Introducing the Virginia Standards of Learning

The complete set of items that appeared on the Spring 2000 Standards of Learning test taken by most public school students in Virginia is presented in the following pages. The intent of this release of these test questions is to provide parents and teachers additional information to accompany the Student Performance Report and/or the Parent Report.

The information accompanying each test question is broken into several components:

**Reporting Category:** Matches the score report and allows for identification of strengths and weaknesses indicated by student scores.

**Standard of Learning:** Presents the SOL used in developing the assessment question.

**Builds On:** Indicates what the student has studied in previous course work.

**Instruction:** Provides information for teachers to use as the SOL is incorporated into instruction.

The answer to each question can be found in the back of the booklet.
Earth Science

Reporting Category: Scientific Investigation

A. Standard of Learning: ES.1 The student will plan and conduct investigations in which:

a) volume, area, mass, elapsed time, direction, temperature, pressure, distance, density, and changes in elevation/depth are calculated utilizing the most appropriate tools.

Builds On: Work with these measurements begins with the second grade SOL and increases in complexity through the eighth grade SOL.

A student found the rock shown above and weighed it to determine its mass. What steps should the student take to find its density?

A. Determine its volume by how much water it displaces, then divide mass by volume.
B. Determine its volume by multiplying length \times width \times height, then divide mass by volume.
C. Crush the rock to a powder and measure its volume in a graduated cylinder, then divide mass by volume.
D. Determine its volume using the formula for the volume of a sphere \( V = \frac{4}{3} \pi r^3 \), then divide mass by volume.

**Instruction:** Provide students an opportunity to investigate how to measure mass and volume of objects and calculate density.
A. Standard of Learning: ES.1 The student will plan and conduct investigations in which:

c) scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted.

Builds On: Work with the construction and interpretation of diagrams, charts, and graphs in the first grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to interpret a chart to determine an alignment through a telescope and to interpret a table of values.

<table>
<thead>
<tr>
<th>Placement of Jupiter’s Moons As Seen from Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 1</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Europa</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Jupiter</td>
</tr>
</tbody>
</table>

The chart shows the placement of Jupiter's moons for the first nine days of February 1996. How would Jupiter and its moons appear on February 7 as seen through a telescope?

The table shows the most common elements in the Earth’s crust and the approximate percentage by weight that each one represents. Which statement is true?

- A. Iron is the most common metal in the crust.
- B. All eight elements are metals.
- C. Two elements comprise nearly 75% of the crust.
- D. Oxygen and silicon are found in equal amounts.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Percentage by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>46.6</td>
</tr>
<tr>
<td>Silicon</td>
<td>27.7</td>
</tr>
<tr>
<td>Aluminum</td>
<td>8.1</td>
</tr>
<tr>
<td>Iron</td>
<td>5.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>3.6</td>
</tr>
<tr>
<td>Sodium</td>
<td>2.8</td>
</tr>
<tr>
<td>Potassium</td>
<td>2.6</td>
</tr>
<tr>
<td>Magnesium</td>
<td>2.1</td>
</tr>
<tr>
<td>All others</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>
A. Standard of Learning: ES.1 The student will plan and conduct investigations in which:

c) scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted.

Builds On: Work with the construction and interpretation of diagrams, charts, and graphs in the first grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate the use of a scale to rank an earthquake and to interpret a graph to answer a question.
A. Standard of Learning: ES.1 The student will plan and conduct investigations in which:

d) variables are manipulated with repeated trials.

Builds On: Work with variables begins in the second grade and increases in complexity through the eighth grade SOL.

B. Standard of Learning: ES.3 The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery. Key concepts include:

a) maps (bathymetric, geologic, topographic, and weather) and star charts.

Builds On: Work with interpretation of maps begins in the third grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to determine the correct use of variables in an experimental design.

Instruction: Provide students an opportunity to interpret information from a star chart.
Earth Science

A. Standard of Learning: ES.3 The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery. Key concepts include:

d) location by latitude and longitude and topographic profiles.

Builds On: Work with latitude and longitude begins in the fourth grade SOL and increases in complexity through the eighth grade SOL.

![Topographic Map](image)

Which area of this map has the steepest slope?

A) A  
B) B  
C) C  
D) D

Instruction: Provide students an opportunity to interpret a topographic map.

Reporting Category: Geology

B. Standard of Learning: ES.5 The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Key concepts include:

a) properties including hardness, color and streak, luster, cleavage, fracture, and unique properties.

Builds On: Work with physical properties begins in the Kindergarten SOL and increases in complexity through the eighth grade SOL.

![Mineral Diagram](image)

Each mineral has a unique crystal shape because of the —

A) arrangement of its atoms  
B) hardness being between 1 and 10  
C) streak being constant  
D) variations in its color

Instruction: Provide students an opportunity to investigate the unique crystal shape of minerals through models, diagrams, and examples.
Earth Science

A. Standard of Learning: ES.5 The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Key concepts include:

b) uses of minerals.

Builds On: Work with minerals begins in the first grade SOL and continues to increase in complexity through the eighth grade SOL.

10 Glass is chemically related to what mineral?
   F) Fluorite
   G) Quartz
   H) Pyrite
   J) Halite

Instruction: Provide students an opportunity to investigate the chemical similarities between glass and quartz.

B. Standard of Learning: ES.6 The student will investigate and understand how to identify common rock types based on mineral composition and textures and the rock cycle as it relates to the transformation of rock types. Key concepts include:

a) igneous (intrusive and extrusive).

Builds On: Work with rock formations begins in the second grade SOL and increases in complexity through the eighth grade SOL.

11 Some extrusive igneous rocks, such as obsidian, are glassy because they —
   A) cool rapidly
   B) have low melting points
   C) contain water
   D) are made of only one mineral

12 This igneous rock is coarse-grained. The dark-colored mineral composing this rock is probably —

   F) magnetite
   G) kaolin
   H) feldspar
   J) quartz

Instruction: Provide students an opportunity to investigate common rocks and to identify mineral composition of igneous rocks.
Earth Science

A. Standard of Learning: ES.6 The student will investigate and understand how to identify common rock types based on mineral composition and textures and the rock cycle as it relates to the transformation of rock types. Key concepts include:

b) sedimentary (clastic and chemical).

Builds On: Work with rock formations begins in the second grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to analyze a rock cycle to determine the formation of sediment and to investigate causes of rock patterns.

B. Standard of Learning: ES.6 The student will investigate and understand how to identify common rock types based on mineral composition and textures and the rock cycle as it relates to the transformation of rock types. Key concepts include:

c) metamorphic (foliated and unfoliated) rocks.

Builds On: Work with rock formations begins in the second grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate the formation of igneous intrusions and metamorphic rock.
Earth Science

A. Standard of Learning: ES.7 The student will investigate and understand the differences between renewable and nonrenewable resources. Key concepts include:

b) advantages and disadvantages of various energy sources.

Builds On: Work with energy sources begins with the third grade SOL and continues to increase in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate the advantages and disadvantages of various energy sources.

16 Some towns in the United States have had to limit the number of wood-burning stoves for environmental reasons. What is the greatest problem caused by the use of wood-burning stoves?

F  The manufacture of the stoves requires iron, which is a rare metal.
G  The heat from the stoves causes thermal pollution.
H  The smoke from the stoves contributes to air pollution.
J  The wood is a scarce fossil fuel.

B. Standard of Learning: ES.7 The student will investigate and understand the differences between renewable and nonrenewable resources. Key concepts include:

c) resources found in Virginia.

Builds On: Work with resources found in Virginia begins with the fourth grade SOL and continues to increase in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate the major mineral resources of Virginia and to investigate the formation of anthracite.

17 Which of the following are some of the major mineral resources of Virginia?

A  Diamonds, sapphires, and rubies
B  Coal, granite, and limestone
C  Salt, haematite, and cobalt
D  Gold, silver, and copper

18 Plant material that accumulates and hardens on the floor of a swamp is known as peat. If a layer of sediments accumulates on top of the peat, its weight, after thousands of years, can compress the peat to form coal. Which of the following types of coal probably formed from the greatest pressure?

F  Anthracite (the hardest coal)
G  Bituminous coal (softer than anthracite)
H  Subbituminous coal (softer than bituminous)
J  Lignite (the softest coal)
Earth Science

A. Standard of Learning: ES.8 The student will investigate and understand geologic processes including plate tectonics. Key concepts include:

   a) how geologic processes are evidenced in the physiographic provinces of Virginia including the Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateau.

Builds On: Work with plate tectonics begins in the fifth grade SOL and increases in complexity through the eighth grade SOL.

In which province would clay, sand, and gravel deposits be found?
A  Appalachian Plateau  
B  Valley and Ridge  
C  Blue Ridge  
D  Coastal Plain

Instruction: Provide students an opportunity to investigate how the Fall Line affects a river and where clay, sand, and gravel deposits would be found in Virginia.
A. Standard of Learning: ES.8 The student will investigate and understand geologic processes including plate tectonics. Key concepts include:

b) processes (faulting, folding, volcanism, metamorphism, weathering, erosion, deposition, and sedimentation) and their resulting features.

Builds On: Work with weathering and erosion begins with the second grade SOL and increases in complexity through the eighth grade SOL.

**Instruction:** Provide students an opportunity to investigate how a river can cause erosion of rock; to investigate the formation of a delta; to investigate how the size of particles in the layer of a river bank are caused by the speed of the water; and to investigate possible causes of geysers.
Earth Science

A. Standard of Learning: ES.8 The student will investigate and understand geologic processes including plate tectonics. Key concepts include:

c) tectonic processes (subduction, rifting and seafloor spreading, and continental collision).

Builds On: Work with the geological processes of the ocean begin with the fourth grade SOL and increase in complexity through the eighth grade SOL.

B. Standard of Learning: ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include:

a) processes of soil development.

Builds On: Work with soil as a natural resource begins with the first grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate the chronological order of geologic events and to investigate a seismogram to understand primary and secondary waves.

Instruction: Provide students an opportunity to investigate porosity and permeability of soils.
Earth Science

A. Standard of Learning: ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include:

b) development of karst topography.

Builds On: Work with the effects of water on the Earth’s surface begins with the second grade SOL and continues with increasing complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate how the carbon dioxide in water can break down limestone.
Earth Science

A. Standard of Learning: ES.10 The student will investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils. Key concepts include:

b) superposition, cross-cutting relationships, and radioactive decay are methods of dating bodies of rock.

Builds On: Work with changes in the Earth’s surface begins in the second grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to interpret a map to locate areas with rocks of similar ages; to investigate the formation of rock in layers; and to drill core samples to determine the youngest layer.
A. Standard of Learning: ES.10 The student will investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils. Key concepts include:

c) absolute and relative dating have different applications but can be used together to determine the age of rocks and structures.

Builds On: Work with changes in the Earth’s surface begins in the second grade SOL and increases in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate drawings of rock formations to determine the sequencing of igneous intrusions.

Reporting Category: Meteorology, Oceanography, and Groundwater

B. Standard of Learning: ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include:

e) dependence on freshwater resources and the effects of human usage on water quality.

Builds On: Work with water quality and resources begins with the first grade SOL and continues in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to interpret a table to determine the amount of rainfall absorbed by land cover.

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Earth Science

A. Standard of Learning: ES.11 The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include:

- Physical and chemical changes (tides, waves, currents, sea level and ice cap variations, upwelling, and salinity concentrations).

Builds On: Work with the oceans begins in the fifth grade SOL and continues to increase in complexity through the eighth grade SOL.

34 The surface of the sea is not level due to all of the following except —
- F. currents
- G. tides
- H. salinity
- J. winds

35 The accumulated salts in seawater make the seawater much more dense than fresh water. One of the characteristics of salt water is that it has —
- A. higher levels of dissolved oxygen than fresh water
- B. a lower freezing point than fresh water
- C. decreased buoyancy for swimmers
- D. ninety elements that are easily extracted from seawater

Instruction: Provide students an opportunity to investigate what causes the surface of the sea not to be level; to investigate characteristics of salt water; and to interpret a table to determine the body of water with the greatest salinity.
Earth Science

A. Standard of Learning: ES.11 The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include:

b) importance of environmental, geologic, and economic implications.

Builds On: Work with the oceans begins in the fifth grade SOL and continues to increase in complexity through the eighth grade SOL.

B. Standard of Learning: ES.11 The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include:

c) systems interactions (energy transfer, weather, and climate).

Builds On: Work with the oceans begins in the fifth grade SOL and continues to increase in complexity through the eighth grade SOL.

37 Many species of the order Cetacea (whales, dolphins, and porpoises) have become so scarce that they are now protected under international law. Which of the following probably did not contribute to the decline in these populations?

A Whaling industry  
B Fishing nets  
C Ocean pollution  
D Greenhouse effect

Instruction: Provide students an opportunity to investigate the order Cetacea and the reasons why some of the species are protected under international law.

38 London and Irkutsk are located at approximately the same latitude. What would help explain why London experiences a more moderate range of temperatures than does Irkutsk?

F A large lake keeps Irkutsk cool  
G Irkutsk has fewer trees than London has  
H High mountains near London block cold winds  
J Warm ocean currents influence London’s climate

Instruction: Provide students an opportunity to investigate the effect of warm ocean currents on climate.
Earth Science

A. Standard of Learning: ES.11 The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include:

d) features of the seafloor (continental margins, trenches, mid-ocean ridges, and abyssal plains) reflect tectonic processes.

Builds On: Work with the oceans begins in the fifth grade SOL and continues to increase in complexity through the eighth grade SOL.

B. Standard of Learning: ES.11 The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include:

e) public policy issues concerning the oceans.

Builds On: Work with the oceans begins in the fifth grade SOL and continues to increase in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate how landmasses drifted over the Earth and formed trenches.

Instruction: Provide students an opportunity to investigate a need for regulations to sustain animal life in the ocean water based on information presented in a table.

As landmasses drifted over the Earth from 180 million years ago to the present day, one significant change that occurred was the —

A. increase in overall landmass size  
B. decrease in the number of transverse faults  
C. increase in the number of trenches  
D. decrease in the number of mid-ocean ridges

Concentration of Gases in Water

<table>
<thead>
<tr>
<th>Factors</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>A drop in water temperature increases solubility of gases.</td>
</tr>
<tr>
<td>Pressure</td>
<td>A rise in pressure increases the solubility of gases.</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>Increases concentration of $O_2$; decreases concentration of $CO_2$.</td>
</tr>
<tr>
<td>Decomposition</td>
<td>Increases concentration of $CO_2$; decreases concentration of $O_2$.</td>
</tr>
</tbody>
</table>

Oxygen must be dissolved in ocean water in order to sustain animal life. Using the above table as a guide, which human activity should be regulated because of the difficulty it causes for sea creatures to breathe?

F. Piping heated waste water into the ocean
G. Excessive motorboat traffic
H. Growing seaweed as a food source
J. Sticks diving around coral reefs
**A. Standard of Learning:** ES.12 The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include:

- a) scientific evidence for atmospheric changes over geologic time.

**Builds On:** Work with the interrelationships of weather (atmosphere) and processes begins with the first grade SOL and continues to increase in complexity through the eighth grade SOL.

**Instruction:** Provide students an opportunity to investigate a diagram of a core sample to determine the number of advances of ice.

**B. Standard of Learning:** ES.12 The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include:

- b) current theories related to the effects of early life on the chemical makeup of the atmosphere.

**Builds On:** Work with the interrelationships of weather (atmosphere) and processes begins with the first grade SOL and continues to increase in complexity through the eighth grade SOL.

**Instruction:** Provide students an opportunity to investigate how the change in life forms on Earth brought about the change in the composition of the atmosphere.
Earth Science

Reporting Category: Astronomy and Space Science

A. Standard of Learning: ES.4 The student will investigate and understand the characteristics of the Earth including:

c) position of the Earth in the solar system.

Builds On: Work with the relationship of the Earth and the sun begins in the first grade SOL and continues to increase in complexity through the eighth grade SOL.

Instruction: Provide students an opportunity to investigate the effect of the sun on the Earth relative to the tilt of the Earth.

This model shows the Earth’s position relative to the sun. At the time of year shown by the model, the areas receiving the most direct sunlight will be near the —

A Arctic Circle
B Tropic of Cancer
C Equator
D Tropic of Capricorn
Earth Science

A. Standard of Learning: ES.14 The student will investigate and understand the planets and other members of the solar system; the history and contributions of the space program; and concepts related to the origin and evolution of the solar system, galaxy, and universe. Key concepts include:

a) characteristics of the sun, planets, their moons, comets, meteors, and asteroids.

Builds On: Work with the solar system, including historical contributions, begins with the fourth grade SOL and increases in complexity through the eighth grade SOL.

The planet Uranus is unusual because its axis of rotation lies almost in the plane of its revolution. If the axis is pointing toward the sun as in the picture, what would occur at point X when the planet turns once on its axis?

F. The point would be in darkness for the complete rotation of the planet.
G. The point would be in daylight for the full rotation.
H. The point would be in twilight for the full rotation.
J. The point would be in daylight for half the time and in darkness for half the time.

If matter from Saturn would float in water, while matter from Earth would sink in water, which of the following is true?

F. Saturn is smaller than Earth.
G. Saturn is smaller than the Sun.
H. Saturn has a lower density than Earth.
J. Saturn has a higher density than Earth.

The moon rotates on its axis at the same rate that it revolves around the Earth. This causes —

A. very high tides
B. the phases of the moon
C. partial eclipses of the moon
D. one side of the moon to always face the Earth

Instruction: Provide students an opportunity to investigate the rotation and revolution of Uranus around the sun; to investigate the result of the rotation of the moon on its axis and its revolution around the Earth at the same rate; and to investigate the density of the planets.
**Earth Science**

**A. Standard of Learning:** ES.14 The student will investigate and understand the planets and other members of the solar system; the history and contributions of the space program; and concepts related to the origin and evolution of the solar system, galaxy, and universe. Key concepts include:

b) cosmology and the origin of stars and stellar systems (the Big Bang, the solar nebular theory, stellar evolution, star systems, nebulae, constellations, and galaxies).

**Builds On:** Work with the solar system, including historical contributions, begins with the fourth grade SOL and increases in complexity through the eighth grade SOL.

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**47 The Life Cycle of a Star**

Which of these stars has completed its life cycle?

A. Black dwarf
B. Supergiant
C. Main-sequence star
D. Red giant

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**48 What powers stars?**

F. Combustion
G. Fission
H. Fusion
J. Radioactivity

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**49 How are the stars distributed in space?**

A. Evenly distributed throughout space with no significant clumping
B. In clumps that are evenly distributed in space with scattered stars in between
C. In clumps that are themselves evenly distributed in space
D. In clumps that are themselves unevenly distributed in space

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**Instruction:** Provide students an opportunity to investigate the life cycle of a star; to investigate how stars are powered; to investigate how stars are distributed in space; and to investigate the relationship between stars over time.
Correct Answers

EARTH SCIENCE TEST

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