Richmond Public Schools

Department of Curriculum and Instruction
Curriculum Pacing And Resource Guide – Unit Plan

Course Title/ Course #: Earth Science 1 Earth's composition, history and pattern of change over time

Unit Title/ Marking Period # (MP): Geologic Processes, Time ES. 7a-b, ES.9a-d,

Start day:

Meetings (Length of Unit):

Desired Results ~ What will students be learning?

Standards of Learning/ Standards

ES.7 The student will investigate and understand geologic processes including plate tectonics. Key concepts include
a) geologic processes and their resulting features; and
b) tectonic processes.

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
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.

Essential Understandings/ Big Ideas

ES.7

- 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.
- The concepts developed in this standard include the following:
- 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

ES. 9

The concepts developed in this standard include the following:

- 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.

Key Essential Skills and Knowledge

ES.7

- analyze the body of evidence for Plate Tectonics Theory (i.e., seafloor age, magnetic information, seismic profiles, laser-measured motion studies, fossil evidence, rock types associated with particular tectonic environments).
- analyze the various structures produced in convergent plate boundaries.
- offer interpretations of the tectonic history of an area based on the range and type of rocks found in that area.
- compare and contrast the tectonic activity of the east coast and the west coast of North America.
- label on a map the physiographic provinces of Virginia.
- comprehend the topographic, rock-type and geologic-structural characteristics of each physiographic province of Virginia.
- analyze the geologic history of Virginia in terms of the structures, rock types, and topography represented in the five physiographic
- provinces.
- integrate and interpret the rock cycle, plate tectonics, and Virginia's geology in an interacting diagram.
- analyze how multiple continental collisions and rifting events over the last billion years have created the current physiography of Virginia.
- comprehend and apply the details of Plate Tectonics Theory to the formation of continents, mountain chains, island arcs, deep open
- trenches, earthquake zones, and continental and mid-ocean volcanism.
- analyze the composition and structure of the continental and oceanic lithosphere in terms of topographic features, density, thickness, and rates of motion.
- compare and contrast various types of volcanism and geothermal activity (i.e., Hawaii, Iceland, Mount St. Helens, Catoctin Greenstone, Tambora, the Deccan Traps, and Yellowstone).
- compare and contrast different types of current and ancient plate boundaries (i.e., Japan, California, New Madrid, Missouri, the
- Appalachian system, Iceland, and Tonga).
- analyze how seismic waves provide evidence of the structure of the deep Earth including the inner and outer core in terms of composition, density, and viscosity. analyze the body of evidence for Plate Tectonics Theory (i.e., seafloor age, magnetic information, seismic profiles, laser-measured motion studies, fossil evidence, rock types associated with particular tectonic environments).
- analyze the various structures produced in convergent plate boundaries.
- offer interpretations of the tectonic history of an area based on the range and type of rocks found in that area.

- compare and contrast the tectonic activity of the east coast and the west coast of North America.

ES. 9

In order to meet this standard, it is expected that students will

- describe how life has changed and become more complex over geologic time.
- interpret a simple geologic history diagram, using superposition and cross-cutting relations.
- analyze how radioactive decay provides a reliable method to determine the age of many types of organic and inorganic materials.
- analyze the impact and role of global catastrophies (including asteroid/comet impacts, volcanism, continental collisions, climate
- collapse) on extinctions and evolution.
- analyze and interpret complex cross sections using both relative and absolute dating to unravel and define the geologic history of the section.

Vocabulary

ES. 7

alluvial	erosion	magnetometer	seismic wave
asthenosphere	faulting	mantle	seismograph
caldera	floodplain	metamorphism	shadow zone
cinder cone	folding	normal fault	soil
composite volcano	glacier	outer core	strike-slip fault
creep	gravity	outwash	subduction
deflation	ice wedging	Pangaea	subduction zones
delta	inner core	reverse fault	till
deposition	leaching	runoff	transform fault
desertification	lithosphere	sea-floor-spreading	volcanism
divergent boundary	loess	sedimentation	weathering
epicenter	focus	seismic wave	wind
Fall line	Tidewater	Shenandoah valley	karst topography
Appalachian Plateau	orogeny	Valley and Ridge	Piedmont

ES. 9

absolute dating	disconformity	Law of Superposition	radioactive
amber	epoch	mold	radiometric dating
angular	extinct	mountain	relative dating
carbonaceous film	period	ridge	fossils
cast	geologic time	petrified remain	unconformities
coastal	half-life	Piedmont	uniformitarianism
decay	index fossil		

Assessment Evidence ~ What is evidence of mastery? What did the students master & what are they missing?

Assessment/ Evidence

Evidence of mastery: Students will display mastery by consistently scoring at a "C" or above on all assessements. Success and mastery will also be shown by increasing scores from the beginning of the unit to the end of the unit. Overall mastery of the content and targeted objectives will be assessed during final unit assessment.

Assessment Methods:

- Teacher created IA Test/Quiz
- Group Discussions
- Predict and Explain Assessments- students apply principles and evidence
- Research Reports & Presentations
- Visual Displays- Concept maps, Diagrams, Models

Possible learning Gaps/Misconceptions

ES. 7

- Only continents move (Wegener's original concept, along with the common use of 'Continental Drift' term in general texts, secondary education earth science films, etc.)
- Most crust motions (especially those associated with processes of mountain building or deep sea trench formation) are due to vertical motions, not lateral (terms like 'mountain uplift' and earth science textbook terminology, as well as relict idea from old cosmologies).
- Divergent ocean ridges are due to vertical uplift or convergence, rather than divergence (In students' experience, buckling is usually due to convergence or uplift, not heat/density differences, so illustrations of ridges do not readily fit with a pulling apart motion).
- Crust and Lithosphere (or plates) are synonymous terms.
- Asthenosphere is liquid (students are only familiar with liquid convection, not solid convection, many secondary education earth science films also specifically refer to a molten internal layer, and some fundamentalist religious groups specifically refer to the existence of a molten layer that is hell's physical location).
- Lower Mantle is liquid (for reasons similar to above).
- Earth's core is hollow, or that large hollow spaces occur deep within Earth (a relict of older cosmology and a mainstay of popular literature

and Hollywood movies).

ES. 9

- Human time scale is too short to observe concepts of geologic time
- Students focus on the most recent time periods, and largely ignore the first 4 billion years of Earth's history
- The Earth has undergone drastic changes since its formation which are hard to conceptualize
- Religious beliefs contradict concepts of geologic time

Learning Plan ~ What are the strategies and activities you plan to use

Learning Experiences/ Best Practice

- Have students to analyze the body of evidence for Plate Tectonics Theory (i.e., seafloor age, magnetic information, seismic profiles, laser-measured motion studies, fossil evidence, rock types associated with particular tectonic environments).
- Have students to analyze the various structures produced in convergent plate boundaries.
- Have student to offer interpretations of the tectonic history of an area based on the range and type of rocks found in that area.
- Have students to compare and contrast the tectonic activity of the east coast and the west coast of North America.
- Have student to describe how life has changed and become more complex over geologic time.
- Have student to interpret a simple geologic history diagram, using superposition and cross-cutting relations.
- Have students to analyze how radioactive decay provides a reliable method to determine the age of many types of organic and inorganic materials.
- Have students to analyze the impact and role of global catastrophes (including asteroid/comet impacts, volcanism, continental collisions, climate collapse) on extinctions and evolution.
- Have students to analyze and interpret complex cross sections using both relative and absolute dating to unravel and define the geologic history of the section.
- Have the student to analyze the array of climate feedback mechanisms that control the Earth's temperature over time, and compare and contrast these feedback mechanisms to those operating on inner planets and the gas giants.
- Have the student to analyze the evidence for atmospheric compositional change over geologic time including oxygen and carbon sinks and the role of photosynthetic organisms.
- Have the student to explain how volcanic activity or meteor impacts could affect the atmosphere and life on Earth.
- Have the student to explain how biologic activity, including human activities, may influence global temperature and climate.
- Have students to contrast the life span and energy output of a blue giant star to that of the sun and relate this to the potential existence of life on planets in its orbit.
- Have students to explain the potential origin and role of ultra massive black holes in the center of galaxies.
- Have students to using the Hertzsprung-Russell diagram, classify stars as to their place on the main sequence or in beginning or end points in their life cycles.
- Have students to evaluate the probability of travel to nearby solar systems using current spacecraft speeds.
- Have student to analyze the various fusion products of a blue giant star over its lifetime, and relate this to the presence

and abundance of elements that make up our solar system and its contents, including living organisms

Technology Integrations

Web Resources

ABC's of nuclear science

Radioactive decay (advanced)

Radiometric time scale

History of radiocarbon dating

Radioactive decay simulations

Fossils and Relative Dating Worksheet

Exploring Geologic Time Illustrated

Laws of superposition, Cross Cutting, Intrusions

Who Dunit? Law of superposition

Graham Cracker Model of Plate Movements

Modeling sea floor spreading

Volcanoes
Ocean floor map
Age of ocean floor
Plate tectonics
Seafloor spreading activity
Plate tectonics activity
Discovering plate boundaries activity
Seafloor spreading

Build a seismograph

Seismology

Locating the epicenter

Virtual earthquake

How a seismograph works

Resources

Sample Lesson Plans (VDOE)
Determine Absolute Age

Cross Curricular Connection

English/ Writing Assignment- Describe how fossils provide important evidence of how life and environmental conditions have changed.

English(Presentation)- Student may bring in articles from magazine and newspapers concerning global warming and/and or the greenhouse Effects and share with the class.