

Introducing the

Virginia Standards of Learning

End
of
Course

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.

Virginia
Standards of Learning Assessments

Earth Science

End
of
Course


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 1



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.

Earth Science

End of Course

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.

2 Placement of Jupiter's Moons As Seen from Earth

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?

F

G

H

J

3 Relative Abundance of Elements in Earth's Crust

Common Earth Elements	Percentage by Weight
Oxygen	46.6
Silicon	27.7
Aluminum	8.1
Iron	5.0
Calcium	3.6
Sodium	2.8
Potassium	2.6
Magnesium	2.1
All others	1.5
Total	100.0

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.

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

Earth Science

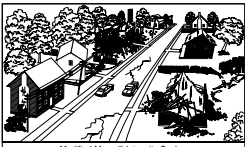
End of Course

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.

4



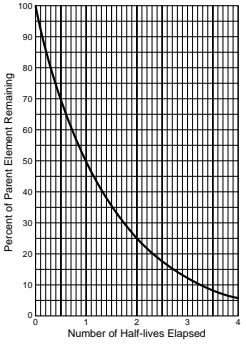
Modified Mercalli Intensity Scale

- I Not felt except by a very few under especially favorable circumstances.
- II Felt only by a few persons at rest, especially on upper floors of buildings.
- III Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize as an earthquake.
- IV During the day felt indoors by many, outdoors by few. Sensation like heavy truck striking building.
- V Felt by nearly everyone, many awakened. Disturbance of trees, poles, and other tall objects sometimes noticed.
- VI Felt by all; many frightened and run outdoors. Some heavy furniture moved; few instances of fallen plaster or damaged chimneys. Damage slight.
- VII Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures.
- VIII Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly-built structures. (Fall of chimneys, factory stacks, columns, monuments, and other vertically oriented features).
- IX Damage considerable in specially designed structures. Buildings shifted off foundations. Ground cracked conspicuously.
- X Some well-built wooden structures destroyed. Most masonry and frame structures destroyed with foundations. Ground badly cracked.
- XI Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground.
- XII Damage total. Waves seen on ground surfaces. Objects thrown upward into air.

How should the earthquake damage in the picture be ranked according to the modified Mercalli Intensity Scale?

F V
G VII
H IX
J XI

5



The graph shows the decay of radioactive isotopes. What approximate amount of the element remains after 3 half-lives have elapsed?

A 50.0%
B 25.0%
C 12.50%
D 6.25%

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.

Earth Science

End of Course

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.

A

6 Students want to compare the relative ability of four materials to absorb heat. The materials they have chosen are light-colored sand, black sand, clear water, and water that has been dyed black. They plan to heat the substances and then measure their temperatures every 10 minutes with a thermometer. Which experimental design would best suit their purpose?

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

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.

B

7

In mid-June the sun enters the constellation Gemini, which is not visible then because of the sun's brightness. According to this star chart, which of these constellations would not be visible in mid-June because of its closeness to the sun?

A Virgo
B Orion
C Ursa Major
D Aquarius

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

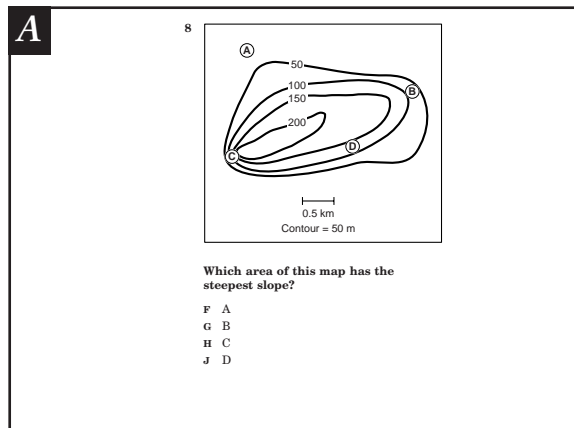
Earth Science

End of Course

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.



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.

B

9 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

End of Course

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.

A

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).

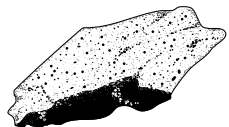
Builds On: Work with rock formations begins in the second grade SOL and increases in complexity through the eighth grade SOL.

B

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

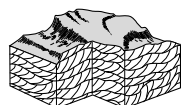
End of Course

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.

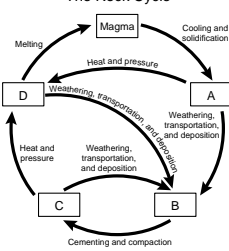
A 13



What probably caused the patterns in this rock?

- A Flowing water or wind deposits
- B Alternating lava and volcanic ash deposits
- C Evaporating salt water
- D Avalanches of soil and rock

14 The Rock Cycle



The chart shows the rock cycle. At which point in the cycle has the formation of sediment occurred?

- F A
- G B
- H C
- J D

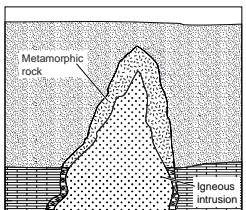
Instruction: Provide students an opportunity to analyze a rock cycle to determine the formation of sediment and to investigate causes of rock patterns.

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.

B 15



Sometimes metamorphic rock is found adjacent to an igneous intrusion, as shown in the drawing. According to geologists, what causes this phenomenon?

- A The metamorphic rock was lighter than the magma and floated to the top and sides.
- B The surrounding rock was metamorphosed when it came into contact with the hot magma.
- C Vapor from the magma condensed to form metamorphic rock.
- D The magma replaced all but the outer edge of existing metamorphic rock.

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

Earth Science

End of Course

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.

- A**
- 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.

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

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.

- B**
- 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 Sulfur, fluorite, 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)

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

Earth Science


End
of
Course

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.

A 19



In which province would clay, sand, and gravel deposits be found?

- A Appalachian Plateau
- B Valley and Ridge
- C Blue Ridge
- D Coastal Plain

20 From the Piedmont province to the Coastal Plain, the land drops as much as several hundred feet. This drop, which is abrupt in some places and gradual in others, is known as the Fall Line. What feature(s) would rivers exhibit when they cross the Fall Line?

- F Waterfalls and rapids
- G Sudden increases in water volume
- H Significantly higher water temperatures
- J Shallow beds and slow currents

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.

Earth Science

End of Course

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.

A

21

Which type of rock appears to be the most easily eroded by the river in this area?

A Limestone
B Shale
C Basalt
D Sandstone

23

The picture shows the layers in the bank of a river. The differences in the size of the particles in the layers are most likely caused by differences in the —

A speed of the water carrying the sediments
B types of plants living on the bank
C types of animals digging in the sediments
D thickness of winter ice in the river

22

Delta Formation

Which sequence best describes the construction of a delta from the youngest formation to the oldest formation?

F A-C-B-D
G C-A-D-B
H C-A-B-D
J B-D-A-C

24 Which of the following can result when underground water is heated by hot igneous rock?

F Metamorphism
G Geysers
H Salt domes
J Karst topography

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

End of Course

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

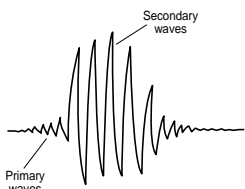
c) tectonic processes (subduction, rifting and seafloor spreading, and continental collision).

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.

A 25 Which geologic event occurred first?

- A Pangaea underwent formation.
- B South America and Africa split apart.
- C Iceland formed at the mid-Atlantic ridge.
- D India collided with Asia, forming the Himalayan Mountains.

26



The sketch above shows a seismogram, which is a record of the primary waves and secondary waves emitted by an earthquake. Primary waves and secondary waves are generated at the same time, but primary waves are recorded first because they —

- F travel a shorter route
- G travel faster
- H are smaller
- J do not travel through water

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

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.

B

27 Porosity is the amount of pore space in soils. Permeability is the ability of water to pass through the soil. Why do some soils have high porosity but low permeability?

- A Some soils have large pores that do not lead anywhere but simply hold groundwater.
- B Sandy soils dry out quickly, and the pore space fills with air which blocks the downward flow of water.
- C Some soils have a large volume of pore space, but the individual pores are too small to allow water to pass through.
- D Water with dissolved iron cannot pass through the magnetic field of soils that are rich in magnetite.

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

Earth Science

End of Course

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.

A

28 In Virginia and some other parts of the world, water has carved vast caverns out of underground limestone deposits. Water, however, must contain dissolved carbon dioxide in order to break down the limestone. What role does the carbon dioxide play?

F It supports the microscopic plant life that destroys the limestone.

G It raises the freezing point so the underground water continues to flow all winter.

H In water it forms an acid which reacts with limestone to produce a water-soluble substance.

J It reduces viscosity so the water flows more quickly.

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

Earth Science

End of Course

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.

A 29

Which other area would most likely contain rocks of the same age as those found around Christianburg?

A Floyd
B Pulaski
C Fairy Stone State Park
D Wytheville

31

Key

Clay Basalt Limestone Sandstone Siltstone

Scientists use drill core samples to study the underlying rock structure. These two core samples were obtained from the ocean floor from locations separated by 10 km. Which layer in core sample two is the youngest?

A Clay
B Limestone
C Sandstone
D Siltstone

30

Which aspect of this rock formation occurred at the earliest time?

F The top sedimentary layer labeled A
G The igneous intrusion labeled B
H The fault labeled C
J The folding of layers labeled D

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.

Earth Science

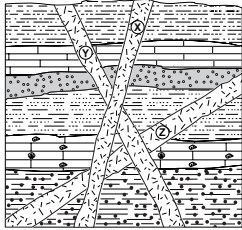
End of Course

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.

A 32



The drawing shows a rock formation with several igneous intrusions. What was the sequence of the intrusions from earliest to most recent times?

F X, Y, Z
G X, Z, Y
H Y, X, Z
J Z, Y, X

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 to increase in complexity through the eighth grade SOL.

B 33

Land Cover	Runoff
Grassland	10% - 50%
Crop land	30% - 70%
Bare clay soils	50% - 80%
Asphalt streets	70% - 95%

Which type of land cover absorbs the most rainwater?

A Grassland
B Crop land
C Bare clay soils
D Asphalt streets

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

Earth Science

End of Course

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:

a) 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.

A

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

36

Environmental Type	Salinity (parts per thousand)
Open Oceans	32-38 (mean = 35)
Shallow coastal areas	27-30 (brackish)
Estuaries	0-30
Semi-enclosed seas (e.g., Baltic Sea)	25 or less
Hypersaline environments (e.g., rock pools, tropical lagoons, Red Sea)	40 or more

Which of the following would have the greatest salinity?

- F Arctic
- G Atlantic
- H Mediterranean
- J Pacific

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

End of Course

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.

A

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.

B

38

← Cold current ← Warm current

Average Monthly Temperature

London (51° 09'N)

Irkutsk (52° 16'N)

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

End of Course

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.

A 39

Key:
 ~~~~~ mid-ocean ridges  
 - - - transverse faults  
 ——— trenches  
 ⇨ direction of drift

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

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

**B** 40

Concentration of Gases in Water

| Factors        | Effects                                                                |
|----------------|------------------------------------------------------------------------|
| Temperature    | A drop in water temperature increases the solubility of gases.         |
| Pressure       | A rise in pressure increases the solubility of gases.                  |
| Photosynthesis | Increases concentration of $O_2$ ; decreases concentration of $CO_2$ . |
| Decomposition  | Increases concentration of $CO_2$ ; decreases concentration of $O_2$ . |

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 Scuba diving around coral reefs

**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.

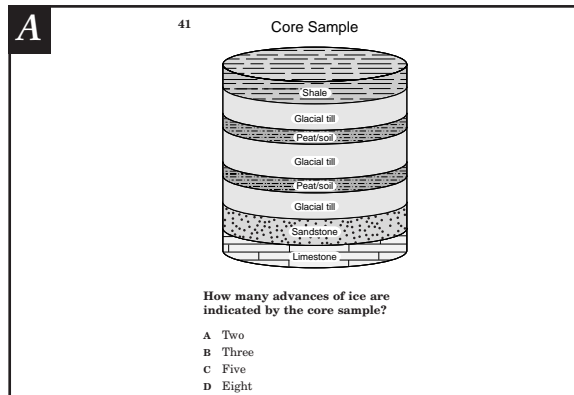
# Earth Science

## End of Course

**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.

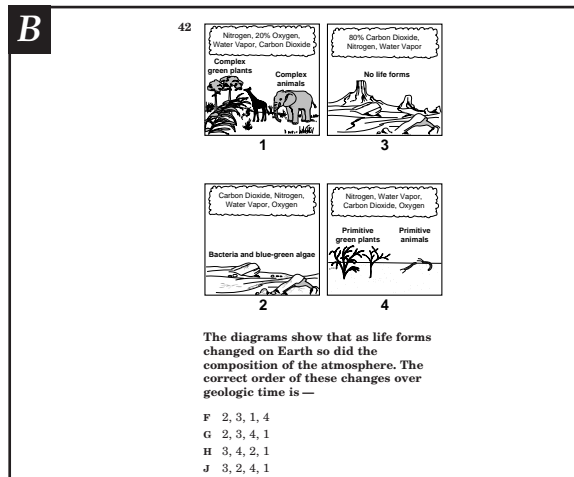


**Instruction:** Provide students an opportunity to investigate a diagram of a core sample to determine the number of advances of ice.

**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

End  
of  
Course

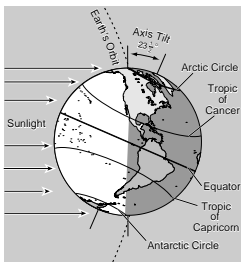
**Reporting Category:** Astronomy and Space Science

**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.

**A** 43



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

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

# Earth Science

## End of Course

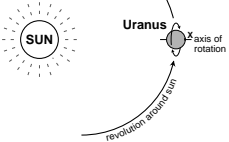
**A. Standard of Learning:** ES.14 The student will investigate and understand the planets and other members of the solar system; the history and contributions of the space program; and concepts related to the origin and evolution of the solar system, galaxy, and universe. Key concepts include:

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.

**A**

44



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.

46 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.

45 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

## End of Course

**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.

**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

**48 What powers stars?**

F Combustion  
G Fission  
H Fusion  
J Radioactivity

**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

**50**

The sequence of pictures above shows the same portion of the night sky over a number of years. Which of the following is an observation about the pair of stars on the left?

F They have a sister star that is only occasionally visible.  
G They are moving to the right.  
H They appear to be revolving around each other.  
J One of them is increasing in brightness as the other one dims.

**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.