



Science Standards of Learning Curriculum Framework

Earth Science

Commonwealth of Virginia
Board of Education
Richmond, Virginia
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Standard ES.1 a, b

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; and
- b) technologies, including computers, probeware, and global positioning systems (GPS), are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions.

Essential Understandings

- *Density* expresses the relationship between mass and volume.

Essential Knowledge and Skills

Skills

- Measure mass and volume of materials in the lab.
- Calculate density.
- Interpret data from a graph or table that shows change in mass, density, or temperature over time.
- Interpret data from a graph or table that shows changes in temperature or pressure with depth.

Standard ES.1 c, d, e

The student will plan and conduct investigations in which

- c) scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted;
- d) variables are manipulated with repeated trials; and
- e) a scientific viewpoint is constructed and defended (the nature of science).

Essential Understandings

- Information and data collected can be organized and expressed in the form of charts, graphs, and diagrams.
- Changing relevant variables will generally change the outcome.
- A hypothesis can be supported, modified, or rejected based on collected data. A *hypothesis* is a tentative explanation that accounts for a set of facts and can be tested by further investigation.
- Experiments are designed to test hypotheses.
- *Scientific laws* are generalizations of observational data that describe patterns and relationships. Laws may change as new data become available.
- *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.

Essential Knowledge and Skills

Skills

- Compare topographic maps of different scales.
- Construct a graph, table, chart, and/or diagram from data.
- Interpret graphs and diagrams.
- Use scientific methodology to design and test a hypothesis.
- Compare and contrast hypotheses, theories, and scientific laws. For example, students should be able to compare/contrast the Law of Superposition and the Theory of Plate Tectonics.

Standard ES.2 a, b, c, d, e

The student will demonstrate scientific reasoning and logic by

- a) analyzing how science explains and predicts the interactions and dynamics of complex Earth systems;
- b) recognizing that evidence is required to evaluate hypotheses and explanations;
- c) comparing different scientific explanations for a set of observations about the Earth;
- d) explaining that observation and logic are essential for reaching a conclusion; and
- e) evaluating evidence for scientific theories.

Essential Understandings

- Earth is a dynamic system, and all atmospheric, geological, and oceanographic processes interrelate and influence one another.
- Conclusions are only as good as the quality of the collected data.
- Any valid hypothesis can be tested.
- Any valid scientific theory has passed tests designed to invalidate it.
- A hypothesis can be supported, modified, or rejected based on collected data.
- Experiments are designed to test hypotheses.
- There can be more than one explanation for any phenomena.

Essential Knowledge and Skills

Skills

- Make predictions, using scientific data and data analysis.
- Use data to support or reject a hypothesis.
- Explain how the scientific method is used to validate scientific theories.

Standard ES.3 a, b, c, d

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;
- b) imagery (aerial photography and satellite images);
- c) direction and measurements of distance on any map or globe; and
- d) location by latitude and longitude and topographic profiles.

Essential Understandings

- Scale relates to actual distance.
- Topographic maps, air photos, and satellite images relate to actual 3-D landforms.
- Grid systems are used to define locations and directions on maps, globes, and charts.

Essential Knowledge and Skills

Skills

- Read and interpret maps, including legends and lines (e.g., contour and isobar).
- Locate points and directions on maps and globes, using latitude and longitude.
- Construct profiles from topographic contours.
- Determine distance and elevation on a map.
- Identify a hilltop, stream, and valley on a topographic map.

Standard ES.14 a, b, c, d, e

The student will investigate and understand scientific concepts related to the origin and evolution of the universe. Key concepts include

- a) nebulae;
- b) the origin of stars and star systems;
- c) stellar evolution;
- d) galaxies; and
- e) cosmology including the big bang theory.

Essential Understandings

- The universe is vast and very old.
- The big bang theory is our best current model for the origin of the universe.
- The solar nebular theory is our best current idea for the origin of the solar system.
- Stars have a finite lifetime and evolve over time.
- The mass of a star controls its evolution, length of its lifetime, and ultimate fate.

Essential Knowledge and Skills

Knowledge

- The big bang theory states that the universe began in a very hot, dense state that expanded and eventually condensed into galaxies.
- The solar nebular theory explains that the planets formed through the condensing of the solar nebula.
- Stars form by condensation of interstellar gas.
- The Hertzsprung-Russell diagram illustrates the relationship between the absolute magnitude and the surface temperature of stars. As stars evolve, their position on the Hertzsprung-Russell diagram moves.
- *Galaxies* are collections of billions of stars. The basic types of galaxies are spiral, elliptical, and irregular.
- The solar system is located in the Milky Way galaxy.

Standard ES.14 a, b, c, d, e (continued)

Essential Understandings	Essential Knowledge and Skills
	<ul style="list-style-type: none">• A <i>light-year</i> is the distance light travels in one year and is the most commonly used measurement for distance in astronomy.• Much of our information about our galaxy and the universe comes from ground-based observations.