

Kindergarten	K.9	The student will investigate and understand that there are simple repeating patterns in his/her daily life. Key concepts include a) weather observations; b) the shapes and forms of many common natural objects including seeds, cones, and leaves; and c) animal and plant growth.
	K.10	The student will investigate and understand that change occurs over time and rates may be fast or slow. Key concepts include a) natural and human-made things may change over time; and b) changes can be observed and measured.
Grade One	1.7	The student will investigate and understand weather and seasonal changes. Key concepts include a) changes in temperature, light, and precipitation affect plants and animals, including humans; b) there are relationships between daily and seasonal changes; and c) changes in temperature, light, and precipitation can be observed and recorded over time.
Grade Two	2.7	The student will investigate and understand that weather and seasonal changes affect plants, animals, and their surroundings. Key concepts include a) effects of weather and seasonal changes on the growth and behavior of living things; and b) weathering and erosion of land surfaces.
Grade Three	3.8	The student will investigate and understand basic patterns and cycles occurring in nature. Key concepts include a) patterns of natural events such as day and night, seasonal changes, simple phases of the moon, and tides; b) animal life cycles; and c) plant life cycles.
	3.9	The student will investigate and understand the water cycle and its relationship to life on Earth. Key concepts include a) there are many sources of water on Earth; b) the energy from the sun drives the water cycle; c) the water cycle involves several processes; d) water is essential for living things; and e) water on Earth is limited and needs to be conserved.
Grade Four	4.7	The student will investigate and understand the organization of the solar system. Key concepts include a) the planets in the solar system; b) the order of the planets in the solar system; and c) the relative sizes of the planets.
	4.8	The student will investigate and understand the relationships among Earth, the moon, and the sun. Key concepts include a) the motions of Earth, the moon, and the sun; b) the causes for Earth's seasons; c) the causes for the phases of the moon; d) the relative size, position, age, and makeup of Earth, the moon, and the sun; and e) historical contributions in understanding the Earth-moon-sun system.
Grade Five	5.7	The student will investigate and understand how Earth's surface is constantly changing. Key concepts include a) identification of rock types; b) the rock cycle and how transformations between rocks occur; c) Earth history and fossil evidence; d) the basic structure of Earth's interior; e) changes in Earth's crust due to plate tectonics; f) weathering, erosion, and deposition; and g) human impact.
Grade Six	6.6	The student will investigate and understand the properties of air and the structure and dynamics of Earth's atmosphere. Key concepts include a) air as a mixture of gaseous elements and compounds; b) pressure, temperature, and humidity; c) atmospheric changes with altitude; d) natural and human-caused changes to the atmosphere and the importance of protecting and maintaining air quality; e) the relationship of atmospheric measures and weather conditions; and f) basic information from weather maps, including fronts, systems, and basic measurements.

	<p>6.8 The student will investigate and understand the organization of the solar system and the interactions among the various bodies that comprise it. Key concepts include</p> <ul style="list-style-type: none"> a) the sun, moon, Earth, other planets and their moons, dwarf planets, meteors, asteroids, and comets; b) relative size of and distance between planets; c) the role of gravity; d) revolution and rotation; e) the mechanics of day and night and the phases of the moon; f) the unique properties of Earth as a planet; g) the relationship of Earth's tilt and the seasons; h) the cause of tides; and i) the history and technology of space exploration.
Life Science	
Physical Science	
Earth Science	<p>ES.3 The student will investigate and understand the characteristics of Earth and the solar system. Key concepts include</p> <ul style="list-style-type: none"> a) position of Earth in the solar system; b) sun-Earth-moon relationships; (seasons, tides, and eclipses); c) characteristics of the sun, planets and their moons, comets, meteors, and asteroids; and d) the history and contributions of space exploration.
	<p>ES.4 The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Key concepts include</p> <ul style="list-style-type: none"> a) hardness, color and streak, luster, cleavage, fracture, and unique properties; and b) uses of minerals.
	<p>ES.5 The student will investigate and understand the rock cycle as it relates to the origin and transformation of rock types and how to identify common rock types based on mineral composition and textures. Key concepts include</p> <ul style="list-style-type: none"> a) igneous rocks; b) sedimentary rocks; and c) metamorphic rocks.
	<p>ES.7 The student will investigate and understand geologic processes including plate tectonics. Key concepts include</p> <ul style="list-style-type: none"> a) geologic processes and their resulting features; and b) tectonic processes.
	<p>ES.9 The student will investigate and understand that many aspects of the history and evolution of Earth and life can be inferred by studying rocks and fossils. Key concepts include</p> <ul style="list-style-type: none"> a) traces and remains of ancient, often extinct, life are preserved by various means in many sedimentary rocks; b) superposition, cross-cutting relationships, index fossils, and radioactive decay are methods of dating bodies of rock; c) absolute and relative dating have different applications but can be used together to determine the age of rocks and structures; and d) rocks and fossils from many different geologic periods and epochs are found in Virginia.
	<p>ES.13 The student will investigate and understand scientific concepts related to the origin and evolution of the universe. Key concepts include</p> <ul style="list-style-type: none"> a) cosmology including the Big Bang theory; and b) the origin and evolution of stars, star systems, and galaxies.

None in Biology, Chemistry and Physics.

Grade K	K.11 The student will investigate and understand that materials can be reused, recycled, and conserved. Key concepts include a) materials and objects can be used over and over again; b) everyday materials can be recycled; and c) water and energy conservation at home and in school helps ensure resources are available for future use.
Grade One	1.8 The student will investigate and understand that natural resources are limited. Key concepts include a) identification of natural resources; b) factors that affect air and water quality; and c) recycling, reusing, and reducing consumption of natural resources.
Grade Two	2.8 The student will investigate and understand that plants produce oxygen and food, are a source of useful products, and provide benefits in nature. Key concepts include a) important plant products are identified and classified; b) the availability of plant products affects the development of a geographic area; c) plants provide oxygen, homes, and food for many animals; and d) plants can help reduce erosion.
Grade Three	3.10 The student will investigate and understand that natural events and human influences can affect the survival of species. Key concepts include a) the interdependency of plants and animals; b) the effects of human activity on the quality of air, water, and habitat; c) the effects of fire, flood, disease, and erosion on organisms; and d) conservation and resource renewal.
	3.11 The student will investigate and understand different sources of energy. Key concepts include a) energy from the sun; b) sources of renewable energy; and c) sources of nonrenewable energy.
Grade Four	4.9 The student will investigate and understand important Virginia natural resources. Key concepts include a) watersheds and water resources; b) animals and plants; c) minerals, rocks, ores, and energy sources; and d) forests, soil, and land.
Grade Five	
Grade Six	6.5 The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include c) the action of water in physical and chemical weathering; d) the ability of large bodies of water to store thermal energy and moderate climate; e) the importance of water for agriculture, power generation, and public health; and f) the importance of protecting and maintaining water resources.
	6.9 The student will investigate and understand public policy decisions relating to the environment. Key concepts include a) management of renewable resources; b) management of nonrenewable resources; c) the mitigation of land-use and environmental hazards through preventive measures; and d) cost/benefit tradeoffs in conservation policies.
Life Science	
Physical Science	
Earth Science	ES.6 The student will investigate and understand the differences between renewable and nonrenewable resources. Key concepts include a) fossil fuels, minerals, rocks, water, and vegetation; b) advantages and disadvantages of various energy sources; c) resources found in Virginia; and d) environmental costs and benefits.

Science SOL Institutes – Strand Alignment

Force, Motion, and Energy

Grade K	K.3 The student will investigate and understand that magnets have an effect on some materials, make some things move without touching them, and have useful applications. Key concepts include a) magnetism and its effects; and b) useful applications of magnetism.
Grade One	1.2 The student will investigate and understand that moving objects exhibit different kinds of motion. Key concepts include a) objects may have straight, circular, and back-and-forth motions; b) objects may vibrate and produce sound; and c) pushes or pulls can change the movement of an object.
Grade Two	2.2 The student will investigate and understand that natural and artificial magnets have certain characteristics and attract specific types of metals. Key concepts include a) magnetism, iron, magnetic/nonmagnetic, poles, attract/repel; and b) important applications of magnetism.
Grade Three	3.2 The student will investigate and understand simple machines and their uses. Key concepts include a) purpose and function of simple machines; b) types of simple machines; c) compound machines; and d) examples of simple and compound machines found in the school, home, and work environments.
	3.11 The student will investigate and understand different sources of energy. Key concepts include a) energy from the sun; b) sources of renewable energy; and c) sources of nonrenewable energy.
Grade Four	4.2 The student will investigate and understand characteristics and interactions of moving objects. Key concepts include a) motion is described by an object's direction and speed; b) changes in motion are related to force and mass; c) friction is a force that opposes motion; and d) moving objects have kinetic energy.
	4.3 The student will investigate and understand the characteristics of electricity. Key concepts include a) conductors and insulators; b) basic circuits; c) static electricity; d) the ability of electrical energy to be transformed into light and motion, and to produce heat; e) simple electromagnets and magnetism; and f) historical contributions in understanding electricity.
Grade Five	5.2 The student will investigate and understand how sound is created and transmitted, and how it is used. Key concepts include a) compression waves; b) vibration, compression, wavelength, frequency, amplitude; c) the ability of different media (solids, liquids, and gases) to transmit sound; and d) uses and applications of sound waves.
	5.3 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include a) transverse waves; b) the visible spectrum; c) opaque, transparent, and translucent; d) reflection of light from reflective surfaces; and e) refraction of light through water and prisms.
Grade Six	6.2 The student will investigate and understand basic sources of energy, their origins, transformations, and uses. Key concepts include a) potential and kinetic energy; b) the role of the sun in the formation of most energy sources on Earth; c) nonrenewable energy sources; d) renewable energy sources; and e) energy transformations.
Physical Science	PS.6 The student will investigate and understand forms of energy and how energy is transferred and transformed. Key concepts include a) potential and kinetic energy; and b) mechanical, chemical, electrical, thermal, radiant, and nuclear energy.

	<p>PS.7 The student will investigate and understand temperature scales, heat, and thermal energy transfer. Key concepts include</p> <ul style="list-style-type: none"> a) Celsius and Kelvin temperature scales and absolute zero; b) phase change, freezing point, melting point, boiling point, vaporization, and condensation; c) conduction, convection, and radiation; and d) applications of thermal energy transfer.
	<p>PS.8 The student will investigate and understand the characteristics of sound waves. Key concepts include</p> <ul style="list-style-type: none"> a) wavelength, frequency, speed, amplitude, rarefaction, and compression; b) resonance; c) the nature of compression waves; and d) technological applications of sound.
	<p>PS.9 The student will investigate and understand the characteristics of transverse waves. Key concepts include</p> <ul style="list-style-type: none"> a) wavelength, frequency, speed, amplitude, crest, and trough; b) the wave behavior of light; c) images formed by lenses and mirrors; d) the electromagnetic spectrum; and e) technological applications of light.
	<p>PS.10 The student will investigate and understand the scientific principles of work, force, and motion. Key concepts include</p> <ul style="list-style-type: none"> a) speed, velocity, and acceleration; b) Newton's laws of motion; c) work, force, mechanical advantage, efficiency, and power; and d) technological applications of work, force, and motion.
	<p>PS.11 The student will investigate and understand basic principles of electricity and magnetism. Key concepts include</p> <ul style="list-style-type: none"> a) static electricity, current electricity, and circuits; b) relationship between a magnetic field and an electric current; c) electromagnets, motors, and generators and their uses; and d) conductors, semiconductors, and insulators.
Earth Science	
Chemistry	
Physics	<p>PH.5 The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes. Key concepts include</p> <ul style="list-style-type: none"> a) linear motion; b) uniform circular motion; c) projectile motion; d) Newton's laws of motion; e) gravitation; f) planetary motion; and g) work, power, and energy.
	<p>PH.6 The student will investigate and understand that quantities including mass, energy, momentum, and charge are conserved. Key concepts include</p> <ul style="list-style-type: none"> a) kinetic and potential energy; b) elastic and inelastic collisions; and c) mass/energy equivalence.
	<p>PH.7 The student will investigate and understand that energy can be transferred and transformed to provide usable work. Key concepts include</p> <ul style="list-style-type: none"> a) transfer and storage of energy among systems including mechanical, thermal, gravitational, electromagnetic, chemical, and nuclear systems; and b) efficiency of systems.
	<p>PH.8 The student will investigate and understand wave phenomena. Key concepts include</p> <ul style="list-style-type: none"> a) wave characteristics; b) fundamental wave processes; and c) light and sound in terms of wave models.

	<p>PH.9 The student will investigate and understand that different frequencies and wavelengths in the electromagnetic spectrum are phenomena ranging from radio waves through visible light to gamma radiation. Key concepts include</p> <ul style="list-style-type: none">a) the properties, behaviors, and relative size of radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays;b) wave/particle dual nature of light; andc) current applications based on the respective wavelengths.
	<p>PH.10 The student will investigate and understand how to use the field concept to describe the effects of gravitational, electric, and magnetic forces. Key concepts include</p> <ul style="list-style-type: none">a) inverse square laws (Newton's law of universal gravitation and Coulomb's law); andb) technological applications.
	<p>PH.11 The student will investigate and understand how to diagram, construct, and analyze basic electrical circuits and explain the function of various circuit components. Key concepts include</p> <ul style="list-style-type: none">a) Ohm's law;b) series, parallel, and combined circuits;c) electrical power; andd) alternating and direct currents.
	<p>PH.12 The student will investigate and understand that extremely large and extremely small quantities are not necessarily described by the same laws as those studied in Newtonian physics. Key concepts may include</p> <ul style="list-style-type: none">a) wave/particle duality;b) wave properties of matter;c) matter/energy equivalence;d) quantum mechanics and uncertainty;e) relativity;f) nuclear physics;g) solid state physics;h) nanotechnology;i) superconductivity; andj) radioactivity.

Science SOL Institutes | Interrelationships in Earth/Space Systems

Grade K	K.8 The student will investigate and understand that shadows occur when light is blocked by an object. Key concepts include a) shadows occur in nature when sunlight is blocked by an object; and b) shadows can be produced by blocking artificial light sources.
Grade One	1.6 The student will investigate and understand the basic relationships between the sun and Earth. Key concepts include a) the sun is the source of energy and light that warms the land, air, and water; and b) the sun's relative position in the morning is east and in the late afternoon is west.
Grade Two	2.6 The student will investigate and understand basic types, changes, and patterns of weather. Key concepts include a) identification of common storms and other weather phenomena; b) the uses and importance of measuring, recording, and interpreting weather data; and c) the uses and importance of tracking weather data over time.
Grade Three	3.7 The student will investigate and understand the major components of soil, its origin, and its importance to plants and animals including humans. Key concepts include a) soil provides the support and nutrients necessary for plant growth; b) topsoil is a natural product of subsoil and bedrock; c) rock, clay, silt, sand, and humus are components of soils; and d) soil is a natural resource and should be conserved.
Grade Four	4.6 The student will investigate and understand how weather conditions and phenomena occur and can be predicted. Key concepts include a) weather phenomena; b) weather measurements and meteorological tools; and c) use of weather measurements and weather phenomena to make weather predictions.
	4.7 The student will investigate and understand the organization of the solar system. Key concepts include a) the planets in the solar system; b) the order of the planets in the solar system; and c) the relative sizes of the planets.
	4.8 The student will investigate and understand the relationships among Earth, the moon, and the sun. Key concepts include a) the motions of Earth, the moon, and the sun; b) the causes for Earth's seasons; c) the causes for the phases of the moon; d) the relative size, position, age, and makeup of Earth, the moon, and the sun; and e) historical contributions in understanding the Earth-moon-sun system.
Grade Five	5.6 The student will investigate and understand characteristics of the ocean environment. Key concepts include a) geological characteristics; b) physical characteristics; and c) ecological characteristics.
Grade Six	6.3 The student will investigate and understand the role of solar energy in driving most natural processes within the atmosphere, the hydrosphere, and on Earth's surface. Key concepts include a) Earth's energy budget; b) the role of radiation and convection in the distribution of energy; c) the motion of the atmosphere and the oceans; d) cloud formation; and e) the role of thermal energy in weather-related phenomena including thunderstorms and hurricanes.
	6.5 The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include c) the action of water in physical and chemical weathering; d) the ability of large bodies of water to store thermal energy and moderate climate; e) the importance of water for agriculture, power generation, and public health; and f) the importance of protecting and maintaining water resources.
Life Science	
Physical Science	

	<p>ES.8 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include</p> <ul style="list-style-type: none"> a) processes of soil development; b) development of karst topography; c) relationships between groundwater zones, including saturated and unsaturated zones, and the water table; d) identification of sources of fresh water including rivers, springs, and aquifers, with reference to the hydrologic cycle; e) dependence on freshwater resources and the effects of human usage on water quality; and f) identification of the major watershed systems in Virginia, including the Chesapeake Bay and its tributaries.
	<p>ES.10The 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</p> <ul style="list-style-type: none"> a) physical and chemical changes related to tides, waves, currents, sea level and ice cap variations, upwelling, and salinity variations; b) importance of environmental and geologic implications; c) systems interactions; d) features of the sea floor as reflections of tectonic processes; and e) economic and public policy issues concerning the oceans and the coastal zone including the Chesapeake Bay.
	<p>ES.11The 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</p> <ul style="list-style-type: none"> a) scientific evidence for atmospheric composition changes over geologic time; b) current theories related to the effects of early life on the chemical makeup of the atmosphere; c) atmospheric regulation mechanisms including the effects of density differences and energy transfer; and d) potential changes to the atmosphere and climate due to human, biologic, and geologic activity.
	<p>ES.12The student will investigate and understand that energy transfer between the sun and Earth and its atmosphere drives weather and climate on Earth. Key concepts include</p> <ul style="list-style-type: none"> a) observation and collection of weather data; b) prediction of weather patterns; c) severe weather occurrences, such as tornadoes, hurricanes, and major storms; and d) weather phenomena and the factors that affect climate including radiation, conduction, and convection.

None in Biology, Chemistry and Physics.

Kindergarten	K.6 The student will investigate and understand the differences between living organisms and nonliving objects. Key concepts include a) all things can be classified as living or nonliving; and b) living organisms have certain characteristics that distinguish them from nonliving objects including growth, movement, response to the environment, having offspring, and the need for food, air, and water.
	K.7 The student will investigate and understand basic needs and life processes of plants and animals. Key concepts include a) animals need adequate food, water, shelter, air, and space to survive; b) plants need nutrients, water, air, light, and a place to grow to survive; c) plants and animals change as they grow, have varied life cycles, and eventually die; and d) offspring of plants and animals are similar but not identical to their parents or to one another.
Grade One	1.4 The student will investigate and understand that plants have basic life needs and functional parts and can be classified according to certain characteristics. Key concepts include a) plants need nutrients, air, water, light, and a place to grow; b) basic parts of plants; and c) plants can be classified based on a variety of characteristics.
	1.5 The student will investigate and understand that animals, including humans, have basic needs and certain distinguishing characteristics. Key concepts include a) basic needs include adequate air, food, water, shelter, and space (habitat); b) animals, including humans, have many different physical characteristics; and c) animals can be classified according to a variety of characteristics.
Grade Two	2.4 The student will investigate and understand that plants and animals undergo a series of orderly changes as they mature and grow. Key concepts include a) animal life cycles; and b) plant life cycles.
Grade Three	3.4 The student will investigate and understand that adaptations allow animals to satisfy life needs and respond to the environment. Key concepts include a) behavioral adaptations; and b) physical adaptations.
Grade Four	4.4 The student will investigate and understand basic plant anatomy and life processes. Key concepts include a) the structures of typical plants and the function of each structure; b) processes and structures involved with plant reproduction; c) photosynthesis; and d) adaptations allow plants to satisfy life needs and respond to the environment.
Grade Five	
Grade Six	
Life Science	LS.5 The student will investigate and understand the basic physical and chemical processes of photosynthesis and its importance to plant and animal life. Key concepts include a) energy transfer between sunlight and chlorophyll; b) transformation of water and carbon dioxide into sugar and oxygen; and c) photosynthesis as the foundation of virtually all food webs.
	LS.13 The student will investigate and understand that populations of organisms change over time. Key concepts include a) the relationships of mutation, adaptation, natural selection, and extinction; b) evidence of evolution of different species in the fossil record; and c) how environmental influences, as well as genetic variation, can lead to diversity of organisms.
Physical Science	

Earth Science	
Biology	BIO.2The student will investigate and understand the chemical and biochemical principles essential for life. Key concepts include a) water chemistry and its impact on life processes; b) the structure and function of macromolecules; c) the nature of enzymes; and d) the capture, storage, transformation, and flow of energy through the processes of photosynthesis and respiration
	BIO.7The student will investigate and understand how populations change through time. Key concepts include a) evidence found in fossil records; b) how genetic variation, reproductive strategies, and environmental pressures impact the survival of populations; c) how natural selection leads to adaptations; d) emergence of new species; and e) scientific evidence and explanations for biological evolution.
Chemistry	
Physics	

Grade K	
Grade One	
Grade Two	<p>2.5 The student will investigate and understand that living things are part of a system. Key concepts include</p> <ul style="list-style-type: none"> a) living organisms are interdependent with their living and nonliving surroundings; b) an animal's habitat includes adequate food, water, shelter or cover, and space; c) habitats change over time due to many influences; and d) fossils provide information about living systems that were on Earth years ago.
Grade Three	<p>3.5 The student will investigate and understand relationships among organisms in aquatic and terrestrial food chains. Key concepts include</p> <ul style="list-style-type: none"> a) producer, consumer, decomposer; b) herbivore, carnivore, omnivore; and c) predator and prey.
	<p>3.6 The student will investigate and understand that ecosystems support a diversity of plants and animals that share limited resources. Key concepts include</p> <ul style="list-style-type: none"> a) aquatic ecosystems; b) terrestrial ecosystems; c) populations and communities; and d) the human role in conserving limited resources.
Grade Four	<p>4.5 The student will investigate and understand how plants and animals, including humans, in an ecosystem interact with one another and with the nonliving components in the ecosystem. Key concepts include</p> <ul style="list-style-type: none"> a) plant and animal adaptations; b) organization of populations, communities, and ecosystems and how they interrelate; c) flow of energy through food webs; d) habitats and niches; e) changes in an organism's niche at various stages in its life cycle; and f) influences of human activity on ecosystems.
Grade Five	<p>5.5 The student will investigate and understand that organisms are made of one or more cells and have distinguishing characteristics that play a vital role in the organism's ability to survive and thrive in its environment. Key concepts include</p> <ul style="list-style-type: none"> a) basic cell structures and functions; b) classification of organisms using physical characteristics, body structures, and behavior of the organism; and c) traits of organisms that allow them to survive in their environment.
Grade Six	<p>6.7 The student will investigate and understand the natural processes and human interactions that affect watershed systems. Key concepts include</p> <ul style="list-style-type: none"> a) the health of ecosystems and the abiotic factors of a watershed; b) the location and structure of Virginia's regional watershed systems; c) divides, tributaries, river systems, and river and stream processes; d) wetlands; e) estuaries; f) major conservation, health, and safety issues associated with watersheds; and g) water monitoring and analysis using field equipment including hand-held technology.
Life Science	<p>LS.2 The student will investigate and understand that all living things are composed of cells. Key concepts include</p> <ul style="list-style-type: none"> a) cell structure and organelles; b) similarities and differences between plant and animal cells; c) development of cell theory; and d) cell division.
	<p>LS.3 The student will investigate and understand that living things show patterns of cellular organization. Key concepts include</p> <ul style="list-style-type: none"> a) cells, tissues, organs, and systems; and b) patterns of cellular organization and their relationship to life processes in living things.
	<p>LS.4 The student will investigate and understand how organisms can be classified. Key concepts include</p> <ul style="list-style-type: none"> a) the distinguishing characteristics of domains of organisms; b) the distinguishing characteristics of kingdoms of organisms; c) the distinguishing characteristics of major animal phyla and plant divisions; and d) the characteristics that define a species.

	<p>LS.6 The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment. Key concepts include</p> <ul style="list-style-type: none"> a) the carbon, water, and nitrogen cycles; b) interactions resulting in a flow of energy and matter throughout the system; c) complex relationships within terrestrial, freshwater, and marine ecosystems; and d) energy flow in food webs and energy pyramids.
	<p>LS.7 The student will investigate and understand that interactions exist among members of a population. Key concepts include</p> <ul style="list-style-type: none"> a) competition, cooperation, social hierarchy, territorial imperative; and b) influence of behavior on a population.
	<p>LS.8 The student will investigate and understand interactions among populations in a biological community. Key concepts include</p> <ul style="list-style-type: none"> a) the relationships among producers, consumers, and decomposers in food webs; b) the relationship between predators and prey; c) competition and cooperation; d) symbiotic relationships; and e) niches.
	<p>LS.9 The student will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem. Key concepts include</p> <ul style="list-style-type: none"> a) differences between ecosystems and biomes; b) characteristics of land, marine, and freshwater ecosystems; and c) adaptations that enable organisms to survive within a specific ecosystem.
	<p>LS.10 The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic, change over time, and respond to daily, seasonal, and long-term changes in their environment. Key concepts include</p> <ul style="list-style-type: none"> a) phototropism, hibernation, and dormancy; b) factors that increase or decrease population size; and c) eutrophication, climate changes, and catastrophic disturbances.
	<p>LS.11 The student will investigate and understand the relationships between ecosystem dynamics and human activity. Key concepts include</p> <ul style="list-style-type: none"> a) food production and harvest; b) change in habitat size, quality, or structure; c) change in species competition; d) population disturbances and factors that threaten or enhance species survival; and e) environmental issues.
	<p>LS.12 The student will investigate and understand that organisms reproduce and transmit genetic information to new generations. Key concepts include</p> <ul style="list-style-type: none"> a) the structure and role of DNA; b) the function of genes and chromosomes; c) genotypes and phenotypes; d) characteristics that can and cannot be inherited; e) genetic engineering and its applications; and f) historical contributions and significance of discoveries related to genetics.
Physical Science	
Earth Science	
Biology	<p>BIO.3 The student will investigate and understand relationships between cell structure and function. Key concepts include</p> <ul style="list-style-type: none"> a) evidence supporting the cell theory; b) characteristics of prokaryotic and eukaryotic cells; c) similarities between the activities of the organelles in a single cell and a whole organism; d) the cell membrane model; and e) the impact of surface area to volume ratio on cell division, material transport, and other life processes.

	<p>BIO.4The student will investigate and understand life functions of Archaea, Bacteria and Eukarya. Key concepts include</p> <ul style="list-style-type: none"> a) comparison of their metabolic activities; b) maintenance of homeostasis; c) how the structures and functions vary among and within the Eukarya kingdoms of protists, fungi, plants, and animals, including humans; d) human health issues, human anatomy, and body systems; e) how viruses compare with organisms; and f) evidence supporting the germ theory of infectious disease.
	<p>BIO.5The student will investigate and understand common mechanisms of inheritance and protein synthesis. Key concepts include</p> <ul style="list-style-type: none"> a) cell growth and division; b) gamete formation; c) cell specialization; d) prediction of inheritance of traits based on the Mendelian laws of heredity; e) historical development of the structural model of DNA; f) genetic variation; g) the structure, function, and replication of nucleic acids; h) events involved in the construction of proteins; i) use, limitations, and misuse of genetic information; and j) exploration of the impact of DNA technologies.
	<p>BIO.6The student will investigate and understand bases for modern classification systems. Key concepts include</p> <ul style="list-style-type: none"> a) structural similarities among organisms; b) fossil record interpretation; c) comparison of developmental stages in different organisms; d) examination of biochemical similarities and differences among organisms; and e) systems of classification that are adaptable to new scientific discoveries.
	<p>BIO.8The student will investigate and understand dynamic equilibria within populations, communities, and ecosystems. Key concepts include</p> <ul style="list-style-type: none"> a) interactions within and among populations including carrying capacities, limiting factors, and growth curves; b) nutrient cycling with energy flow through ecosystems; c) succession patterns in ecosystems; d) the effects of natural events and human activities on ecosystems; and e) analysis of the flora, fauna, and microorganisms of Virginia ecosystems.
Chemistry	
Physics	

Kindergarten	K.4	The student will investigate and understand that the position, motion, and physical properties of an object can be described. Key concepts include a) colors of objects; b) shapes and forms of objects; c) textures and feel of objects; d) relative sizes and weights of objects; and e) relative positions and speed of objects.
	K.5	The student will investigate and understand that water flows and has properties that can be observed and tested. Key concepts include a) water occurs in different phases; b) water flows downhill; and c) some materials float in water, while others sink.
Grade One	1.3	The student will investigate and understand how different common materials interact with water. Key concepts include a) some liquids will separate when mixed with water, but others will not; b) some solids will dissolve in water, but others will not; and c) some substances will dissolve more readily in hot water than in cold water.
Grade Two	2.3	The student will investigate and understand basic properties of solids, liquids, and gases. Key concepts include a) identification of distinguishing characteristics of solids, liquids, and gases; b) measurement of the mass and volume of solids and liquids; and c) changes in phases of matter with the addition or removal of energy.
Grade Three	3.3	The student will investigate and understand that objects are made of materials that can be described by their physical properties. Key concepts include a) objects are made of one or more materials; b) physical properties remain the same as the material is changed in visible size; and c) visible physical changes are identified.
Grade Four		
Grade Five	5.4	The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. Key concepts include a) distinguishing properties of each phase of matter; b) the effect of temperature on the phases of matter; c) atoms and elements; d) molecules and compounds; and e) mixtures including solutions.
Grade Six	6.4	The student will investigate and understand that all matter is made up of atoms. Key concepts include a) atoms consist of particles, including electrons, protons, and neutrons; b) atoms of a particular element are alike but are different from atoms of other elements; c) elements may be represented by chemical symbols; d) two or more atoms interact to form new substances, which are held together by electrical forces (bonds); e) compounds may be represented by chemical formulas; f) chemical equations can be used to model chemical changes; and g) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere.
	6.5	The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include a) water as the universal solvent; b) the properties of water in all three phases.
Physical Science	PS.2	The student will investigate and understand the nature of matter. Key concepts include a) the particle theory of matter; b) elements, compounds, mixtures, acids, bases, and salts; c) solids, liquids, and gases; d) physical properties; e) chemical properties; and f) characteristics of types of matter based on physical and chemical properties.
	PS.3	The student will investigate and understand the modern and historical models of atomic structure. Key concepts include a) the contributions of Dalton, Thomson, Rutherford, and Bohr in understanding the atom; and b) the modern model of atomic structure.

	<p>PS.4 The student will investigate and understand the organization and use of the periodic table of elements to obtain information. Key concepts include</p> <ul style="list-style-type: none"> a) symbols, atomic numbers, atomic mass, chemical families (groups), and periods; b) classification of elements as metals, metalloids, and nonmetals; and c) formation of compounds through ionic and covalent bonding.
	<p>PS.5 The student will investigate and understand changes in matter and the relationship of these changes to the Law of Conservation of Matter and Energy. Key concepts include</p> <ul style="list-style-type: none"> a) physical changes; b) chemical changes; and c) nuclear reactions.
Earth Science	
Chemistry	<p>CH.2 The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure. The periodic table is a tool used for the investigations of</p> <ul style="list-style-type: none"> a) average atomic mass, mass number, and atomic number; b) isotopes, half lives, and radioactive decay; c) mass and charge characteristics of subatomic particles; d) families or groups; e) periods; f) trends including atomic radii, electronegativity, shielding effect, and ionization energy; g) electron configurations, valence electrons, and oxidation numbers; h) chemical and physical properties; and i) historical and quantum models.
	<p>CH.3 The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations. Key concepts include</p> <ul style="list-style-type: none"> a) nomenclature; b) balancing chemical equations; c) writing chemical formulas; d) bonding types; e) reaction types; and f) reaction rates, kinetics, and equilibrium.
	<p>CH.4 The student will investigate and understand that chemical quantities are based on molar relationships. Key concepts include</p> <ul style="list-style-type: none"> a) Avogadro's principle and molar volume; b) stoichiometric relationships; c) solution concentrations; and d) acid/base theory; strong electrolytes, weak electrolytes, and nonelectrolytes; dissociation and ionization; pH and pOH; and the titration process.
	<p>CH.5 The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles. Key concepts include</p> <ul style="list-style-type: none"> a) pressure, temperature, and volume; b) partial pressure and gas laws; c) vapor pressure; d) phase changes; e) molar heats of fusion and vaporization; f) specific heat capacity; and g) colligative properties.
	<p>CH.6 The student will investigate and understand how basic chemical properties relate to organic chemistry and biochemistry. Key concepts include</p> <ul style="list-style-type: none"> a) unique properties of carbon that allow multi-carbon compounds; and b) uses in pharmaceuticals and genetics, petrochemicals, plastics, and food.
Physics	