# **Earth Science II: Geology Content Guidelines**

## I. Science and Engineering Practices

Using the content in the Earth Science II - Geology Content Guidelines, students will demonstrate an understanding of scientific and engineering practices by

1. asking questions and defining problems

* ask questions that arise from careful observation of phenomena, examination of a model or theory, or unexpected results, and/or to seek additional information
* determine which questions can be investigated within the scope of the school laboratory or field experience
* generate hypotheses based on research and scientific principles
* make hypotheses that specify what happens to a dependent variable when an independent variable is manipulated
* define design problems that involve the development of a process or system with multiple components and criteria

1. planning and carrying out investigations

* individually and collaboratively plan and conduct observational and experimental investigations
* plan and conduct investigations to test design solutions in a safe and ethical manner including considerations of environmental, social and personal effects
* select and use appropriate tools and technology including hand specimens, topographic maps and other types of contour maps, geologic maps, surveying compass, microscopy, image processing, digital electronic tools, and other scientific instruments to collect, record, analyze, and evaluate data

1. interpreting, analyzing, and evaluating data

* construct and interpret data tables showing independent and dependent variables, repeated trials, and means
* construct, analyze, and interpret graphical displays of data and consider limitations of data analysis
* apply mathematical and statistical concepts and processes in building and revising models, supporting explanations of phenomena, or testing solutions to problems
* analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution

1. constructing and critiquing conclusions and explanations

* construct and revise explanations based on valid and reliable evidence obtained from a variety of sources including students’ own investigations, models, theories, simulations, and peer review
* apply scientific ideas, principles, and/or evidence to explain phenomena and design solutions
* construct arguments concerning geological theories and models based on evidence and discuss these issues from multiple scientific viewpoints
* compare and evaluate competing arguments or design solutions in light of currently accepted explanations and new scientific evidence
* construct arguments or counter-arguments based on data and evidence

1. developing and using models

* evaluate the merits and limitations of models
* develop, revise, and/or use models based on evidence to illustrate or predict relationships
* construct and/or interpret map scales, satellite imagery, diagrams, classification charts, graphs, tables, models, geologic cross sections, and topographic profiles
* read and interpret topographic and basic geologic maps and globes, including location by latitude and longitude
* develop and/or use models to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems

1. obtaining, evaluating, and communicating information

* compare, integrate, and evaluate sources of information presented in different media or formats to address a scientific question or solve a problem
* gather, read, and evaluate scientific and/or technical information from multiple sources, assessing the evidence and credibility of each source
* communicate scientific and/or technical information about phenomena and/or a design process in multiple formats

## II. Earth Materials

ES II. 2 The student will investigate and understand that there are 20 common minerals on Earth that have specific characteristics. Key concepts include

* there are eight chemical elements composing the greatest percentage of minerals on Earth;
* minerals are classified based on chemical composition; and
* the characteristics of minerals are the result of its chemical composition and processes of mineral formation.

ES II. 3 The student will investigate and understand that geologists categorize rocks into three basic classifications. Key concepts include

* igneous rock identification is based on the relative mineral composition and the rate of mineral crystallization that produce different textures;
* sedimentary rock identification is based on the grain size, texture, and mineral composition of the rock;
* metamorphic rock identification is based on the observed texture/fabric and mineral composition; and
* geological processes and/or ancient environments can be inferred based on observations of rock.

## III. Geologic Time

ES II. 4 The student will investigate and understand that Earth’s history is subdivided into blocks of geological time based on major events. Key concepts include

* geologists use evidence found in radiometric dating to determine that the Earth is 4.6 billion years old;
* relative and absolute dating are methods used to interpret Earth's geologic history;
* Earth’s history is subdivided into block of time using observations of rock types and fossil assemblages resulting in scientific interpretations of global events; and
* the geologic history of Virginia can be interpreted using rocks, fossils, geological maps, and the geological time scale.

ES II. 5 The student will investigate and understand how fossils are formed and how they are used to infer aspects of Earth’s history. Key ideas include

* fossilization processes are dependent upon tissue type, external conditions, and form of preservation;
* observations demonstrate that fossils occur in a predictable succession in Earth's history; and
* fossils found in Virginia and other places can be used to infer ancient climates and/or environmental conditions of the region.

## III. Earth Systems and Plate Tectonics

ES II. 6 The student will investigate and understand that recent advances in technologies have resulted in data analyses that continually change our understanding of Earth’s environmental and geophysical systems. Key concepts include

* analyses of world-wide seismic data have resulted in our evolving understanding of Earth’s interior functions and processes;
* global instrumentation and analysis has demonstrated the relationship between geological systems and environmental systems;
* changes in atmospheric and geologic systems drive changes in hydrologic, biologic, and environmental systems.
* in geologic history alterations in tectonic and environmental systems have produced global climate changes and mass extinctions defined in the geo-historical record;
* more recent human alterations to Earth’s geological systems are altering Earth’s environmental systems; and
* advances in geospatial technologies provide new information and data that influence society.

ES II. 7 The student will investigate and understand that the Theory of Plate Tectonics explains a diverse set of geological phenomena. Key concepts include

* the development of the Theory of Plate Tectonics demonstrates the nature of science;
* Earth’s crust is differentiated into oceanic crust and continental crust and separated into approximately 24 large plates;
* plates move independently and interact at boundaries;
* stress at plate boundaries alters rock, producing folds, faults, and metamorphism;
* Earth’s crust is in isostatic equilibrium with the gravitational field; and
* the geologic map of Virginia can be used to interpret the geologic history of Virginia, and predict types of rock to be found.

## IV. Geomorphology

ES II. 8 The student will investigate and understand the processes that shape Earth’s surface landscapes. Key concepts include

* Water and climate have shaped, and continue to shape Earth’s surface;
* Chemical and physical weathering processes result from the interactions between the geosphere, hydrosphere, atmosphere, and biosphere;
* Rates and styles of weathering change with climate and landscape and affect and alter Earth’s biogeochemical systems; and
* Virginia has a variety of different landscapes and landforms that have developed across the Physiographic Provinces of Virginia as a result of erosion, deposition, and underlying stratigraphy.