1st Grade

Science Pacing Guide

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Waynesboro PUBLIC SCHOOLS

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Based on the 2018 VDOE Curriculum Framework:

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.

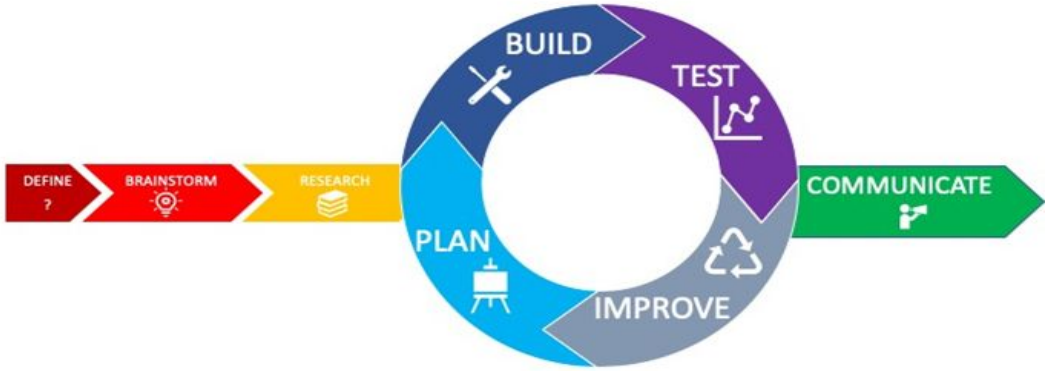

Figure 1: Engineering Design Process image based on the National Aeronautics and Space Administration (NASA) engineering design model.

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 One

How I interact with my world

In first-grade science, students become aware of factors that affect their daily lives. Students continue to learn about the basic needs of all living things and that living things respond to factors in their environment, including weather and the change of season. They continue the examination of matter by observing physical properties and how materials interact with light. Throughout the elementary years, students will develop scientific skills, supported by mathematics and computational thinking, as they learn science content. In first grade, students will develop skills in posing simple questions, conducting simple investigations, observing, classifying, and communicating information about the natural world. Students are introduced to the engineering design process.

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
SOL 1.1

ALL YEAR

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

a) asking questions and defining problems
- ask questions and make predictions based on observations
- identify a simple problem that can be solved through the development of a new tool or improved object

b) planning and carrying out investigations
- with guidance, conduct investigations to produce data
- identify characteristics and properties of objects by observations
- use tools to measure relative length, weight, volume, and temperature of common objects

c) interpreting, analyzing, and evaluating data
- use and share pictures, drawings, and/or writings of observations
- describe patterns and relationships
- classify and arrange objects based on a single physical characteristic or property
- organize and represent various forms of data using tables, picture graphs, and object graphs
- read and interpret data displayed in tables, picture graphs, and object graphs, using the vocabulary *more, less, fewer, greater than, less than, and equal to*

d) constructing and critiquing conclusions and explanations
- make simple conclusions based on data or observations
- recognize unusual or unexpected results

e) developing and using models
- use physical models to demonstrate simple phenomena and natural processes

f) obtaining, evaluating, and communicating information
- communicate observations and data using simple graphs, pictures, drawings, numbers, speech and/or writing

Living Systems: Life Needs SOL 1.5	Weeks 10-12

1.5 The student will investigate and understand that animals, including humans, have basic life needs that allow them to survive. Key ideas include

a) animals need air, food, water, shelter, and space (habitat);
b) animals have different physical characteristics that perform specific functions; and
c) animals can be classified based on a variety of characteristics.

Central Idea: Energy and matter are needed for all organisms to survive. Animals use matter and energy to move, eat, breathe, and reproduce. Each type of animal has characteristics that allow it to function in unique and specific ways to obtain food, reproduce, and survive in its environment. These characteristics are used to classify animals.

Vertical Alignment: Students learn about classifying things as living and nonliving in kindergarten (K.6). In kindergarten, students also learn about the basic needs and life processes of animals (K.7). In second grade, students learn more about the life cycles as they learn the series of orderly changes of animal growth and development (2.4). Students learn that organisms and their living and nonliving surroundings are interdependent (2.5).

Enduring Understandings	Essential Knowledge and Practices
Energy and matter are required for all organisms to survive. • Animals, including humans, have basic life needs, including air, food, water, shelter, and space (habitat) (1.5 a). • Animals, including humans, have a variety of physical characteristics that help them survive. These include - appendages such as arms, legs, wings, fins, and tails which extend from the body and have specific functions - body coverings which include hair, fur, feathers, scales, and shells (1.5 b). Students will not need to classify animals by their groups (reptiles, birds, mammals, etc.). • Physical characteristics can also determine - whether an animal lives in water or on land (e.g., scales and fins that allow fish to live in water or fur and legs that allow dogs to live on land) - their method of movement which may include walking, crawling, flying, and swimming (1.5 b). • Animals can be classified based on characteristics (1.5 c).	In order to meet this standard, it is expected that students will • describe the life needs of animals, including air, food, water, shelter, and space (1.5 a) • identify physical characteristics of an animal (1.5 b) design and construct a model of a habitat for an animal based on physical characteristics (1.5 a) observe animals in the schoolyard and describe their physical properties (1.5 b) predict what type of home (land or water) an animal would live in based on its physical characteristics (1.5 b) group animals using similar characteristics and explain the grouping (1.5 c).

1.7 The student will investigate and understand that there are weather and seasonal changes. Key ideas include

a) changes in temperature, light, and precipitation occur over time;
b) there are relationships between daily weather and the season; and
c) changes in temperature, light, and precipitation affect plants and animals, including humans.

Central Idea: Repeating patterns are clues to cause-and-effect relationships and provide the opportunity to make predictions. In this standard, students look at how changes in temperature, light, and precipitation can help predict the weather (which affects plants and animals).

Vertical Alignment: In kindergarten, students investigate and understand that there are patterns in nature such as daily weather, seasonal changes, and day and night (K.9). In second grade, students investigate and understand that weather patterns and seasonal changes affect plants, animals, and their surroundings and that these changes can happen quickly or slowly (2.6, 2.7).

Enduring Understandings	Essential Knowledge and Practices
Repeating patterns in nature, or events that occur together with regularity, are clues to cause-and-effect relationships. • The daily weather is composed of light, temperature, and precipitation (1.7 a). • Weather patterns and the amount of sunlight determine the seasons (1.7 b). • Seasonal changes in plants include budding, growth, and losing leaves (1.7 c). • Seasonal changes in animals include hibernation (e.g., bats and frogs) and migration (e.g., birds and butterflies), resulting in changes in habitat (1.7 c). Students do not need to know the terms migration, hibernation, and habitat. • The body coverings of some animals change with the seasons. This includes thickness of fur and coloration (1.7 c). • Changes made by people include their dress and recreation (1.7 c).	In order to meet this standard, it is expected that students will • identify types of precipitation as rain, snow, and ice and describe the temperature conditions of each type of precipitation (1.7 a) observe, record, and compare seasonal data throughout the year, including relative temperature, amount of precipitation, and relative amount of sunlight (1.7 a, b) represent data in tables and graphic displays to describe typical weather conditions during a season (1.7 b) observe and record seasonal changes in plants, including budding, growth, and losing leaves; recognize the seasons during which budding and losing leaves will most likely occur (1.7 c) • compare the physical characteristics of some common plants during summer and winter (1.7 c) • compare the activities of some common animals during summer and winter by describing changes in their behaviors and their body coverings (1.7 c) infer the season based on humans' dress and recreational activities (1.7 c).

Matter: Physical Properties SOL 1.3	Weeks 16-17

1.3 The student will investigate and understand that objects are made from materials that can be described by their physical properties. Key ideas include

a) objects are made of one or more materials with different physical properties and can be used for a variety of purposes;
b) when a material is changed in size most physical properties remain the same; and
c) the type and amount of material determine how much light can pass through an object.

Central Idea: Different materials may have different physical properties; these properties are used to describe and classify objects.
Vertical Alignment: Students are introduced to objects having physical properties, which include color, shape or form, texture, and size in kindergarten (K.3). Students relate this concept directly to water as they learn the properties of water, to include an introduction of phases (K.4). In second grade, students further explore characteristics of three phases of water and the effect heating and cooling have on each phase (2.3).

Enduring Understandings	Essential Knowledge and Practices
Objects can be described and compared by their properties. • Objects are made of one or more materials. These materials can be described by their properties. These properties include light transfer, texture, weight, length, color, and odor (1.3 a). • Different properties are suited for different purposes (1.3 a). • Most properties of materials remain the same regardless of their visible size. Physical properties such as how much light passes through a material, color, texture, odor, ability to dissolve in water remain the same; however, properties such as mass, volume, and length change when the size changes (1.3 b). • Some materials allow light to pass through them, others allow only some light through, and others block all the light. For materials that allow light to pass through, adding more of that material can change the amount of light that passes through (1.3 c). *Students are not required to know the terms* translucent, transparent, *and* opaque.	In order to meet this standard, it is expected that students will make and communicate observations about the physical properties of materials (1.3 a) classify objects based on physical properties and explain how the objects were classified (1.3 a) • recognize that an object may be composed of different materials and these materials have different physical properties (1.3 a) analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose (1.3 a) • compare the physical properties of larger and smaller samples of the same material (1.3 b) • identify uses for different materials based on the amount of light that passes through each (1.3 a, c) with guidance, conduct an investigation to determine how the type and amount of material affects how much light can pass through an object (1.3 c).

Force, Motion, and Energy SOL 1.2	Weeks 18-19

1.2 The student will investigate and understand that objects can move in different ways. Key ideas include
a) objects may have straight, circular, spinning, and back-and-forth motions; and
b) objects may vibrate and produce sound.

Central Idea: Forces between objects can cause objects to move or have a change in their motion. In this standard, students explore the different ways that objects can move. Students also learn that it is possible to produce sound when objects vibrate.

Vertical Alignment: Students are introduced to the concept of forces in kindergarten as they explore the relationship between the strength of pushes and pulls and the motion of objects (K.2). In second grade, students are introduced to indirect forces (magnetism and gravity) and how these forces affect them (2.2).

Enduring Understandings	Essential Knowledge and Practices
Forces between objects can cause a change in motion. • Objects may move in straight, circular, spinning (rotational), and back-and-forth motions (1.2 a). • One kind of back-and-forth motion is vibration. An object's vibrations may create sound (1.2 b). • Sound can make matter vibrate, and vibrating matter can make sound (1.2 b).	In order to meet this standard, it is expected that students will make and communicate observations about the ways objects move (1.2 a) • compare the movement of two different objects (1.2 a) design a device that uses movement to transfer an object from one location to another (1.2 a) make and communicate observations of an object with rapid back-and-forth motion (vibration) (1.2) • describe the relationship between vibration and sound (1.2 b) with guidance, plan and conduct an investigation that addresses the question of whether vibrating objects create sound (1.2 b).

Living Systems: Plants SOL 1.4	Weeks 28-29

1.4 The student will investigate and understand that plants have basic life needs and functional parts that allow them to survive. Key ideas include

a) plants need nutrients, air, water, light, and a place to grow;
b) structures of plants perform specific functions; and
c) plants can be classified based on a variety of characteristics.

Central Idea: Energy and matter are needed for all organisms to survive. Plants use matter and energy to grow and reproduce. Each type of plant has characteristics that allow it to function in unique and specific ways in its environment. These characteristics are used to classify plants.

Vertical Alignment: Students learn that all organisms need food to survive in kindergarten and first grade (K.7, 1.4, 1.5). Students in first grade are introduced to the concept that plants and animals have both physical features and behaviors that help them to survive in their environments. In second grade, students investigate and understand plant life cycles (2.4). Students learn that plants produce oxygen and food for other living things, are a source of useful products, and provide benefits in nature (2.8).

Enduring Understandings	Essential Knowledge and Practices
Energy and matter are required for all organisms to survive. • Plants have basic needs, including nutrients, air, water, light, and space to grow (1.4 a). • Plants have different structures such as stems, roots, leaves, and flowers. These structures serve different functions in growth, survival, and reproduction (1.4 b). • Plants can be classified by their characteristics (1.4 c).	In order to meet this standard, it is expected that students will • describe the basic life needs of plants (1.4 a) with guidance, plan and conduct an investigation to determine if plants need sunlight and water to grow (1.4 a) • explain the functions of the root, stem, and leaf (1.4 b) create and interpret a physical model/drawing of a plant, including roots, stems, leaves, and flowers to identify and explain the functions of each plant part (1.4 b) classify plants by characteristics (1.4 c).

Earth Resources SOL 1.8	Weeks 30-31

1.8 The student will investigate and understand that natural resources can be used responsibly. Key ideas include

a) most natural resources are limited;
b) human actions can affect the availability of natural resources; and
c) reducing, reusing, and recycling are ways to conserve natural resources.

Central Idea: Our natural resources, including clean water, clean air, and undeveloped land, are limited. If we want to enjoy these resources in the future, we need to take care of them now.

Vertical Alignment: Students understand that materials can be reused, recycled, and conserved in kindergarten. This concept establishes the foundation for increasingly advanced conservation concepts (K.11). This standard builds on that initial introduction to reusing and recycling. In second grade, the content focuses on plants as important natural resources (2.8).

Enduring Understandings	Essential Knowledge and Practices
Natural resources are limited and should be conserved. • People use natural resources in their daily lives (1.8 a). • There are a variety of natural resources, which include plants, animals, water, air, land, minerals, forests, and soil. Many of these resources are limited (1.8 a). • The decisions that people make about using natural resources makes a difference in how long natural resources last (1.8 b). • Natural resources can be conserved by reducing our use of materials, reusing items, or recycling (1.8 c).	In order to meet this standard, it is expected that students will • identify natural resources such as plants, animals, water, air, land, forests, minerals, and soil (1.8 a) • compare ways of conserving resources (1.8 c) determine a resource in the school or home that may be conserved, brainstorm solutions, and implement a plan to address the conservation concern (1.8 a, b, c).

Earth and Space Systems SOL 1.6	Weeks 32-33

1.6 The student will investigate and understand that there is a relationship between the sun and Earth. Key ideas include
a) the sun is the source of energy and light that warms the Earth's land, air, and water; and
b) the sun's relative position changes in the Earth's sky throughout the day.

Central Idea: The sun is a source of energy that provides light and warmth for Earth and can be seen in different locations of the sky throughout the day.

Vertical Alignment: In kindergarten, students conduct weather investigations and understand that light influences temperature on Earth's surfaces and can cause shadows (K.9). In second grade, students investigate and understand types of weather and weather patterns and measure and record current weather data (2.7).

Enduring Understandings	Essential Knowledge and Practices
The sun is the primary source of energy for Earth and provides the Earth with light and warmth. • Energy from the sun warms the land, air, and water by transferring energy (warmth) to the Earth (1.6 a). • Patterns of the motion of the sun in the sky can be observed, described, and predicted. The sun's relative position in the morning is in the eastern sky and in the late afternoon is in the western sky (1.6 b). Students are not expected to learn about the Earth's rotation.	In order to meet this standard, it is expected that students will with guidance, conduct simple investigations to show how sunlight changes the temperature of land, air, and water (1.6 a) observe where the sun rises in the morning and sets in the evening and describe the pattern (1.6 b) with guidance, conduct a simple investigation to show how the sunlight changes the temperature at different times during the day (1.6 b) design a structure to reduce the change in temperature that occurs in sunlight throughout the day (1.6 a, b) use observations of the sun to describe patterns that can be predicted (1.6 a, b).