

# Scientific Investigation, Reasoning, and Logic SOL

The “Scientific Investigation, Reasoning, and Logic” strand runs through the Virginia SOL for Grades K–6. The first of the standards listed for each grade level falls into this strand. Beyond Grade 6, the first standard for each of the subsequent science courses also prescribes process skills for that course.

## TEACHING BASIC SCIENCE PROCESS SKILLS IN THE ELEMENTARY GRADES

This section of the curriculum packet begins with a content chapter, “Teaching the Science Process Skills,” discussing teaching the basic skills in elementary school. This section of the

packet also includes a lesson for Grade 3, “Lesson 8– Observing a Stream,” in which students practice the process skills of observation and communication. An earlier section of the curriculum packet, “How Can We Help Protect Our Water Resources?” contains another lesson for Grade 3, “Lesson 1 – Classifying Aquatic Debris,” in which students use the process skill of classification. The observing, communicating, and classifying skills are fundamental for the practice of science. The other basic science process skills of measuring, inferring, and predicting depend upon these, as does successful use of integrated science process skills.

### — SOME BASIC SCIENCE PROCESS SKILLS IN THE EARLY GRADES —

SOME PROCESS SKILLS	STANDARDS OF LEARNING
<p><b>Observing &amp; Communicating</b></p> <p><i>Kindergarten (K.1, K.2)</i></p> <p><i>Grade 1 (1.1)</i></p> <p><i>Grade 2 (2.1)</i></p> <p><i>Grade 3 (3.1)</i></p>	<ul style="list-style-type: none"> <li>• Identifying basic properties of objects by direct observation.</li> <li>• Describing objects pictorially and verbally.</li> <li>• Using the five senses to make observations.</li> <li>• Using descriptive words to describe observations made using the five senses.</li> <li>• Communicating observations and data orally and with simple graphs, pictures, written statements, and numbers.</li> <li>• Repeating observations to ensure accuracy.</li> <li>• Measuring.</li> <li>• Constructing picture graphs and bar graphs.</li> <li>• Making accurate metric measurements.</li> <li>• Gathering, charting, and graphing data using line plots, picture graphs, and bar graphs.</li> </ul>

## HOW CAN WE UNDERSTAND OUR WATER RESOURCES?

<b>Classifying</b> <i>Kindergarten (K.1)</i>	<ul style="list-style-type: none"><li>• Sequencing a set of objects according to size.</li><li>• Separating a set of objects into two groups based on a single physical attribute.</li></ul>
<i>Grade 1 (1.1)</i>	<ul style="list-style-type: none"><li>• Classifying and arranging both objects and events according to various attributes or properties.</li></ul>
<i>Grade 2 (2.1)</i>	<ul style="list-style-type: none"><li>• Classifying items using two or more attributes.</li></ul>
<i>Grade 3 (3.1)</i>	<ul style="list-style-type: none"><li>• Sequencing natural events chronologically.</li><li>• Classifying objects with similar characteristics into at least two sets and two subsets.</li></ul>

### TEACHING INTEGRATED SCIENCE PROCESS SKILLS IN GRADES 9 AND 10

This section of the curriculum packet contains two content chapters that discuss teaching integrated science process skills to high school students, “Analyzing Experimental Data” and “Designing an Experiment.” This section of the packet also contains two corresponding lessons, “Lesson 9 – Comparing Water Quality Data,” written for Grade 9 Earth Science, and “Lesson 10 – A Scientific Cleanup,” written for Grade 10 Biology.

Making inferences from observations and related data analysis skills are developed progressively through all the grade levels.

Analytical skills become a major focus in the Grade 9 Earth Science SOL. The Earth Science SOL also stress the use of technology, and so ninth grade was chosen as the most appropriate grade level for a lesson combining data analysis with the use of computer data sources and analysis tools. The skills of formulating questions and answering questions by experiments are also developed through the grade levels. The Grade 10 Biology SOL emphasize the importance of scientific research to validate or challenge ideas. Students should learn to design their own experimental tests as a logical follow-up to having developed proficiency in analyzing data provided from another source.

## HOW CAN WE UNDERSTAND OUR WATER RESOURCES?

### — INTEGRATING THE SCIENCE PROCESS SKILLS IN GRADES 9 AND 10 —

SOME PROCESS SKILLS	STANDARDS OF LEARNING
<b>Interpreting, Analyzing, and Evaluating Data</b> <i>Grade 9 Earth Science (ES.1, ES.2, ES.3)</i>	<ul style="list-style-type: none"><li>• Using technologies to collect, analyze, and report data.</li><li>• Constructing and interpreting scales, diagrams, maps, charts, graphs, tables, and profiles.</li><li>• Constructing and defending a scientific viewpoint.</li><li>• Recognizing that evidence is required to evaluate hypotheses and explanations.</li></ul>
<b>Designing and Carrying Out Experiments</b> <i>Grade 10 Biology (BIO.1)</i>	<ul style="list-style-type: none"><li>• Formulating hypotheses based on direct observations and information from the scientific literature.</li><li>• Defining variables and designing investigations to test hypotheses.</li><li>• Forming conclusions based on recorded quantitative and qualitative data.</li><li>• Constructing and defending a scientific viewpoint.</li></ul>

