# Kindergarten Science Standards of Learning for Virginia Public Schools – January 2010

## Introduction

The *Science Standards of Learning* for Virginia Public Schools identify academic content for essential components of the science curriculum at different grade levels. Standards are identified for kindergarten through grade five, for middle school, and for a core set of high school courses — Earth Science, Biology, Chemistry, and Physics. Throughout a student's science schooling from kindergarten through grade six, content strands, or topics are included. The Standards of Learning in each strand progress in complexity as they are studied at various grade levels in grades K-6, and are represented indirectly throughout the high school courses. These strands are

- Scientific Investigation, Reasoning, and Logic;
- Force, Motion, and Energy;
- Matter;
- Life Processes;
- Living Systems;
- Interrelationships in Earth/Space Systems;
- Earth Patterns, Cycles, and Change; and
- Earth Resources.

Five key components of the science standards that are critical to implementation and necessary for student success in achieving science literacy are 1) Goals; 2) K-12 Safety; 3) Instructional Technology; 4) Investigate and Understand; and 5) Application. It is imperative to science instruction that the local curriculum consider and address how these components are incorporated in the design of the kindergarten through high school science program.

## Goals

The purposes of scientific investigation and discovery are to satisfy humankind's quest for knowledge and understanding and to preserve and enhance the quality of the human experience. Therefore, as a result of science instruction, students will be able to achieve the following objectives:

1. Develop and use an experimental design in scientific inquiry.
2. Use the language of science to communicate understanding.
3. Investigate phenomena using technology.
4. Apply scientific concepts, skills, and processes to everyday experiences.

5. Experience the richness and excitement of scientific discovery of the natural world through the collaborative quest for knowledge and understanding.
6. Make informed decisions regarding contemporary issues, taking into account the following:
    - public policy and legislation;
    - economic costs/benefits;
    - validation from scientific data and the use of scientific reasoning and logic;
    - respect for living things;
    - personal responsibility; and
    - history of scientific discovery.
7. Develop scientific dispositions and habits of mind including:
    - curiosity;
    - demand for verification;
    - respect for logic and rational thinking;
    - consideration of premises and consequences;
    - respect for historical contributions;
    - attention to accuracy and precision; and
    - patience and persistence.
8. Develop an understanding of the interrelationship of science with technology, engineering and mathematics.
9. Explore science-related careers and interests.

**K-12 Safety**

In implementing the *Science Standards of Learning*, teachers must be certain that students know how to follow safety guidelines, demonstrate appropriate laboratory safety techniques, and use equipment safely while working individually and in groups.

Safety must be given the highest priority in implementing the K-12 instructional program for science. Correct and safe techniques, as well as wise selection of experiments, resources, materials, and field experiences appropriate to age levels, must be carefully considered with regard to the safety precautions for every instructional activity. Safe science classrooms require thorough planning, careful management, and constant monitoring of student activities. Class enrollment should not exceed the designed capacity of the room.

Teachers must be knowledgeable of the properties, use, and proper disposal of all chemicals that may be judged as hazardous prior to their use in an instructional activity. Such information is referenced through Materials Safety Data Sheets (MSDS). The identified precautions involving the use of goggles, gloves, aprons, and fume hoods must be followed as prescribed.

While no comprehensive list exists to cover all situations, the following should be reviewed to avoid potential safety problems. Appropriate safety procedures should be used in the following situations:

- observing wildlife; handling living and preserved organisms; and coming in contact with natural hazards, such as poison ivy, ticks, mushrooms, insects, spiders, and snakes;
- engaging in field activities in, near, or over bodies of water;
- handling glass tubing and other glassware, sharp objects, and labware;
- handling natural gas burners, Bunsen burners, and other sources of flame/heat;
- working in or with direct sunlight (sunburn and eye damage);
- using extreme temperatures and cryogenic materials;
- handling hazardous chemicals including toxins, carcinogens, and flammable and explosive materials;
- producing acid/base neutralization reactions/dilutions;
- producing toxic gases;
- generating/working with high pressures;
- working with biological cultures including their appropriate disposal and recombinant DNA;
- handling power equipment/motors;
- working with high voltage/exposed wiring; and
- working with laser beam, UV, and other radiation.

The use of human body fluids or tissues is generally prohibited for classroom lab activities. Further guidance from the following sources may be referenced:

- OSHA (Occupational Safety and Health Administration);
- ISEF (International Science and Engineering Fair) rules; and
- public health departments' and school divisions' protocols.

**Instructional Technology**

The use of current and emerging technologies is essential to the K-12 science instructional program. Specifically, technology must accomplish the following:

- Assist in improving every student's functional literacy. This includes improved communication through reading/information retrieval (the use of

telecommunications), writing (word processing), organization and analysis of data (databases, spreadsheets, and graphics programs), presentation of one's ideas (presentation software), and resource management (project management software).

- Be readily available and regularly used as an integral and ongoing part of the delivery and assessment of instruction.
- Include instrumentation oriented toward the instruction and learning of science concepts, skills, and processes. Technology, however, should not be limited to traditional instruments of science, such as microscopes, labware, and data-collecting apparatus, but should also include computers, robotics, video-microscopes, graphing calculators, probeware, geospatial technologies, online communication, software and appropriate hardware, as well as other emerging technologies.
- Be reflected in the "instructional strategies" generally developed at the school division level.

In most cases, the application of technology in science should remain "transparent" unless it is the actual focus of the instruction. One must expect students to "do as a scientist does" and not simply hear about science if they are truly expected to explore, explain, and apply scientific concepts, skills, and processes.

As computer/technology skills are essential components of every student's education, it is important that teaching these skills is a shared responsibility of teachers of all disciplines and grade levels.

**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*.

**Application**

Science provides the key to understanding the natural world. The application of science to relevant topics provides a context for students to build their knowledge and make connections across content and subject areas. This includes applications of science among technology, engineering, and mathematics, as well as within other science disciplines. Various strategies can be used to facilitate these applications and to promote a better understanding of the interrelated nature of these four areas.

# Kindergarten

The kindergarten standards stress the use of basic science skills to explore common materials, objects, and living things and will begin the development of an understanding that scientific knowledge is based on evidence. Emphasis is placed on using the senses to gather information. Students are expected to develop skills in posing simple questions, measuring, sorting, classifying, and communicating information about the natural world. The science skills are an important focus as students learn about life processes and properties of familiar materials, such as magnets and water. Through phenomena including shadows, patterns of weather, and plant growth, students are introduced to the concept of change. The significance of natural resources and conservation is introduced in the kindergarten standards.

### Scientific Investigation, Reasoning, and Logic

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

a) basic characteristics or properties of objects are identified by direct observation;
b) observations are made from multiple positions to achieve different perspectives;
c) a set of objects is sequenced according to size;
d) a set of objects is separated into two groups based on a single physical characteristic;
e) nonstandard units are used to measure the length, mass, and volume of common objects;
f) observations and predictions are made for an unseen member in a sequence of objects;
g) a question is developed and predictions are made from one or more observations;
h) observations are recorded;
i) picture graphs are constructed;
j) unusual or unexpected results in an activity are recognized; and
k) objects are described both pictorially and verbally.

K.2 The student will investigate and understand that humans have senses that allow them to seek, find, take in, and react or respond to information in order to learn about their surroundings. Key concepts include

a) the five senses and corresponding sensing organs; and
b) sensory descriptors used to describe common objects and phenomena.

**Force, Motion, and Energy**

K.3 The student will investigate and understand that magnets have an effect on some materials, make some things move without touching them, and have useful applications. Key concepts include
a) magnetism and its effects; and
b) useful applications of magnetism.

**Matter**

K.4 The student will investigate and understand that the position, motion, and physical properties of an object can be described. Key concepts include
a) colors of objects;
b) shapes and forms of objects;
c) textures and feel of objects;
d) relative sizes and weights of objects; and
e) relative positions and speed of objects.

K.5 The student will investigate and understand that water flows and has properties that can be observed and tested. Key concepts include
a) water occurs in different phases;
b) water flows downhill; and
c) some materials float in water, while others sink.

**Life Processes**

K.6 The student will investigate and understand the differences between living organisms and nonliving objects. Key concepts include
a) all things can be classified as living or nonliving; and
b) living organisms have certain characteristics that distinguish them from nonliving objects including growth, movement, response to the environment, having offspring, and the need for food, air, and water.

K.7 The student will investigate and understand basic needs and life processes of plants and animals. Key concepts include
a) animals need adequate food, water, shelter, air, and space to survive;
b) plants need nutrients, water, air, light, and a place to grow to survive;
c) plants and animals change as they grow, have varied life cycles, and eventually die; and
d) offspring of plants and animals are similar but not identical to their parents or to one another.

**Interrelationships in Earth/Space Systems**

K.8 The student will investigate and understand that shadows occur when light is blocked by an object. Key concepts include
a) shadows occur in nature when sunlight is blocked by an object; and
b) shadows can be produced by blocking artificial light sources.

**Earth Patterns, Cycles, and Change**

K.9 The student will investigate and understand that there are simple repeating patterns in his/her daily life. Key concepts include
- a) weather observations;
- b) the shapes and forms of many common natural objects including seeds, cones, and leaves; and
- c) animal and plant growth.

K.10 The student will investigate and understand that change occurs over time and rates may be fast or slow. Key concepts include
- a) natural and human-made things may change over time; and
- b) changes can be observed and measured.

**Earth Resources**

K.11 The student will investigate and understand that materials can be reused, recycled, and conserved. Key concepts include
- a) materials and objects can be used over and over again;
- b) everyday materials can be recycled; and
- c) water and energy conservation at home and in school helps ensure resources are available for future use.