

Virginia Earth Science Standards of Learning

<http://www.pen.k12.va.us/go/Sols/science.html#EarthScience>

The Earth Science standards connect the study of the Earth's composition, structure, processes, and history; its atmosphere, fresh water, and oceans; and its environment in space. The standards emphasize historical contributions in the development of scientific thought about the Earth and space. The standards stress the interpretation of maps, charts, tables, and profiles; the use of technology to collect, analyze, and report data; and science skills in systematic investigation. Problem solving and decision making are an integral part of the standards, especially as they relate to the costs and benefits of utilizing the Earth's resources. Major topics of study include plate tectonics, the rock cycle, Earth history, the oceans, the atmosphere, weather and climate, and the solar system and universe.

- ES.1 The student will plan and conduct investigations in which
- * volume, area, mass, elapsed time, direction, temperature, pressure, distance, density, and changes in elevation/depth are calculated utilizing the most appropriate tools;
 - * technologies, including computers, are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions;
 - * scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted;
 - * variables are manipulated with repeated trials; and
 - * a scientific viewpoint is constructed and defended.
- ES.2 The student will demonstrate scientific reasoning and logic by
- * analyzing how science explains and predicts the interactions and dynamics of complex Earth systems;
 - * recognizing that evidence is required to evaluate hypotheses and explanations;
 - * comparing different scientific explanations for the same observations about the Earth;
 - * explaining that observation and logic are essential for reaching a conclusion;
 - * evaluating evidence for scientific theories related to plate tectonics, the structure of the Earth, and its ancient age and origin; and
 - * making informed judgments related to resource use and its effects on Earth systems.

- ES.3 The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery. Key concepts include
- * maps (bathymetric, geologic, topographic, and weather) and star charts;
 - * imagery (aerial photography and satellite images);
 - * direction and distance measurements on any map or globe; and
 - * location by latitude and longitude and topographic profiles.
- ES.4 The student will investigate and understand the characteristics of the Earth including
- * plate tectonics;
 - * water in all three states;
 - * position of the Earth in the solar system; and
 - * effects of density differences and energy transfer on the activities of the atmosphere, oceans, and Earth's interior.

- 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
- * properties including hardness, color and streak, luster, cleavage, fracture, and unique properties; and
 - * uses of minerals.
- 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
- * igneous (intrusive and extrusive);
 - * sedimentary (clastic and chemical); and
 - * metamorphic (foliated and unfoliated) rocks.
- ES.7 The student will investigate and understand the differences between renewable and nonrenewable resources. Key concepts include
- * fossil fuels, minerals, rocks, water, and vegetation;
 - * advantages and disadvantages of various energy sources;
 - * resources found in Virginia;
 - * use of resources and their effects on standards of living; and
 - * environmental costs and benefits.
- ES.8 The student will investigate and understand geologic processes including plate tectonics. Key concepts include
- * how geologic processes are evidenced in the physiographic provinces of Virginia including the Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateau;
 - * processes (faulting, folding, volcanism, metamorphism, weathering, erosion, deposition, and sedimentation) and their resulting features; and
 - * tectonic processes (subduction, rifting and sea floor spreading, and continental collision).
- ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include
- * processes of soil development;
 - * development of karst topography;
 - * identification of groundwater zones including water table, zone of saturation, and zone of aeration;
 - * identification of other sources of fresh water including aquifers with reference to the hydrologic cycle; and
 - * dependence on freshwater resources and the affects of human usage on water quality.

- 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
- * traces or remains of ancient, often extinct, life are preserved by various means in many sedimentary rocks;
 - * superposition, cross-cutting relationships, and radioactive decay are methods of dating bodies of rock;
 - * absolute and relative dating have different applications but can be used together to determine the age of rocks and structures; and
 - * rocks and fossils from many different geologic periods and epochs are found in Virginia.
- ES.11 The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include
- * physical and chemical changes (tides, waves, currents, sea level and ice cap variations, upwelling, and salinity concentrations);
 - * importance of environmental, geologic, and economic implications;
 - * systems interactions (energy transfer, weather, and climate);
 - * features of the sea floor (continental margins, trenches, mid-ocean ridges, and abyssal plains) reflect tectonic processes; and
 - * public policy issues concerning the oceans.
- 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
- * scientific evidence for atmospheric changes over geologic time;
 - * current theories related to the effects of early life on the chemical makeup of the atmosphere;
 - * comparison of the Earth's atmosphere to that of other planets;
 - * atmospheric regulation mechanisms; and
 - * potential atmospheric compositional changes due to human, biologic, and geologic activity.
- ES.13 The student will investigate and understand that energy transfer between the sun, Earth, and the Earth's atmosphere drives weather and climate on Earth. Key concepts include
- * observation and collection of weather data;
 - * prediction of weather patterns; and
 - * weather phenomena and the factors that affect climate.

- 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
- * characteristics of the sun, planets, their moons, comets, meteors, and asteroids; and
 - * cosmology and the origin of stars and stellar systems (the Big Bang, the solar nebular theory, stellar evolution, star systems, nebulae, constellations, and galaxies).