

ASOL SCIENCE SCOPE AND SEQUENCE MATRIX: HIGH SCHOOL

ASOL SCIENCE – MATRIX			
Based on the 2010 <i>Science Standards of Learning</i>			
Reporting Category	Grade 5	Grade 8	High School
Scientific Investigation	5S-SI 1 5S-SI 2	8S-SI 1 8S-SI 2 8S-SI 3	
Scientific Investigation and the Nature of Science			HSS-SI 1 HSS-SI 2
Force, Motion, Energy and Matter	5S-FME 1 5S-FME 2 5S-FME 3 5S-FME 4 5S-FME 5	8S-FME 1 8S-FME 2 8S-FME 3 8S-FME 4 8S-FME 5	
Life Processes and Living Systems	5S-LPS 1 5S-LPS 2 5S-LPS 3 5S-LPS 4		
Life Systems		8S-LS 1 8S-LS 2 8S-LS 3 8S-LS 4 8S-LS 5 8S-LS 6	
Earth/Space Systems and Cycles	5S-ESS 1 5S-ESS 2 5S-ESS 3 5S-ESS 4 5S-ESS 5 5S-ESS 6		
Ecosystems		8S-ECO 1	

		8S-ECO 2 8S-ECO 3 8S-ECO 4 8S-ECO 5 8S-ECO 6 8S-ECO 7	
Earth and Space Systems		8S-ESS 1 8S-ESS 2 8S-ESS 3 8S-ESS 4 8S-ESS 5 8S-ESS 6 8S-ESS 7	HSS-ESS 1 HSS-ESS 2 HSS-ESS 3
Earth Materials and Processes			HSS-EMP 1 HSS-EMP 2 HSS-EMP 3 HSS-EMP 4
Cosmology, Origins, and Time			HSS-COT 1
Earth Resources and Human Interactions			HSS-ERH 1 HSS-ERH 2 HSS-ERH 3

REPORTING CATEGORIES	HIGH SCHOOL ASOL BLUEPRINT	UNDERSTANDING THE STANDARD
Scientific Investigation and the Nature of Science	HSS-SI 1 (SOL ES.1)	The concepts developed in this standard include the concept that density expresses the relationship between mass and volume; information and data collected can be organized and expressed in the form of charts, graphs, and diagrams; and scale relates to actual distance. Topographic maps and satellite imagery are two-dimensional models that provide information defining three-dimensional landforms. They contain extensive information related to geographic as well as human structures and changes to the land surface, and are useful in understanding geologic processes. Grid systems of latitude and longitude are used to define locations and directions on maps, globes, and charts.
	HSS-SI 2 (SOL ES.2)	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • The nature of science refers to the foundational concepts that govern the way scientists formulate explanations about the natural world. The nature of science includes the concepts a) the natural world is understandable; b) science is based on evidence - both observational and experimental; c) science is a blend of logic and innovation; d) scientific ideas are durable yet subject to change as new data are collected; e) science is a complex social endeavor; and f) scientists try to remain objective and engage in peer review to help avoid bias. • Earth is a dynamic system, and all atmospheric, lithospheric, and hydrospheric processes interrelate and influence one another. A hypothesis is a tentative explanation that accounts for a set of facts and can be tested by further investigation. Only hypotheses that are testable are valid. A hypothesis can be supported, modified, or rejected based on collected data. Experiments are designed to test hypotheses. • Scientific theories are systematic sets of concepts that offer explanations for observed patterns in nature. Theories provide frameworks for relating data and guiding future research. Theories may change as new data become available. Any valid scientific theory has passed tests designed to invalidate it. • There can be more than one scientific explanation for phenomena. However, with competing explanations, generally one idea will eventually supersede the other as new tools, new observations, and verified data become available. • Changing relevant variables will generally change the outcome. • Scientific laws are generalizations of observational data that describe patterns and relationships. Laws may change as new data become available.
	HSS-ESS 1 (SOL ES.3)	<p>The concepts developed in this standard include the following</p> <ul style="list-style-type: none"> • The solar system consists of many types of celestial bodies. Earth is the third planet from the sun and is located between the sun and the asteroid belt. It has one natural satellite, the moon. Water occurs on Earth as a solid (ice), a liquid, or a gas (water vapor) due to Earth's position in the solar system. • Earth revolves around the sun tilted on its axis. The axial tilt is responsible for the incidence and duration of sunlight striking a given hemisphere that varies during the Earth's revolution around the Sun, thus causing seasons. Equinoxes and solstices represent four distinct quarterly points signaling the cyclic change of seasons. • The moon revolves around Earth creating the moon phases and eclipses. Solar eclipses occur when the moon blocks sunlight from Earth's surface, while lunar eclipses occur when Earth blocks sunlight from reaching the moon's surface.

Earth and Space Systems		<ul style="list-style-type: none"> • The tides are the periodic rise and fall of water level caused by the gravitational pull of the sun and moon. • The sun consists largely of hydrogen gas. Its energy comes from nuclear fusion of hydrogen to helium. • There are essentially two types of planets in our solar system. The four inner (terrestrial) planets consist mostly of solid rock. The four outer planets are gas giants, consisting of thick outer layers of gaseous materials, perhaps with small rocky cores. • The dwarf planet, Pluto, has an unknown composition but appears to be solid. It is part of the Kuiper Belt. • Moons are natural satellites of planets and vary widely in composition. • Comets orbit the sun and consist mostly of frozen gases. • A meteoroid is debris located outside Earth's atmosphere; a meteor is debris located within Earth's atmosphere; and a meteorite is debris that has broken apart into smaller pieces before reaching Earth's surface. • Asteroids are usually leftover debris of the formation of the solar system, or creations of the collisions of other asteroids. • The atmosphere of Venus is mostly carbon dioxide and very dense. The atmosphere of Mars is very thin and mostly carbon dioxide. • Much of our knowledge about the solar system is a result of space exploration efforts. These efforts continue to improve our understanding of the solar system.
	HSS-ESS 2 (SOL ES.8)	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Soil is formed from the weathering of rocks and organic activity and is composed of loose rock fragments and clay derived from weathered rock mixed with organic material. • Karst topography is developed in areas underlain by carbonate rocks, including limestone and dolomite. Karst topography includes features like caves and sinkholes and forms when limestone is slowly dissolved away by slightly acidic groundwater. Where limestone is abundant in the Valley and Ridge province of Virginia, karst topography is common. • Permeability is a measure of the ability of a rock or sediment to transmit water or other liquids. Water does not pass through impermeable materials. A substantial amount of water is stored in permeable soil and rock underground. • Earth's fresh water supply is finite. Geological processes, such as erosion, and human activities, such as waste disposal, can pollute water supplies. • Water is continuously being passed through the hydrologic cycle. Fresh water is necessary for survival and most human activities. • The three major regional watershed systems in Virginia lead to the Chesapeake Bay, the North Carolina sounds, and the Gulf of Mexico.
	HSS-ESS 3 (SOL ES.12)	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Energy transfer between Earth's surface and the atmosphere creates the weather. • Weather and climate are different. Both weather and climate are measurable and, to a certain extent, predictable. Weather describes day-to-day changes in atmospheric conditions. Climate describes the typical weather patterns for a given location over a period of many years. Instrumentation is used to collect weather and climate data. • The four major factors affecting climate are latitude, elevation, proximity to bodies of water, and position relative to

		<p>mountains. Earth's major climatic zones are the polar, temperate, and tropical zones. Areas near the equator receive more of the sun's energy per unit area than areas nearer the poles.</p> <ul style="list-style-type: none"> • Earth's surface is much more efficiently heated by the sun than is the atmosphere. The amount of energy reaching any given point on Earth's surface is controlled by the angle of sunlight striking the surface and varies with the seasons. • Winds are created by uneven heat distribution at Earth's surface and modified by the rotation of Earth. The Coriolis effect causes deflections of the atmosphere due to the rotation of Earth. Global wind patterns result from the uneven heating of Earth by the sun and are influenced by the Coriolis effect. • Convection in the atmosphere is a major cause of weather. Convection is the major mechanism of energy transfer in the oceans, atmosphere, and Earth's interior. • The conditions necessary for cloud formation are air at or below dew point and presence of condensation nuclei. Cloud droplets can join together to form precipitation. • A tornado is a narrow, violent funnel-shaped column of spiral winds that extends downward from the cloud base toward Earth. A hurricane is a tropical cyclone (counterclockwise movement of air) characterized by sustained winds of 120 kilometers per hour (75 miles per hour) or greater.
Earth Materials and Processes	HSS-EMP 1 (SOL ES.4)	<ul style="list-style-type: none"> • There is a difference between rocks and minerals. Most rocks are made of one or more minerals. • A mineral is a naturally occurring, inorganic, solid substance with a definite chemical composition and structure and can be identified based on specific chemical and physical properties. • The major elements found in Earth's crust are oxygen, silicon, aluminum, and iron. The most abundant group of minerals is the silicates, which contain silicon and oxygen. Some common silicates include feldspar and quartz. • The carbonate group of minerals is composed of the carbonate compound CO₃. Some common carbonates are calcite and dolomite. • The oxide group of minerals is composed of oxygen and a metal. Some common oxides include hematite and magnetite.
	HSS-EMP 2 (SOL ES.5)	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Rocks can be identified on the basis of mineral content and texture. • The processes by which rocks are formed define the three major groups of rocks. • The rock cycle is the process by which all rocks are formed and how basic Earth materials are recycled through time. • Igneous rock forms from molten rock that cools and hardens either below or on Earth's surface. Extrusive igneous rocks have small or no crystals, resulting in fine-grained or glassy textures and include pumice, obsidian, and basalt. Intrusive igneous rocks have larger crystals and a coarser texture and include granite. • Sedimentary rocks may be formed either by rock fragments or organic matter being bound together or by chemical precipitation. Clastic sedimentary rocks are made up of fragments of other rocks and include sandstone, conglomerate, and shale. Non-clastic sedimentary rocks include limestone and rock salt. • Metamorphic rocks form when any rock is changed by the effects of heat, pressure, or chemical action. Foliated metamorphic rocks have bands of different minerals and include slate, schist, and gneiss. Unfoliated metamorphic rocks have little or no banding and are relatively homogenous throughout and include marble and quartzite.
	HSS-EMP 3 (SOL ES.7)	<p>The concepts developed in this standard include the following:</p>

	<ul style="list-style-type: none"> • Virginia has a billion-year-long tectonic and geologic history. • Virginia has five physiographic provinces produced by past episodes of tectonic activity and continuous geologic activity. • Each province has unique physical characteristics resulting from its geologic past. • Geologic processes produce characteristic structures and features. • The five physiographic provinces of Virginia are Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateau. • The Coastal Plain is a flat area composed of young, unconsolidated sediments underlain by older crystalline basement rocks. These layers of sediment were produced by erosion of the Appalachian Mountains and Piedmont and then deposited on the Coastal Plain when sea levels were higher in the past. • The Piedmont is an area of rolling hills underlain by mostly ancient igneous and metamorphic rocks. The igneous rocks are the roots of volcanoes formed during an ancient episode of subduction that occurred before the formation of the Appalachian Mountains. • The Blue Ridge is a high ridge separating the Piedmont from the Valley and Ridge Province. The billion-year-old igneous and metamorphic rocks of the Blue Ridge are the oldest in the state. • The Valley and Ridge province is an area with long parallel ridges and valleys underlain by ancient folded and faulted sedimentary rocks. The folding and faulting of the sedimentary rocks occurred during a collision between Africa and North America. The collision, which occurred in the late Paleozoic era, produced the Appalachian Mountains. • The Appalachian Plateau has rugged, irregular topography and is underlain by ancient, flat-lying sedimentary rocks. The area is actually a series of plateaus separated by faults and erosional down-cut valleys. Most of Virginia's coal resources are found in the plateau province. • Earth consists of a solid, mostly iron inner core; a liquid, mostly iron outer core; a crystalline but largely plastic mantle; and a rocky, brittle crust. • Earth's lithosphere is divided into plates that are in motion with respect to one another. The lithosphere is composed of the crust and upper portion of the mantle. There are two different types of lithospheres — oceanic and continental — that have very different physical and mineralogic characteristics. The ocean lithosphere is relatively thin, young, and dense. The continental lithosphere is relatively thick, old, and less dense. • Most large scale, high-energy events of geologic activity (e.g., earthquakes, volcanoes, and mountain building) occur as a result of relative motion along plate boundaries. • Plate motion occurs as a consequence of convection in Earth's mantle, including upwelling of material from the deep mantle in rift zones, the lateral movement of tectonic plates, and the sinking dense, old plates at subduction zones. • Weathering, erosion, and deposition are interrelated processes. Weathering is the process by which rocks are broken down chemically and physically by the action of water, air, and organisms. Erosion is the process by which Earth materials are physically incorporated by moving water, ice, or wind for transportation. Deposition is the process by which Earth materials carried by wind, water, or ice settle out and are left in a location when energy levels decrease. The size of the material deposited is proportional to the available energy of the medium of transport. • Relative plate motions and plate boundaries are convergent (subduction and continental collision), divergent (seafloor spreading), or transform. Major features of convergent boundaries include collision zones (folded and thrust-faulted
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		<p>mountains) and subduction zones (volcanoes and trenches). Major features of divergent boundaries include mid-ocean ridges, rift valleys, fissure volcanoes, and flood lavas. Major features of transform boundaries include strike-slip faults.</p> <ul style="list-style-type: none"> • Earthquake activity of varying energy levels and depths is associated with all plate boundaries. • A volcano is an opening where magma erupts onto Earth’s surface. Most volcanic activity is associated with subduction, rifting, or seafloor spreading. Hot spot volcanic activity, such as volcanic islands, is exceptional in that it is not related to plate boundaries but derived from a deep, localized heat source. • A fault is a break or crack in Earth’s crust along which movement has occurred. • Plate tectonic processes serve as the major driver of the rock cycle. Plate tectonics drive the evolution of Earth’s surface features and materials by fractionating material by chemical, mineralogic, and physical properties. Continental drift is a consequence of plate tectonics.
	<p>HSS-EMP 4 (SOL ES.8)</p>	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Soil is formed from the weathering of rocks and organic activity and is composed of loose rock fragments and clay derived from weathered rock mixed with organic material. • Karst topography is developed in areas underlain by carbonate rocks, including limestone and dolomite. Karst topography includes features like caves and sinkholes and forms when limestone is slowly dissolved away by slightly acidic groundwater. Where limestone is abundant in the Valley and Ridge province of Virginia, karst topography is common. • Permeability is a measure of the ability of a rock or sediment to transmit water or other liquids. Water does not pass through impermeable materials. A substantial amount of water is stored in permeable soil and rock underground. • Earth’s fresh water supply is finite. Geological processes, such as erosion, and human activities, such as waste disposal, can pollute water supplies. • Water is continuously being passed through the hydrologic cycle. Fresh water is necessary for survival and most human activities.
<p>Cosmology, Origins and Time</p>	<p>HSS-COT 1 (SOL ES.9)</p>	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • The history of Earth and the ages of rocks can be investigated and understood by studying rocks and fossils. • Evidence of ancient, often extinct life is preserved in many sedimentary rocks. A fossil is the remains, impression, or other evidence preserved in rock of the former existence of life. Fossil evidence indicates that life forms have changed and become more complex over geologic time. Some ways in which fossils can be preserved are molds, casts, and original bone or shell. • Relative time places events in a sequence without assigning any numerical ages. Fossils, superposition, and cross-cutting relations are used to determine the relative ages of rocks. Absolute time places a numerical age on an event. Radioactive decay is used to determine the absolute age of rocks. • The age of Earth is about 4.6 billion years. • In Virginia, fossils are found mainly in the Coastal Plain, Valley and Ridge, and Appalachian Plateau provinces. Most Virginia fossils are of marine organisms. This indicates that large areas of the state have been periodically covered by seawater. • Paleozoic, Mesozoic, and Cenozoic fossils are found in Virginia.

Earth Resources and Human Interactions	HSS-ERH 1 (SOL ES.4)	<ul style="list-style-type: none"> • There is a difference between rocks and minerals. Most rocks are made of one or more minerals. • A mineral is a naturally occurring, inorganic, solid substance with a definite chemical composition and structure and can be identified based on specific chemical and physical properties. • The major elements found in Earth's crust are oxygen, silicon, aluminum, and iron. The most abundant group of minerals is the silicates, which contain silicon and oxygen. Some common silicates include feldspar and quartz. • The carbonate group of minerals is composed of the carbonate compound CO₃. Some common carbonates are calcite and dolomite. • The oxide group of minerals is composed of oxygen and a metal. Some common oxides include hematite and magnetite. • Minerals are important to human wealth and welfare.
	HSS-ERH 2 (SOL ES.6)	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Resources are limited and are either renewable or nonrenewable. • There are advantages and disadvantages to using any energy source. • Virginia has many natural resources. • Modern living standards are supported by extensive use of both renewable and nonrenewable resources. • Extraction and use of any resource carries an environmental cost that must be weighed against economic benefit. • Renewable resources can be replaced by nature at a rate close to the rate at which they are used. Renewable resources include vegetation, sunlight, and surface water. • Nonrenewable resources are replenished very slowly or not at all. Nonrenewable resources include coal, oil, and minerals. • Fossil fuels are nonrenewable and may cause pollution, but they are relatively cheap and easy to use once they are extracted. • In Virginia, major rock and mineral resources include coal for energy, gravel and crushed stone for road construction, silica for electronics, zirconium and titanium for advanced metallurgy, and limestone for making concrete. • Clean water resources, while renewable, are directly impacted by human activity through extraction and pollution.
	HSS-ERH 3 (SOL ES.8)	<p>The concepts developed in this standard include the following:</p> <ul style="list-style-type: none"> • Soil is formed from the weathering of rocks and organic activity and is composed of loose rock fragments and clay derived from weathered rock mixed with organic material. • Karst topography is developed in areas underlain by carbonate rocks, including limestone and dolomite. Karst topography includes features like caves and sinkholes and forms when limestone is slowly dissolved away by slightly acidic groundwater. Where limestone is abundant in the Valley and Ridge province of Virginia, karst topography is common. • Permeability is a measure of the ability of a rock or sediment to transmit water or other liquids. Water does not pass through impermeable materials. A substantial amount of water is stored in permeable soil and rock underground. • Earth's fresh water supply is finite. Geological processes, such as erosion, and human activities, such as waste disposal, can pollute water supplies. • Water is continuously being passed through the hydrologic cycle. Fresh water is necessary for survival and most

		<p>human activities.</p> <ul style="list-style-type: none">• The three major regional watershed systems in Virginia lead to the Chesapeake Bay, the North Carolina sounds, and the Gulf of Mexico.
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