3rd Grade

Science Pacing Guide

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NOTICE
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The *2018 Virginia Science Standards of Learning Curriculum Framework* can be found on the Virginia Department of Education's website at http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml

Introduction

The *2018 Virginia Science Standards of Learning Curriculum Framework* amplifies the *Science Standards of Learning for Virginia Public Schools* (SOL) and defines the content knowledge, skills, and understandings that provide a foundation in science concepts and practices. The framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers as they plan their lessons by identifying enduring understandings and defining the essential science and engineering practices students need to master. This framework delineates in greater specificity the minimum content requirements that all teachers should teach and all students should learn.

School divisions should use the framework as a resource for developing sound curricular and instructional programs. This framework should not limit the scope of instructional programs. Additional knowledge and skills that can enrich instruction and enhance students' understanding of the content identified in the SOL should be included in quality learning experiences.

The framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the framework. Students are expected to continue to apply knowledge and skills from the SOL presented in previous grades as they build scientific expertise.

The Board of Education recognizes that school divisions will adopt a K–12 instructional sequence that best serves their students. The design of the SOL assessment program, however, requires that all Virginia school divisions 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 SOL tests, for which students may earn verified units of credit, are administered in a locally determined sequence.

Each topic in the framework is developed around the SOL. The format of the framework facilitates teacher planning by identifying the enduring understandings and the scientific and engineering practices that should be the focus of instruction for each standard. The categories of scientific and engineering practices appear across all grade levels and content areas. Those categories are: asking questions and defining problems; planning and carrying out investigations; interpreting, analyzing, and evaluating data; constructing and critiquing conclusions and explanations; developing and using models; and obtaining, evaluating, and communicating information. These science and engineering practices are embedded in instruction to support the development and application of science content.

Science and Engineering Practices

Science utilizes observation and experimentation along with existing scientific knowledge, mathematics, and engineering technologies to answer questions about the natural world. Engineering employs existing scientific knowledge, mathematics, and technology to create, design, and develop new devices, objects, or technology to meet the needs of society. By utilizing both scientific and engineering practices in the science classroom, students develop a deeper understanding and competence with techniques at the heart of each discipline.

Engineering Design Practices

Engineering design practices are similar to those used in an inquiry cycle; both use a system of problem solving and testing to come to a conclusion. However, unlike the inquiry cycle in which students ask a question and use the scientific method to answer it, in the engineering and design process, students use existing scientific knowledge to solve a problem. Both include research and experimentation; however, the engineering design process has a goal of a solving a societal problem and may have multiple solutions. More information on the engineering and design process can be found at https://www.eie.org/overview/engineering-design-process.

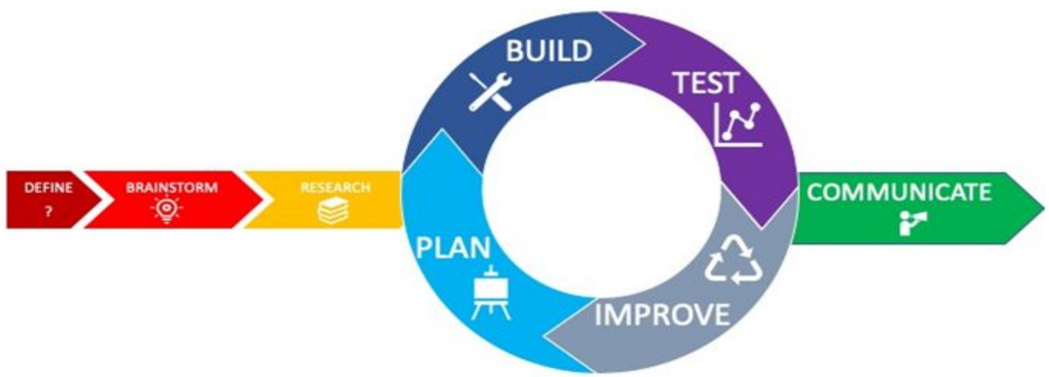

Figure 1: Engineering Design Process image based on the National Aeronautics and Space Administration (NASA) engineering design model.

The Engineering Design Process:

1. Define: Define the problem, ask a question
2. Imagine: Brainstorm possible solutions
3. Research: Research the problem to determine the feasibility of possible solutions
4. Plan: Plan a device/model to address the problem or answer the question
5. Build: Build a device/model to address the problem or answer the question
6. Test: Test the device/model in a series of trials
   - Does the design meet the criteria and constraints defined in the problem?
     i. Yes? Go to Share (#8)
     ii. No? Go to Improve (#7)
7. Improve: Using the results of the test, brainstorm improvements to the device/model; return to #3
8. Share: Communicate your results to stakeholders and the public

Computational Thinking

The term *computational thinking* is used throughout this framework. Computational thinking is a way of solving problems that involves logically organizing and classifying data and using a series of steps (algorithms). Computational thinking is an integral part of Virginia's computer science standards and is explained as such in the *Computer Science Standards of Learning:*

> *Computational thinking is an approach to solving problems that can be implemented with a computer. It involves the use of concepts, such as abstraction, recursion, and iteration, to process and analyze data, and to create real and virtual artifacts. Computational thinking practices such as abstraction, modeling, and decomposition connect with computer science concepts such as algorithms, automation, and data visualization. [Computer Science Teachers Association & Association for Computing Machinery]*

Students engage in computational thinking in the science classroom when using both inquiry and the engineering design process. Computational thinking is used in laboratory experiences as students develop and follow procedures to conduct an investigation.

Structure of the 2018 Virginia Science Standards of Learning Curriculum Framework

The framework is divided into two columns: Enduring Understandings and Essential Knowledge and Practices. The purpose of each column is explained below.

Enduring Understandings
The Enduring Understandings highlight the key concepts and the big ideas of science that are applicable to the standard. These key concepts and big ideas build as students advance in their scientific and engineering understanding. The bullets provide the context of those big ideas at that grade or content level.

Essential Knowledge and Practices
Each standard is expanded in the Essential Knowledge and Practices column. What each student should know and be able to do as evidence of understanding of the standard is identified here. This is not meant to be an exhaustive list nor is a list that limits what is taught in the classroom. It is meant to be the key knowledge and practices that define the standard. Science and engineering practices are highlighted with a leaf bullet (see footer).

The *2018 Virginia Science Standards of Learning Curriculum Framework* is informed by the Next Generation Science Standards (https://www.nextgenscience.org/).

Grade Three

Interactions in our world

The focus of science in third grade is interactions in our world. Students continue to study forces and matter by learning about simple machines and by examining the interactions of materials in water. They also look at how plants and animals, including humans, are constantly interacting with living and nonliving aspects of the environment. This includes examining how adaptations satisfy life needs and the importance of water, soil, and the sun in the survival of plants and animals. Throughout the elementary years, students will develop scientific skills, supported by mathematics and computational thinking, as they learn science content. In third grade, students will develop more sophisticated skills in posing questions and predicting outcomes, planning and conducting simple investigations, collecting and analyzing data, constructing explanations, and communicating information about the natural world. Students begin to use the engineering design process to apply their scientific knowledge to solve problems.

Scientific and Engineering Practices

Engaging in the practices of science and engineering helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the many ways to investigate, model, and explain the world. These scientific and engineering practices include the use of scientific skills and processes to explore the content of science as outlined in the *Science Standards of Learning*. The engineering design practices are the application of science content to solve a problem or design an object, tool, process, or system. These scientific and engineering practices are critical to science instruction and are to be embedded throughout the year.

Scientific and Engineering Practices — ALL YEAR
SOL 3.1

3.1 The student will demonstrate an understanding of scientific and engineering practices by

a) asking questions and defining problems
- ask questions that can be investigated and predict reasonable outcomes
- ask questions about what would happen if a variable is changed
- define a simple design problem that can be solved through the development of an object, tool, process, or system

b) planning and carrying out investigations
- with guidance, plan and conduct investigations
- use appropriate methods and/or tools for collecting data
- estimate length, mass, volume, and temperature
- measure length, mass, volume, and temperature in metric and U.S. Customary units using proper tools
- measure elapsed time
- use tools and/or materials to design and/or build a device that solves a specific problem

c) interpreting, analyzing, and evaluating data
- organize and represent data in pictographs or bar graphs
- read, interpret, and analyze data represented in pictographs and bar graphs
- analyze data from tests of an object or tool to determine if it works as intended

d) constructing and critiquing conclusions and explanations
- use evidence (measurements, observations, patterns) to construct or support an explanation
- generate and/or compare multiple solutions to a problem
- describe how scientific ideas apply to design solutions

e) developing and using models
- use models to demonstrate simple phenomena and natural processes
- develop a model (e.g., diagram or simple physical prototype) to illustrate a proposed object, tool, or process

f) obtaining, evaluating, and communicating information
- read and comprehend reading-level appropriate texts and/or other reliable media
- communicate scientific information, design ideas, and/or solutions with others

Force, Matter, and Energy — Weeks 5-9
SOL 3.2

3.2 The student will investigate and understand that the direction and size of force affects the motion of an object. Key ideas include

a) multiple forces may act on an object;
b) the net force on an object determines how an object moves;
c) simple machines increase or change the direction of a force; and
d) simple and compound machines have many applications.

Central Idea: Forces between objects can cause a change in motion. A machine is any device that helps people do work by changing the direction or the size of the force.

Vertical Alignment: In second grade, students discover how forces affect them in daily life. They are introduced to the indirect forces, magnetism and gravity (2.2). In fifth grade, students will explore the effect of direct and indirect forces on the motion of an object. At that time, students learn about energy transformations in collisions and collect and record time and position data of a moving object (5.2, 5.3, 5.4).

Enduring Understandings	Essential Knowledge and Practices
Forces between objects can cause a change in motion. • Forces are pushes or pulls that can cause objects to move, stop moving, change speed, or change direction. Gravity is an example of a pulling force (3.2 a). • Friction is a force that opposes the motion of an object (3.2 a). • The net force is the combination of all the forces acting on an object (3.2 b). Students are not expected to calculate net force. • Whether an object stays still or moves often depends on the effects of multiple pushes or pulls. An object at rest typically has multiple forces acting on it, but they result in a zero net force on the object. Forces that do not sum to zero net force can cause changes in the objects speed or direction of motion (3.2 b). Students are not expected to calculate net force.	In order to meet this standard, it is expected that students will • describe the relative size and direction of forces acting upon an object (3.2 a, b) • plan and conduct an investigation concerning the effect forces have on an object's motion (3.2 b) • explain how humans use machines to make work easier (3.2 c,d) • differentiate and classify the six types of simple machines (i.e., lever, inclined plane, wedge, wheel and axle, screw, and pulley) found in school and household items (3.2 c) • collaboratively plan an investigation to demonstrate the direction of the forces acting on a lever, pulley, and inclined plane as they relate to net forces; design a model labeling identified forces (3.2 c) • plan and conduct an experiment that compares the relative force required to move an object with and without the aid of a simple machine (3.2 b, c)

SOL 3.2 Continued	
Enduring Understandings	Essential Knowledge and Practices
• Simple machines are devices that change the direction or size of a force (3.2 c). • Compound machines contain more than one simple machine (3.2 d).	identify a common task that might be easier if done with a simple machine; collaboratively design and build an apparatus that incorporates simple machines to accomplish the task, and explain how the apparatus works and the importance of using simple machines (3.2 c) • explain how simple machines work together to form a compound machine (3.2 c, d) • identify compound machines and the simple machines that comprise them within the school and household environment (3.2 c, d).

3.3 The student will investigate and understand how materials interact with water. Key ideas include
a) solids and liquids mix with water in different ways; and
b) many solids dissolve more easily in hot water than in cold water.

Central Idea: Many substances interact in water; when substances dissolve in water, a solution is formed. The dissolved substance is still present even though it cannot be seen.

Vertical Alignment: Students explore characteristics of three phases of matter and the effect heating and cooling have on each phase in second grade (2.3). In fifth grade, students expand upon this knowledge as they learn matter has properties and interactions (5.7).

Enduring Understandings	Essential Knowledge and Practices
Water dissolves more substances than any other liquid. Some liquids will mix with water, while others will not. • Dissolving is when a substance is distributed evenly throughout another substance. The substance being dissolved breaks down into smaller pieces that cannot be seen (3.3 a). • Some solids will dissolve in water while others will not (3.3 a). • Substances dissolve faster in hot water than cold water because hot water has more energy than cold water. When water is heated, the molecules gain energy and, thus, move faster. As the molecules move faster, they make contact with the sugar more often, causing it to dissolve faster (3.3 b). *Students do not need to know the terms* solute, solvent, atoms, molecules, or particles.	In order to meet this standard, it is expected that students will • plan and conduct an investigation to identify liquid materials that will mix with water (3.3 a) • classify liquids by their ability to mix with water (3.3 a) • plan and conduct an investigation to determine solids that will dissolve in water (3.3 a) • classify solids based on their ability to dissolve in water (3.3 b) • plan and conduct an investigation to determine the effect of water temperature on the dissolving of a solid (3.3 b).

3.7 The student will investigate and understand that there is a water cycle and water is important to life on Earth. Key ideas include a) there are many reservoirs of water on Earth; b) the energy from the sun drives the water cycle; and c) the water cycle involves specific processes.	
Central Idea: Water is essential to Earth processes. The water cycle is a model that illustrates how water is conserved within environments. **Vertical Alignment:** In second grade, students examine matter in different phases and discover that heating and cooling can cause a change in the phase of matter (2.3). In fourth grade, students investigate Virginia watersheds, studying the importance of rivers, bays, lakes, and the Atlantic Ocean (4.7, 4.8).	
Enduring Understandings	Essential Knowledge and Practices
The water cycle is a chain of events that repeats. The cycling of water ensures its availability for life processes. • Water is essential for life on Earth (3.7). • The water cycle is important because its process provides Earth with the natural, continual water supply all living things need to survive (3.7 a, b, c). • The water cycle is the continuous movement of water on, in, and above Earth. As with all cycles, it does not have a specific beginning or end point. While water does circulate from one point or state to another in the water cycle, the paths it can take are variable. The energy that drives the water cycle comes from the sun (3.7 b). • During the water cycle, liquid water is heated and changed to a gas (water vapor) by a process called *evaporation.* The gas (water vapor) is cooled and changed back to a liquid by a process known as *condensation*, or it can form ice crystals (solid). Water falls to the ground as a liquid or a solid through a process called *precipitation* (3.7 c).	In order to meet this standard, it is expected that students will • identify the ways organisms get water from the environment (3.7) • compare major waterways including rivers, lakes, ponds, oceans, groundwater, and wells (3.7 a) • identify and locate major water sources in the local community (3.7 a) • identify the origin of energy that drives the water cycle (3.7 b) • describe the processes of evaporation, condensation, and precipitation as these relate to the water cycle (3.7 c) • construct and interpret a model of the water cycle (3.7 c).

Living Systems and Processes: Organisms & Living Systems and Processes: Ecosystems. Weeks 22-27 SOL 3.4 & 3.5

3.4 The student will investigate and understand that adaptations allow organisms to satisfy life needs and respond to the environment. Key ideas include

a) populations may adapt over time;
b) adaptations may be behavioral or physical; and
c) fossils provide evidence about the types of organisms that lived long ago as well as the nature of their environments.

Central Idea: Lasting changes (adaptations) in populations of organisms take place gradually over long periods of time (often thousands to millions of years). These changes are due to changes in the genetic makeup of populations.
Vertical Alignment: Students learn how living organisms are part of a system and interact with other living organisms and their surroundings in second grade (2.4). In fourth grade, students learn how internal and external structures enable organisms to obtain energy and reproduce (4.2).

Enduring Understandings	Essential Knowledge and Practices
Organisms possess physical characteristics and behaviors that enable them to survive in their environment and obtain resources to meet basic needs and carry out life processes. • Adaptations are physical features or behaviors that aid organisms in survival (3.4 b). • A population is a group of organisms of the same kind that live in the same place (3.4 a). • For populations to survive, their life needs must be met. This includes finding food, defending themselves, and reproducing (3.4 b). • Populations may adapt (over long periods of time) due to changes in their environment. If populations do not adapt to environmental changes or do not move to a new environment, they will not survive (3.4 a). • Physical adaptations help animals survive in their environment. An example is camouflage, a means by which animals escape the notice of predators, usually because of a resemblance to their surroundings using coloration or outer coverage patterns. Another example of a physical adaptation is the webbed feet of a swimming bird such as a duck (3.4 b). • Fossils are the remains or impressions of organisms preserved in a petrified form or as a mold or cast in rock. Paleontologists can use fossil evidence to make inferences about life and conditions of the past (3.4 c).	In order to meet this standard, it is expected that students will • provide an example of how an environmental change may affect the ability of a population to survive (3.4 a) • explain how populations may adapt over time in response to changes in the environment (3.4 a) • differentiate between physical and behavioral adaptations (3.4 b) • explain how an animal's behavioral adaptations help it live in its habitat (3.4 b) • compare the physical characteristics of animals and explain how they are adapted to their environment (3.4 b) 🍃 design and construct a model of a habitat for an animal with a specific adaptation (3.4 b) • explain the role of fossils in making inferences about organisms and the environment from long ago (3.4 c).

3.5 The student will investigate and understand that aquatic and terrestrial ecosystems support a diversity of organisms. Key ideas include

a) ecosystems are made of living and nonliving components of the environment; and
b) relationships exist among organisms in an ecosystem.

Central Idea: Ecosystems are diverse in both their living and nonliving components. These complex environments lead to a diversity of organisms that engage in a variety of relationships as they strive to meet life needs.

Vertical Alignment: Students are introduced to the concept that living things are a part of a system that provides resources necessary for survival in second grade (2.5). In fourth grade, students examine how organisms interact with each other and with the nonliving environment (with a specific focus on ocean environments) and how food webs can illustrate the energy pathways in an ecosystem (4.3).

Enduring Understandings	Essential Knowledge and Practices
All ecosystems are affected by complex biotic and abiotic interactions involving exchange in matter and energy. • An ecosystem supports a diversity of organisms that interact with each other and their nonliving environment (3.5 a, b). • Water-related ecosystems include those with fresh water or salt water. Examples include ponds, marshes, swamps, streams, rivers, and oceans (3.5). • Dry-land ecosystems include deserts, grasslands, rain forests, and forests (3.5). • There are distinct differences in the nonliving and living components that make up pond, marshland, swamp, stream, river, ocean, desert, grassland, rainforest, and forest ecosystems (3.5 a). • Organisms depend on each other and on the nonliving components in their environment. They often compete for limited resources (3.5 b). • Nonliving components of an environment include sunlight, water, nutrients, soil, and air (3.5 b). *Students are not expected to identify additional nonliving components in third grade.* • A food chain shows a feeding relationship among organisms in a specific area or environment that illustrates the flow of energy in the ecosystem. The arrows in a food chain illustrate the flow of energy from one organism to another. The arrows always point to the organism doing the eating (receiving the energy) (3.5 b).	In order to meet this standard, it is expected that students will • describe basic living and nonliving components in different types of terrestrial and aquatic ecosystems (3.5 a) • compare plants and animals that compose aquatic and terrestrial ecosystems (3.5 a) • differentiate among producers, consumers, and decomposers and identify examples of each within aquatic and terrestrial ecosystems (3.5 b) • construct and analyze a food chain that models the relationships and the flow of energy within an ecosystem (3.5 b) • explain how a change in one part of a food chain might affect the rest of the food chain (3.5 b) • identify the sun as the source of energy in food chains (3.5 b).

Earth and Space: Soil & Earth Resources — Weeks 28-33
SOL 3.6 & 3.8

3.6 The student will investigate and understand that soil is important in ecosystems. Key ideas include
a) soil, with its different components, is important to organisms; and
b) soil provides support and nutrients necessary for plant growth.

Central Idea: Soil is often referred to as dirt; however, it is a complex combination of organic and inorganic materials.

Vertical Alignment: Students learn about soil erosion and how plants help reduce erosion in second grade (2.8). In fourth grade, students expand on the importance of soil as a natural resource in Virginia (4.8).

Enduring Understandings	Essential Knowledge and Practices
Soil is composed of different components that have properties that support organisms within an ecosystem. • Soil is important because it provides support, nutrients, and a habitat for organisms (3.6 a, b). • Rock, clay, silt, sand, humus, air, and water are components of soil (3.6 a). • Plants and animals need nutrients to live and grow (3.6 a). • Soil is important because many plants grow in soil, and it provides support and nutrients for the plants (3.6 b).	In order to meet this standard, it is expected that students will • explain the importance of soil to an ecosystem (3.6 a, b) • analyze and describe the different components of soil (3.6 a) • plan and conduct an investigation that determines how different types of soil affect plant growth (3.6 b).

3.8 The student will investigate and understand that natural events and humans influence ecosystems. Key ideas include

a) human activity affects the quality of air, water, and habitats;
b) water is limited and needs to be conserved;
c) fire, flood, disease, and erosion affect ecosystems; and
d) soil is a natural resource and should be conserved.

Central Idea: Human behaviors and natural disasters can negatively affect organisms and their habitats. Conservation practices can lessen the effects of human activity and natural disasters on the environment.

Vertical Alignment: Students learn that organisms are interdependent with their living and nonliving surroundings in second grade. Students also learn that habitats change over time due to many influences (2.5). In fourth grade, students investigate issues that affect the local watershed (4.8).

Enduring Understandings	Essential Knowledge and Practices
A variety of factors can affect an ecosystem; human actions may reduce the effects of these factors on an ecosystem. • Human actions (e.g., polluting, clearing large plots of land to build neighborhoods or plant crops, over-fertilizing lawns, burning fossil fuels) can negatively affect the survival of organisms in an ecosystem (3.8 a). • Humans can make choices that reduce their impact on an environment (3.8 a). • The water supply on Earth is limited. Pollution reduces the amount of usable water; therefore, the supply should be conserved (3.8 b). • Natural occurrences (e.g., earthquakes, forest fires, tornadoes, hurricanes, floods, coastal erosion, disease) can harm the organisms in an environment (3.8 c). • Humans cannot eliminate natural occurrences, but they can take steps to reduce their impact. Mitigation measures such as adoption of zoning, land-use practices, and building codes can prevent or reduce damage (3.8 c). • Conservation is the careful use and preservation of natural resources. Humans need to help conserve limited resources (3.8 b, d). • Since soil takes a long time to form, it should be conserved, not wasted (3.8 d).	In order to meet this standard, it is expected that students will • analyze the effects of human influences on the quality of air, water, and habitats (3.8 a) • describe the effects of fire, flood, disease, and erosion on organisms and habitats (3.8 c) • explain how conservation efforts can reduce the negative impacts of human activity on a habitat (3.8 a) • propose a solution or design a device that will reduce the impact of a human activity or a natural event on an ecosystem (3.8 a, c) • research, explain, and communicate methods of water conservation to be used in homes and schools (3.8 b) • observe water use in the school setting and identify possible water conservation solutions (3.8 b) • collaboratively design and implement a plan to conserve water at home or at school (3.8 b) • observe and provide evidence of soil erosion around the schoolyard or community; create and implement a plan to reduce erosion (3.8 d).