constants Hypotheses and repeat trails Make predications Current applications of science skills	Infused throughout the year with content-specific objectives. Skills are reinforced with hands-on activities.
Energy (Sources, origins, transformations, and uses)	Force, Motion, Energy, and Matter	**6.2a, e** Potential energy Kinetic energy Energy transformations	5 blocks (with SOL 6.9 infused)
	Earth and Space Systems	**6.2b-d** Sun as an energy source Nonrenewable energy Renewable energy	10 blocks
Energy in the Atmosphere	Force, Motion, Energy, and Matter	**6.3** Earth's energy budget Radiation Convection Cloud formation Thermal energy and weather Motion of the atmosphere and oceans	8 blocks
Matter	Force, Motion, Energy, and Matter	**6.4** Particles in atoms Elements Chemical symbols Bonds Chemical formulas Chemical equation	8 blocks
Earth's Waters	Force, Motion, Energy, and Matter	**6.5a-b** Water properties Phases of water	3 blocks
	Earth and Space Systems	**6.5c-f** Physical and chemical weathering Climate moderation Importance of water and water resources	13 blocks

Unit	VA SOL Reporting Category	Objectives	Suggested Time Allocation
Weather	Force, Motion, Energy, and Matter	**6.6 a** Composition of air	2 blocks
	Earth and Space Systems	**6.6b-f** Pressure, temperature, and humidity Atmospheric changes Air quality Atmospheric measures and weather Weather map interpretation	7 blocks
Watershed Systems	Ecosystems	**6.7** Ecosystems — Virginia watershed systems River systems — Stream processes Wetlands — Estuaries Watershed conservation — Water monitoring	15 blocks (with SOL 6.9 infused)
	Earth and Space Systems	**6.9** Resource management — Land-use Environmental hazards — Conservation policies	Infused with SOL 6.2 and 6.7
The Solar System	Earth and Space Systems	**6.8** Sun — Moons Earth — Planets Meteors — Asteroids Comets — Gravity Rotation — Revolution Day/night mechanics — Phases of the moon Properties of Earth — Earth's tilt and seasons Tides — Space exploration	15 blocks

Grade 8 Science: Test Blueprint Summary Table

Reporting Category	Grade 6 Standards of Learning	Life Science Standards of Learning	Physical Science Standards of Learning	Number of Items
Assessed with Other SOL	6.1j	LS.1j	PS.1n	
Scientific Investigation	6.1a-i	LS.1a-i	PS.1a-m	10
Force, Motion, Energy, and Matter	6.2a, e 6.4a-g 6.5a-b 6.6a		PS.2a-f PS.3a-b PS.4a-c PS.5a-c PS.6a-b PS.7a-d PS.8a-d PS.9a-e PS.10a-d PS.11a-d	15
Life Systems		LS.2a-d LS.3a-b LS.4a-d LS.5a-c LS.12a-f LS.13a		7
Ecosystems	6.7a-g	LS.6a-d LS.7a-b LS.8a-e LS.9a-c LS.10a-c LS.11a-e		7
Earth and Space Systems	6.2b-d 6.3a-e 6.5c-f 6.6b-f 6.8a-i 6.9a-d	LS.13b-c		11
Excluded from Testing			None	
Number of Operational Items			50	
Number of Field Test Items*			10	
Total Number of Items on Test			60	

6.1 Overview

In the PWCS Curriculum, all .1 standards are intended to develop investigative and inquiry skills and an understanding of the nature of science. The skills described in standard 6.1 are intended to define the "investigate" component of all of the other sixth-grade standards (6.2–6.9). The intent of standard 6.1 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 at the sixth grade. **Standard 6.1 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 sixth-grade 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 concepts in the standards. It is also intended that models, simulations, and current applications are used throughout the course in order to learn and reinforce science concepts.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Science Process Skills (Suggested Time: Infused) **SOL Reporting Category** Scientific Investigation **Virginia SOL 6.1** The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which a) observations are made involving fine discrimination between similar objects and organisms; b) precise and approximate measurements are recorded; c) scale models are used to estimate distance, volume, and quantity; d) hypotheses are stated in ways that identify the independent and dependent variables; e) a method is devised to test the validity of predictions and inferences; f) one variable is manipulated over time, using many repeated trials; g) data are collected, recorded, analyzed, and reported using metric measurements and tools; h) data are analyzed and communicated through graphical representation; i) models and simulations are designed and used to illustrate	**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. • make observations that can be used to discriminate similar objects and organisms, paying attention to fine detail. • make precise and consistent measurements and estimations. • create approximate scale models to demonstrate an understanding of distance, volume, and quantity. • differentiate between independent and dependent variables in a hypothesis. • propose hypotheses or predictions from observed patterns. • compare and contrast predictions and inferences. Analyze and judge the evidence, observations, scientific principles, and data used in making predictions and inferences. • design an experiment in which one variable is manipulated over many trials. • collect, record, analyze, and	**Essential Questions** • Why are discriminate observations objects and organisms important when forming conclusions? • Why is it necessary to focus and refine research questions? • How can data be depicted graphically? • What purpose does a hypothesis serve and how should it be technically stated? • How do we ensure the validity of data that are produced from an investigation? • What are some methods of collecting, recording, and reporting data from an experiment? • Why is it important to select appropriate data collection methods for a particular investigation? • What is the purpose of models? **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 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. • To communicate an observation accurately, one must provide critical details of exactly what is being observed. Using that information, students will be able to differentiate definitively between or among similar objects and/or organisms. • Systematic investigations require accurate measurements; however, in the absence of precision tools, observers must record careful estimations.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
explain phenomena and systems; and j) current applications are used to reinforce science concepts. **<u>Foundational Standards</u>** 4.1 5.1	report data, using metric terminology and tools. • analyze and communicate data, using graphs (bar, line, and circle), charts, and diagrams. • design a model that explains a sequence, for example, the sequence of events involved in the formation of a cloud. **<u>Key Vocabulary</u>** constant control dependent variables experiment hypothesis independent variables inference investigation meniscus observations prediction qualitative data quantitative data validity	• Scale models must maintain relative values of size and/or quantity in order to maintain the integrity of the object or topic being modeled. • An experiment is a structured test of a hypothesis. A hypothesis is stated in terms of a testable relationship. • A scientific prediction is a forecast about what may happen in some future situation. It is based on the application of scientific principle and factual information. • An inference is an explanation based on observations and background knowledge. A conclusion is formulated from collected data. For example, one might observe darkly colored pond water and make the inference that it is polluted. However, only after data are collected can a conclusion be formulated. • Patterns discerned from direct observations can be the basis for predictions or hypotheses that attempt to explain the mechanism responsible for the pattern. • Accurate observations and evidence are necessary to draw realistic and plausible conclusions. • In order to conduct an experiment, one must recognize all of the potential variables that can affect an outcome. • In a scientific investigation, data should be collected, recorded, analyzed, and reported using appropriate metric measurement and tools. • In a scientific investigation, data should be organized and communicated through appropriate graphical representation (graph, chart, table, and diagram). • Models provide a way of visually representing abstract concepts. The use of models permits students to order events or processes. • Science concepts are applied through observations and connections with everyday life and technology.

6.2 Overview

Many sources of energy on Earth are the result of solar radiation. This can be energy Earth is currently receiving or energy that has been stored as fossil fuels. All energy exists in two basic forms — kinetic and potential. Understanding the forms of energy and their transformations will provide the foundation for students to investigate the transfer of energy within living and Earth systems as well as to understand chemical reactions, force, and motion. This standard builds upon concepts of energy sources introduced in science standard 3.11. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Energy (sources, origins, transformations, and use) (Suggested Time: 15 blocks) **SOL Reporting Category** Force, Motion, Energy, and Mater Earth and Space Systems **Virginia SOL 6.2** The 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. **Foundational Standards** 3.11 The student will investigate and understand different sources of energy.	**The student will** • compare and contrast potential and kinetic energy through common examples found in the natural environment. • analyze and describe the transformations of energy involved with the formation and burning of coal and other fossil fuels. • compare and contrast renewable (solar, wind, water [hydropower, tidal and waves], biofuels, geothermal, and biomass) and nonrenewable energy sources (coal, petroleum, natural gas, nuclear power). • explain that hydrogen is not an energy source, but a means of storing and transporting energy. • design an application of the use of solar and wind energy. • chart and analyze the energy a person uses during a 24-hour period and determine the sources. • compare and contrast energy sources in terms of their origins, how they are utilized, and their availability. • analyze the advantages and disadvantages of using various energy sources and their impact	**Essential Questions** • What are the basic forms of energy? • What are specific energy resources? • In what ways are primary energy sources transferred? • How do energy resources change over time? **Essential Understandings** • Potential energy is energy that is not "in use" and available to do work. Kinetic energy is energy that is "in use" — the energy a moving object has due to its motion. For example, moving water and wind have kinetic energy. The chemical energy in fossil fuels is potential energy until it is released. • Solar energy from the ancient past is stored in fossil fuels, such as coal, petroleum, and natural gas. Fossil fuels are rich in the elements carbon and hydrogen. These sources of energy take very long periods of time to form and once depleted, are essentially nonrenewable. Nuclear power is also a source of nonrenewable energy. • Many of Earth's energy resources are available on a perpetual basis. These include solar, wind, water (hydropower, tidal and waves), biofuels and geothermal energy. Some energy sources can be replenished over relatively short periods of time. These include wood and other biomass. All are considered renewable. • Secondary sources of energy, such as electricity, are used to store, move, and deliver energy easily in usable form. Hydrogen is also a secondary source of energy, also called an energy carrier. • Thermal and radiant energy can be converted into mechanical energy, chemical energy, and electrical energy and back again.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	on climate and the environment. • analyze and describe how the United States' energy use has changed over time. • analyze and describe sources of energy used in Virginia related to energy use nationally and globally. • predict the impact of unanticipated energy shortages. • comprehend and apply basic terminology related to energy sources and transformations. • create and interpret a model or diagram of an energy transformation. • design an investigation that demonstrates how light energy (radiant energy) can be transformed into other forms of energy (mechanical, chemical and electrical). **Key Vocabulary** biomass biofuels chemical energy energy transformation fossil fuels geothermal energy hydroelectric hydro power kinetic energy mechanical energy nonrenewable energy	

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	nuclear power potential energy radiant energy renewable energy solar energy thermal energy tidal energy	

6.3 Overview

The key concepts defined in this standard are intended to expand student understanding of the effects of solar radiation entering Earth's atmosphere on weather and ocean current patterns. The distribution of energy through convection and radiation are explored as students study cloud formation and movement patterns of the atmosphere and the world's oceans. This standard is closely related to standards 6.2 and 6.6 and builds on the weather concepts developed in standard 4.6 and concepts of visible light in standard 5.3. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Energy in the Atmosphere (Suggested Time: 8 blocks) **SOL Reporting Category** Force, Motion, Energy, and Matter **Virginia SOL 6.3** The student will investigate and understand the role of solar energy in driving most natural processes within the atmosphere, the hydrosphere, and on Earth's surface. Key concepts include a) Earth's energy budget; b) the role of radiation and convection in the distribution of energy; c) the motion of the atmosphere and the oceans; d) cloud formation; and e) the role of thermal energy in weather-related phenomena including thunderstorms and hurricanes. **Foundational Standards** 4.6 The student will investigate and understand how weather conditions and phenomena occur and can be predicted. 5.3 The student will investigate and understand basic characteristics of visible light and how it behaves.	**The student will** • comprehend and apply basic terminology related to solar energy, including wavelength; ultraviolet, visible, and infrared radiation; and reflection and absorption. • analyze and interpret a chart or diagram showing Earth's energy budget. • analyze, model, and explain the greenhouse effect in terms of the energy entering and leaving the atmosphere. • design an investigation to determine the effect of sunlight on the heating of a surface. • analyze and explain how convection currents occur and how they distribute thermal energy in the atmosphere and oceans. • analyze the role of heating and cooling in the formation of clouds. • order the sequence of events that takes place in the formation of a cloud. • describe the relationship between thermal energy and the formation of hurricanes and thunderstorms.	**Essential Questions** • How is the energy from the sun used to power Earth processes? • What might happen if the energy balance between the Earth and space is disrupted? • How are radiation and convection involved in the transfer of energy? • What role does heat energy distribution play in weather phenomena? **Essential Understandings** • Earth receives only a very small portion of the sun's energy, yet this energy is responsible for powering the motion of the atmosphere, the oceans, and many processes at Earth's surface. • Solar radiation is made up of different types of radiation (including infrared, visible light, and ultraviolet). • Incoming solar radiation is in close balance with the energy that leaves the atmosphere; otherwise Earth would heat up or cool down. Excess carbon dioxide and other gases may disrupt this balance, creating a greenhouse effect. • About one-third of the sun's incoming energy is reflected back out to space. About one-half of the energy striking Earth is absorbed by Earth's surface. • Earth's surface is heated unequally. • When air or water is heated, the molecules move faster and farther apart, reducing their density and causing them to rise. Cooler air or water molecules move more slowly and are denser than warm air or water. Warm air or water rising coupled with cooler air or water descending forms a cyclic rising/falling pattern called convection. • Radiation and convection from Earth's surface transfer thermal energy. This energy powers the global circulation of the atmosphere and the oceans on our planet. • As bodies of water (oceans, lakes, rivers, etc.) absorb thermal energy, the water evaporates causing the air to be warm and moist. Warm, moist air is less dense than cold, dry air, so it rises relative to colder, drier air. As warm,

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	Key Vocabulary absorption atmosphere cloud convection currents density (denser) Greenhouse Effect hydrosphere infrared radiation radiation reflection solar radiation thermal ultraviolet radiation visible radiation wavelength	moist air rises, it gives off some thermal energy as the moisture condenses, forming clouds. Clouds are not gaseous water vapor; rather they are minute, condensed water particles. • Some thunderstorms are formed where the land is strongly heated. Hurricanes form over warm, tropical water and are fed by the energy of that water.

6.4 Overview

Standard 6.4 focuses on an understanding of the basic structure of the atom, including electrons, protons, and neutrons. The concepts defined in standard 6.4 build on students' basic understanding of the concept of matter as introduced in science standards 3.3 and 5.4. Knowledge of basic chemistry concepts is fundamental to understanding the physical sciences, life processes, and Earth and environmental science ideas. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Matter (Suggested Time: 8 blocks) **SOL Reporting Category** Force, Motion, Energy, and Matter **Virginia SOL 6.4** The 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. **Foundational Standards** K.4 The student will investigate and understand that the position, motion, and physical properties of	**The student will** • create and interpret a simplified modern model of the structure of an atom. • compare and contrast the atomic structure of two different elements. • explain that elements are represented by symbols. • identify the name and number of each element present in a simple molecule or compound, such as O_2, H_2O, CO_2, or $CaCO_3$. • model a simple chemical change with an equation and account for all atoms. Distinguish the types of elements and number of each element in the chemical equation. (Balancing equations will be further developed in Physical Science.) • name some of the predominant elements found in the atmosphere, the oceans, living matter, and Earth's crust. **Key Vocabulary** atom chemical bonds chemical formulas chemical reaction chemical symbols compound electrons	**Essential Questions** • What are the components of the atom? • How can matter be classified? • What are the properties of matter? • What changes can matter undergo? **Essential Understandings** • The basic structural components of a typical atom are electrons, protons, and neutrons. Protons and neutrons comprise the nucleus of an atom. • An element is a form of matter made up of one type of atom. The atoms of an element are basically alike, though the number of neutrons may vary. • The atoms of one element differ from those of another element in the number of protons. • Elements can be represented by chemical symbols. • Two or more atoms of different elements may combine to form a compound. • Compounds can be represented by chemical formulas. Each different element in the compound is represented by its unique symbol. The number of each type of element in the compound (other than 1) is represented by a small number (the subscript) to the right of the element symbol. • Chemical equations can be used to model chemical changes, illustrating how elements become rearranged in a chemical reaction. • A limited number of elements, including silicon, aluminum, iron, sodium, calcium, potassium, magnesium, hydrogen, oxygen, nitrogen, and carbon, form the largest portion of Earth's crust, living matter, the oceans, and the atmosphere.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
an object can be described. K.5 The student will investigate and understand that water flows and has properties that can be observed and tested. 1.3 The student will investigate and understand how different common materials interact with water. 2.3 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.	elements matter molecule neutrons periodic table protons sub-atomic particles	

6.5 Overview

Standard 6.5 is intended to develop student understanding of the unique properties of water and the importance of protecting and managing water resources. Understanding the structure, properties, and behavior of the water molecule is fundamental to understanding more complex environmental systems. Concepts like solubility, surface tension, cohesion, adhesion, density, condensation, and evaporation can be investigated to appreciate why the properties of water are critical to life processes and living things. This standard also introduces the concept of the ability of large bodies of water to moderate the climate on land. The connections between water resources and agriculture, power generation, and public health are also investigated. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Earth's Water (Suggested Time: 16 blocks) **SOL Reporting Category** Force, Motion, Energy, and Matter Earth and Space Systems **Virginia SOL 6.5** The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include a) water as the universal solvent; b) the properties of water in all three phases; c) the action of water in physical and chemical weathering; d) the ability of large bodies of water to store thermal energy and moderate climate; e) the importance of water for agriculture, power generation, and public health; and f) the importance of protecting and maintaining water resources. **Foundational Standards** None	**The student will** • comprehend and apply key terminology related to water and its properties and uses. • model and explain the shape and composition of a water molecule. • design an investigation to demonstrate the ability of water to dissolve materials. • comprehend the adhesive and cohesive properties of water. • compare the effects of adding thermal energy to the states of water. • explain why ice is less dense than liquid water. • relate the three states of water to the water cycle. • design an investigation to model the action of freezing water on rock material. • design an investigation to determine the presence of water in plant material (e.g., a fruit). • infer how the unique properties of water are key to the life processes of organisms. • design an investigation to model the action of acidified water on building materials such as concrete, limestone, or marble.	**Essential Questions** • Why is water the universal solvent? • What are the properties of water in all three states? • Describe the action of water in physical and chemical weathering. • How do large bodies of water store heat and moderate climate? • What is the origin and occurrence of water on Earth? • What is the importance of water for agriculture, power generation, and public health? • How can the water resources be protected and maintained? **Essential Understandings** • Among water's unique properties is that one side of each water molecule is slightly negative and the other is slightly positive. Individual water molecules, therefore, attract other water molecules like little magnets as the slightly positive portion of a water molecule is attracted to the slightly negative portion of an adjacent water molecule. In this way, water molecules "stick together." • Due to water's polar nature, a large number of substances will "dissolve" in water. For this reason, water is often called the universal solvent. • Water is the only compound that commonly exists in all three states (solid, liquid, gas) on Earth. The unique properties of water are a major factor in the ability of our planet to sustain life. • Additional properties of water are its high surface tension and the large range of temperature (0–100 degrees Celsius) in which it can be found in the liquid state, as well as the fact that, unlike other substances, solid water is less dense than liquid water. • Water is able to absorb thermal energy without showing relatively large changes in temperature. Large bodies of water act to moderate the climate of surrounding areas by absorbing thermal energy in summer and slowly releasing that energy in the winter. For this reason, the climate near large bodies of water is slightly milder than areas without large bodies of water.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	• chart, record, and describe evidence of chemical weathering in the local environment. • analyze and explain the difference in average winter temperatures among areas in central and western Virginia and cities and counties along the Chesapeake Bay and Atlantic coast. • explain the role of water in power generation. • describe the importance of careful management of water resources. **Key Vocabulary** acidic adhesion aqueduct aquifers basic chemical weathering cistern climate condense cohesion condensation deterioration dissolve evaporation irrigation physical weathering polar molecule precipitation reservoirs	• Water (rain, ice, snow) has shaped our environment by physically and chemically weathering rock and soil and transporting sediments. Freezing water can break rock without any change in the minerals that form the rock (physical weathering). This usually produces small particles and sand. Water with dissolved gases and other chemicals causes the minerals in rocks to be changed, leading to the deterioration of the rock (chemical weathering). • Most of Earth's water is salt water in the oceans (97 percent). Nonfrozen, fresh water makes up less than 1 percent of the water on Earth. • Water is essential for agriculture. Crops watered by reliable irrigation systems are more productive and harvests more dependable. • Water is an important resource used in power generation. Hydroelectric power plants make use of the kinetic energy of water as it flows through turbines. Water is also heated in power plants and turned to steam. The steam is used to turn turbines, which generate electricity. • In the past, streams and rivers were often used to dispose of human waste, and open sewers were common. During the mid-1800s, public health officials recognized the connection between disease outbreaks and contamination of public wells and drinking water. Advances in water treatment and sanitary sewers have helped eliminate diseases associated with human waste. • Due to water's importance in power generation, agriculture, and human health, it is important to conserve water resources.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	sanitary sewer sediment solute solution solvent surface tension turbine water vapor wells	

6.6 Overview

Standard 6.6 is intended to provide students with a basic understanding of the properties of air, the structure of the atmosphere, weather, and air quality. Students need to understand there are both natural and human-caused changes to the atmosphere and that the results of these changes are not yet fully known. A basic understanding of weather and weather prediction builds on the key concepts in standard 4.6. Standard 6.6 also focuses on student understanding of air quality as an important parameter of human and environmental health. It is important to make the obvious connections between this standard and the other sixth-grade standards. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Weather (Suggested Time: 8 blocks) **SOL Reporting Category** Force, Motion, Energy, and Matter Earth and Space Systems **Virginia SOL 6.6** The student will investigate and understand the properties of air and the structure and dynamics of Earth's atmosphere. Key concepts include a) air is a mixture of gaseous elements and compounds; b) pressure, temperature, and humidity; c) atmospheric changes with altitude; d) natural and human-caused changes to the atmosphere and the importance of protecting and maintaining air quality; e) the relationship of atmospheric measures and weather conditions; and f) basic information from weather maps, including fronts, systems, and basic measurements. **Foundational Standards** 4.6 The student will investigate and understand how weather conditions and phenomena occur and can be predicted.	**The student will** • comprehend and apply basic terminology related to air and the atmosphere. • identify the composition and physical characteristics of the atmosphere. • analyze and interpret charts and graphs of the atmosphere in terms of temperature and pressure. • measure and record air temperature, air pressure, and humidity, using appropriate units of measurement and tools. • analyze and explain some of the effects that natural events and human activities may have on weather, atmosphere, and climate. • evaluate their own roles in protecting air quality. • design an investigation to relate temperature, barometric pressure, and humidity to changing weather conditions. • compare and contrast cloud types and relate cloud types to weather conditions. • compare and contrast types of precipitation • compare and contrast weather-related phenomena, including	**Essential Questions** • What is the composition of the air? • What are air pressure, temperature, and humidity? • How does the atmosphere change with altitude? • How do natural and human-caused events impact the atmosphere? • What influences does air pressure temperature and humidity have on weather? • What information do clouds provide about atmosphere change with altitude? **Essential Understandings** • Air is a mixture of gaseous elements and compounds. These include nitrogen, oxygen, water, argon and carbon dioxide. Nitrogen makes up the largest proportion of air. • Air exerts pressure. Air pressure decreases as altitude increases. • Moisture in the air is called humidity. • The atmosphere is made up of layers (troposphere, stratosphere, mesosphere, and thermosphere) that have distinct characteristics. • Temperature decreases as altitude increases in the lowest layer of the atmosphere. • Most of the air that makes up the atmosphere is found in the troposphere (the lowest layer). Virtually all weather takes place there. • Forest fires and volcanic eruptions are two natural processes that affect Earth's atmosphere. Many gaseous compounds and particles are released into the atmosphere by human activity. All of the effects of these materials are not yet fully understood. • The amounts of thermal energy and water vapor in the air and the pressure of the air largely determine what the weather conditions are. • Clouds are important indicators of atmospheric conditions. Clouds are found at various levels within the troposphere. Three major types of clouds are cumulus, stratus, and cirrus.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	thunderstorms, tornadoes, hurricanes, and drought. • interpret basic weather maps and make forecasts based on the information presented. • map the movement of cold and warm fronts and interpret their effects on observable weather conditions. **Key Vocabulary** air pressure altitude atmosphere barometric pressure climate cirrus clouds cold front cumulonimbus clouds cumulus clouds drought forecast humidity hurricanes mesosphere ozone precipitation stratosphere stratus clouds temperature thermosphere thunderstorms tornadoes troposphere warm front weather weather system	• Ozone, a form of oxygen, can form near the surface when exhaust pollutants react with sunlight. This pollutant can cause health problems. Naturally occurring ozone is also found in the upper atmosphere and helps to shield Earth from ultraviolet radiation. • Maintaining good air quality is a crucial goal for modern society, and it is everyone's responsibility to work toward it. • Weather maps show much useful information about descriptive air measurements, observations, and boundaries between air masses (fronts). The curved lines showing areas of equal air pressure and temperature are key features of weather maps. Weather maps are important for understanding and predicting the weather.

6.7 Overview

Standard 6.7 is intended to provide students with a basic understanding of how natural processes and human interactions impact watershed systems. This includes an understanding of the physical geography of Virginia's portions of the three major watershed systems (the Chesapeake Bay, the North Carolina sounds, and the Gulf of Mexico) and the various features associated with moving water (surface and groundwater). Wetlands have become an important focus of scientists as we learn their role in flood and erosion control as well as their importance as habitat for many species of living things. Students are introduced to major safety and conservation issues associated with watersheds and become familiar with the testing parameters and tools used in the field. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Watershed Systems (Suggested Time: 15 blocks) **SOL Reporting Category** Ecosystems **Virginia SOL 6.7** The student will investigate and understand the natural processes and human interactions that affect watershed systems. Key concepts include a) the health of ecosystems and the abotic factors of a watershed; b) the location and structure of Virginia's regional watershed systems; c) divides, tributaries, river systems, and river and stream processes; d) wetlands; e) estuaries; f) major conservation, health, and safety issues associated with watersheds; and g) water monitoring and analysis using field equipment including hand-held technology. **Foundational Standards** None	**The student will** • comprehend and apply basic terminology related to watersheds. • use topographic maps to determine the location and size of Virginia's regional watershed systems. • locate their own local watershed and the rivers and streams associated with it. • design an investigation to model the effects of stream flow on various slopes. • analyze and explain the functioning of wetlands and appraise the value of wetlands to humans. • explain what an estuary is and why it is important to people. • propose ways to maintain water quality within a watershed. • explain the factors that affect water quality in a watershed and how those factors can affect an ecosystem. • forecast potential water-related issues that may become important in the future. • locate and critique a media article or editorial (print or electronic) concerning water use or water	**Essential Questions** • What are the conditions necessary for the health of abiotic and biotic factors of the watershed? • How does land formation effect water flow through Virginia's watershed system? • How can the location and structure of Virginia regional watershed system be described? • What is the importance of wetlands and estuaries in Virginia watershed systems? • What are the major conservation, health, and safety issues associated with watersheds? • How is water monitoring and analysis using field equipment useful for watershed conservation? **Essential Understandings** • An ecosystem is made up of the biotic (living) community and the abiotic (nonliving) factors that affect it. The health of an ecosystem is directly related to water quality. • Abiotic factors determine ecosystem type and its distribution of plants and animals as well as the usage of land by people. Abiotic factors include water supply, topography, landforms, geology, soils, sunlight, and air quality/O_2 availability. • Human activities can alter abiotic components and thus accelerate or decelerate natural processes. For example, people can affect the rate of natural erosion. Plowing cropland can cause greater erosion, while planting trees can prevent it. Flood protection/wetland loss is another example. • A watershed is the land that water flows across or through on its way to a stream, lake, wetland, or other body of water. Areas of higher elevations, such as ridgelines and divides, separate watersheds. • The three major regional watershed systems in Virginia lead to the Chesapeake Bay, the North Carolina sounds, or the Gulf of Mexico.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	quality. Analyze and evaluate the science concepts involved. • argue for and against commercially developing a parcel of land containing a large wetland area. Design and defend a land-use model that minimizes negative impact. • measure, record, and analyze a variety of water quality indicators and describe what they mean to the health of an ecosystem. **Key Vocabulary** abiotic biotic conservation dissolve ecosystem erosion estuaries flood plains habitat landforms nutrients pH reservoir runoff salinity stream surface water topographic map tributaries turbidity water quality watershed wetlands	• River systems are made up of tributaries of smaller streams that join along their courses. Rivers and streams generally have wide, flat, border areas, called flood plains, onto which water spills out at times of high flow. • Rivers and streams carry and deposit sediment. As water flow decreases in speed, the size of the sediment it carries decreases. • Wetlands form the transition zone between dry land and bodies of water such as rivers, lakes, or bays. Both tidal and nontidal wetlands perform important water quality functions, including regulating runoff by storing flood waters; reducing erosion by slowing down run-off; maintaining water quality by filtering sediments, trapping nutrients, and breaking down pollutants; and recharging groundwater. They also provide food and shelter for wildlife and fish and nesting and resting areas for migratory birds. • Estuaries perform important functions, such as providing habitat for many organisms and serving as nurseries for their young. • The Chesapeake Bay is an estuary where fresh and salt water meet and are mixed by tides. It is the largest estuary in the contiguous United States and one of the most productive. • Water quality monitoring is the collection of water samples to analyze chemical and/or biological parameters. Simple parameters include pH, temperature, salinity, dissolved oxygen, turbidity, and the presence of macroinvertebrate organisms.

6.8 Overview

Standard 6.8 is intended to provide students with a basic understanding of the solar system and the relationships among bodies within the solar system. This standard develops an understanding of Earth as part of the solar system and builds significantly on standards 3.8, 4.7, and 4.8. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit The Solar System (Suggested Time: 15 blocks) **SOL Reporting Category** Earth and Space Systems **Virginia SOL 6.8** The student will investigate and understand the organization of the solar system and the interactions among the various bodies that comprise it. Key concepts include a) the sun, moon, Earth, other planets and their moons, dwarf planets, meteors, asteroids, and comets; b) relative size of and distance between planets; c) the role of gravity; d) revolution and rotation; e) the mechanics of day and night and the phases of the moon; f) the unique properties of Earth as a planet; g) the relationship of Earth's tilt and the seasons; h) the cause of tides; and i) the history and technology of space exploration. **Foundational Standards** 3.8 The student will investigate and understand basic patterns and cycles occurring in nature.	**The student will** • describe the planets and their relative positions from the sun. • compare the characteristics of Pluto to the planets and explain its designation as a dwarf planet. • design and interpret a scale model of the solar system. (A scale model may be a physical representation of an object or concept. It can also be a mathematical representation that uses factors such as ratios, proportions, and percentages.) • explain the role of gravity in the solar system. • compare and contrast revolution and rotation and apply these terms to the relative movements of planets and their moons. • model and describe how day and night and the phases of the moon occur. • model and describe how Earth's axial tilt and its annual orbit around the sun cause the seasons. • describe the unique characteristics of planet Earth. • discuss the relationship between the gravitational pull of the moon and the cycle of tides.	**Essential Questions** • What are the components of the solar system? • What characteristics distinguish different celestial bodies (meteors, asteroids, comets, dwarf planets, and other planets moons) in our solar system? • How do we distinguish between planets with very different physical properties? • What are some distinguishing characteristics of Earth as a planet? • How do we differentiate between the rotation, revolution, and axial tilt of the 8 planets? • How would scientist prove that we see phases of the moon because of the moon's rotation and axial tilt? • What is the relationship between the Earth's tilt and the seasons? • How does the relationship between Earth and the moon's movements create tides? • How has the development of technology influenced scientific knowledge and views of the solar system over time? **Essential Understandings** • The solar system consists of the sun, moon, Earth, other planets and their moons, meteors, asteroids, and comets. Each body has its own characteristics and features. • The distance between planets and sizes of the planets vary greatly. The outer, "gas" planets are very large, and the four inner planets are comparatively small and rocky. • Gravity is a force that keeps the planets in motion around the sun. Gravity acts everywhere in the universe. • Planets revolve around the sun, and moons revolve around planets. A planet rotates upon an axis. • A dwarf planet revolves around the sun, and can maintain a nearly round shape as planets do, but it cannot move other objects away from its orbital

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
4.7 The student will investigate and understand the organization of the solar system. 4.8 The student will investigate and understand the relationships among Earth, the moon, and the sun.	• compare and contrast the ideas of Ptolemy, Aristotle, Copernicus, and Galileo related to the solar system. • create and interpret a timeline highlighting the advancements in solar system exploration over the past half century. This should include information on the first modern rockets, artificial satellites, orbital missions, missions to the moon, Mars robotic explorers, and exploration of the outer planets. **Key Vocabulary** asteroids axis comet eclipse ellipses galaxy geocentric gravitational pull heliocentric Jovian or gas planets meteor Northern Hemisphere revolution rotation Southern Hemisphere star terrestrial planets Universe wanes (waning) waxes (waxing)	neighborhood. • As Earth rotates, different sides of Earth face toward or away from the sun, thus causing day and night, respectively. • The phases of the moon are caused by its position relative to Earth and the sun. • Earth is a rocky planet, extensively covered with large oceans of liquid water and having frozen ice caps in its polar regions. Earth has a protective atmosphere consisting predominantly of nitrogen and oxygen and has a magnetic field. The atmosphere and the magnetic field help shield Earth's surface from harmful solar radiation. Scientific evidence indicates that Earth is about 4.5 billion years old. • Seasons are caused by a combination of the tilt of Earth on its axis, the curvature of Earth's surface and, thus, the angle at which sunlight strikes the surface of Earth during its annual revolution around the sun. • Tides are the result of the gravitational pull of the moon and sun on the surface waters of Earth. • The ideas of Ptolemy, Aristotle, Copernicus, and Galileo contributed to the development of our understanding of the solar system. • With the development of new technology over the last half-century, our knowledge of the solar system has increased substantially.

6.9 Overview

Standard 6.9 is intended to develop student understanding of the importance of Earth's natural resources, the need to manage them, how they are managed, and the analysis of costs and benefits in making decisions about those resources. It applies and builds on the concepts described in several lower grades, especially science standard 4.9. Knowledge gained from this standard will be important to understanding numerous concepts in Life Science and Earth Science. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and an understanding of the nature of science (6.1) in the context of the key concepts presented in this standard.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
Unit Watershed Systems (Suggested Time: Infused with SOL 6.2 and 6.7) **SOL Reporting Category** Earth and Space Systems **Virginia SOL 6.9** The student will investigate and understand public policy decisions relating to the environment. Key concepts include a) management of renewable resources; b) management of nonrenewable resources; c) the mitigation of land-use and environmental hazards through preventive measures; and d) cost/benefit tradeoffs in conservation policies. **Foundational Standards** 4.9 The student will investigate and understand important Virginia natural resources.	**The student will** • differentiate between renewable and nonrenewable resources. • describe the role of local and state conservation professionals in managing natural resources. These include wildlife protection; forestry and waste management; and air, water, and soil conservation. • analyze resource-use options in everyday activities and determine how personal choices have costs and benefits related to the generation of waste. • analyze how renewable and nonrenewable resources are used and managed within the home, school, and community. • analyze reports, media articles, and other narrative materials related to waste management and resource use to determine various perspectives concerning the costs/benefits in real-life situations. • evaluate the impact of resource use, waste management, and pollution prevention in the school and home environment. **Key Vocabulary** contamination conserve	**Essential Questions** • Why is it important that natural resources be managed? • What are some environmental issues we are currently debating? • How are renewable and nonrenewable resources managed? • Why must we consider the cost / benefit tradeoffs of environmental decisions? **Essential Understandings** • People, as well as other living organisms, are dependent upon the availability of clean water and air and a healthy environment. • Local, state, and federal governments have significant roles in managing and protecting air, water, plant, and wildlife resources. • Modern industrial society is dependent upon energy. Fossil fuels are the major sources of energy in developed and industrialized nations and should be managed to minimize adverse impacts. • Many renewable and nonrenewable resources are managed by the private sector (private individuals and corporations). • Renewable resources should be managed so that they produce continuously. Sustainable development makes decisions about long-term use of the land and natural resources for maximum community benefit for the longest time and with the least environmental damage. • Regulations, incentives, and voluntary efforts help conserve resources and protect environmental quality. • Conservation of resources and environmental protection begin with individual acts of stewardship. • Use of renewable (water, air, soil, plant life, animal life) and nonrenewable resources (coal, oil, natural gas, nuclear power, and mineral resources) must be considered in terms of their cost/benefit tradeoffs. • Preventive measures, such as pollution prevention or thoughtfully planned and enforced land-use restrictions, can reduce the impact of potential problems in the future.

Curriculum Information	Essential Knowledge, Skills, and Processes; Key Vocabulary	Essential Questions and Understandings
	depleted extinction incentives mismanaged natural resources pollutants pollution prevention regulations species stewardship voluntary waste waste management	• Pollution prevention and waste management are less costly than cleanup.