APS Science Curriculum Unit Planner

Grade Level/Subject	High School Earth Science
Stage 1: Desired Results	
Enduring Understanding	
The processes of Earth are cyclical in nature, continually reshaping the Earth and its materials with no loss or gain of matter.	
Correlations	
Unifying Understanding	
VA SOL	ES.5 a,b, ES.6 a-c, ES-7 a,c, ES.9 a-d,f
NSES (grade level)	UCP 3,4, ES 2b, ES 3c, PS 2,3, SPSP 5, HNS 3
AAAS Atlas	
Essential Questions	
• How does the Earth's heat change or create rocks and minerals? • How are rocks and minerals found, differentiated, and used to benefit human life? • How do Earth processes change Earth materials? • How have Earth's physical features evolved over time?	
Knowledge and Skills	
Students should know:	
• How to interpret and explain the rock cycle diagram. • Uses of certain rocks and minerals as resources and their benefits • The effect of human use on resources • Processes involved in soil formation • How water shapes the Earth with the assistance of gravity both above and below ground • How to interpret and explain the water cycle • Explain how Earth's processes breakdown and move Earth materials	
Students should be able to:	
• Identify physical characteristics of minerals • Identify geologic process, texture, and composition of specific rocks • Identify basic structure of a watershed • Compare and contract renewable and non-renewable resources • Identify major VA rock and mineral resources	
Stage 2: Assessment Evidence	
Prior Knowledge and Skills	
• Explain the basic structure of matter and bonding. • Interpret the periodic table of elements. • Ability to compare and contrast • Use various kinds of computer technology(internet, Word, PowerPoint) • Scientific method • Concept of a resource as a useful commodity • Know the water cycle	

- *The three different types of rocks and how they are formed*
- *The terminology associated with the water cycle (transpiration, runoff, condensation, precipitation, evaporation)*
- *Examples of the three types of rock*
- *The distinct soil layers and unique features*
- *The definition of renewable and nonrenewable resources and examples*
- *The various ways that humans use resources*
- *The definition of minerals and ways to identify them*
- *The four main agents of erosion*
- *The difference between chemical and physical weathering*

Formative Assessment	**Summative Assessment**
• Labs • Worksheets • Quizzes	• Notebook • Tests • *Projects*

Stage 3: Learning Plan

References to Adopted Materials

- Holt Ch 5 – Defining and Identifying minerals
- Holt Ch 6 – Rocks and the rock cycle
- Holt Ch 7 – Resources and Energy
- Holt Ch 14, Sect 3,4 – Soil formation, Erosion
- Holt Ch 15 – River systems
- Holt Ch 16 – Groundwater

- *Prentice Hall, Pg. 32-63 (Minerals)*
- *Prentice Hall, Pg. 64-91 (Rocks)*
- *Prentice Hall, Pg. 92-123 (Earth's Resources)*
- *Prentice Hall, Pg. 126-132 (Weathering)*
- *Prentice Hall, Pg. 133-142 (Soil)*
- *Prentice Hall, Pg. 143-155 (Mass Movement)*
- *Prentice Hall, Pg. 158-159 (Water Cycle)*
- *Prentice Hall, Pg. 164 (Water Erosion)*
- *Prentice Hall, Pg. 192-195 (Glacier Erosion)*
- *Prentice Hall, Pg. 203-204 (Wind Erosion)*
- *Prentice Hall, Pg. 208-209 (Erosion : How the Earth Works)*

Suggested Investigations

- Identify connections with the carbon fixing cycle
- Mineral Activity, p103
- Growing crystals inquiry lab, p106
- Copper Recovery, Chapter Resources
- Using density to define minerals
- Mineral identification station lab
- Geologic Map of Virginia, p152
- Poster project on rock types, p132

- Wind mill inquiry lab modeling, p178
- Natural gas from biofuels inquiry, Chapter resources
- Identifying alternative energy resources in VA, Chapter resources
- Stream table lab
- Compost lab for soil demonstration
- Soil profiling lab, Chapter resources
- Colorado river investigation/project
- Mississippi river delta changes/Katrina connections
- Ogallala aquifer mapping, p416
- Permeability lab, p398
- Himalayan glacial fed rivers
- Needs for damming, salt water purification systems
- Debate on urgency between energy emergency or the water emergency

- *Create a rock cycle diagram using arrows, terminology, and rocks in the proper places*
- *Identify rocks and minerals using specific properties and tests*
- *Mining for ores using a chocolate chip cookie*
- *Research alternative ways of using resources that are being depleted*
- *Edible Rock Cycle*
- *Research ways that minerals are used that come from Virginia (i.e. kyanite) and create a PowerPoint to teach the class*
- *Create a soil profile box*
- *Create a soil profile using pudding, M&Ms, and coconut*
- *Create a soil profile using various horizons*
- *Take samples of soils and analyze them for sediment size and use the chart to determine what type of soil it is*
- *Research one mineral and come up with a poster of its characteristics (formula, traits, etc.)*
- *Discuss how minerals and rocks are used in everyday life*
- *Identify the watersheds that you live in and some of the environmental concerns associated with them*
- *Identify various objects and the type of weathering that has impacted them*
- *Present the four types of erosion and the terminology associated with examples of where they can be found*

Outdoor Education Applications

- Local stream investigations

- *Look at the various rocks/minerals and identify/classify them*
- *Analyze soils*
- *Look at the watershed in your area and analyze water samples*

Resources

Web Sites

- Atlanta Water Crisis WebQuest (here)
- http://www.agiweb.org/earthcomm/naturalresources/index.html?State=VA
- http://www.agiweb.org/earthcomm/environment/riversystems/index.html?State=VA
- http://geoweb.tamu.edu/faculty/herbert/bigbend

• http://library.thinkquest.org/J002289/index.html • http://earth.simmons.edu/monitoring_projects/index.html • http://www.galaxynet.com/~corvid/ear/earu_rocks.htm • http://www.bbc.co.uk/schools/gcsebitesize/chemistry/changestoearthandatmosphere/0rocksrev1.shtml
Videos
• Virginia Geology CD-ROM series • Bill Nye: Rocks and Soils
Online clips
• Minerals (here), Discovery Streaming
Field Trips
• Luray Caverns • *Go to the Virginia Department of Mines & Mineral Resources and look at their rock garden* • *Go to the USGS in Reston, Virginia and look at the various samples that they have and talk to a scientist* • *Go to the Natural History Museum and view the rocks/minerals exhibit* • *Visit some of the local watershed*
Other
• Virginia Geology Maps

*_Italics_ denote additional suggestions for Intensified. Intensified may include suggestions from Regular.

Textbook Correlations to Essential Questions and Enduring Understandings	
How does the Earth's heat change rocks and minerals?	
Matter cycles on earth in the rock cycle driven by internal heat of mantle convection and differential solar warming, atmospheric and hydrologic exposures.	Holt: Ch 2. 1, .2 Prentice Hall Ch 3.1
The earth is differentiated into layers of distinct elemental composition, thickness and temperature.	Holt: Ch 2. 1, .2; Ch 13.1 Prentice Hall Ch 2.1, .2; Ch 8
The crystallization of minerals in magma is determined by the elemental composition of the liquid and occurs in a predictable pattern known as Bowen's reaction series.	Holt: Ch 6.1 Prentice Hall Ch 2.2
Rocks are combinations of minerals bound together in some way by forces of heat and/or pressure.	Holt: Ch 5.1, .2 Prentice Hall Ch 3
How are rocks and minerals found, differentiated, and used to benefit human life?	
Minerals and rocks are found in the earth's crust and differentiated by their composition and process of formation. Rocks are classified into three groups: igneous, metamorphic, and sedimentary.	Holt: Ch 6.1, .2, .3 Prentice Hall Ch 2.2
Metallic minerals such as gold and silver are native elements and can exist in the crust as nuggets of pure metal. Humans obtain these and other valuable ores through mining processes.	Holt: Ch 7.1 Prentice Hall Ch 2

Knowledge of geology aids the discovery of mineral deposits. Atomic structure determines a mineral's physical and chemical properties.	Holt: Ch 7.1 Prentice Hall Ch 2.2
Tools used in exploration measure and identify patterns of magnetism, gravity, radioactivity and rock color.	Holt: Ch 7.1
Earth's resources are used to benefit life in a variety of ways by providing raw materials, e.g., metals for wiring and other electronics applications, iron for making steel, quartz for glass, calcite as building material, etc.	Holt: Ch 7.1 Prentice Hall Ch 4
How do Earth processes change Earth materials?	
Minerals and rocks can be physically altered by weathering processes.	Holt: Ch 5.1, .2; Ch 6.1 -.4; Ch 14.1-.4 Prentice Hall Ch 3.1; Ch 5.1
Minerals and rocks can be chemically altered by weathering processes.	Holt: Ch 5.1, .2; Ch 6.1 -.4; Ch 14.1-.4 Prentice Hall Ch 3.1; Ch 5.1
Tectonic processes can uplift and expose rocks and heat and pressure can metamorphosis existing rock.	Holt: Ch 6.1 -.4 Prentice Hall Ch 3.1
Porosity and permeability determine how water moves through rock and sediment; the composition of these materials determine the structures to be created: aquifers, caverns, sinkholes, karst topography	Holt: Ch 16.1, .2 Prentice Hall Ch 6
Erosion by wind, waves, ice and water reshape topography in such features as canyons, mesas, buttes, hanging valleys, barrier islands, sea arches	Holt: Ch 14, 15, 16, 17, 18 Prentice Hall Ch 7
How have Earth's physical features evolved over time?	
Chemical and physical changes have turned the remains of plants into coal.	Holt: Ch 7.2 Prentice Hall Ch 4.1
Chemical and physical changes have turned the remains of ancient microorganisms into petroleum and natural gas.	Holt: Ch 7.2 Prentice Hall Ch 4.1
Humans have used fossil fuels and in doing so altered the composition of the atmosphere.	Holt: Ch 7.2 Prentice Hall Ch 4.3
Earth's features are constantly changing as weathering reshapes the surface; running water redistributes weathered rock and creates soil through the process of erosion.	Ch 14.1-.4; Ch 15.1-.3 Prentice Hall Ch 5
Running water shapes its watershed; the weathering of mountain ranges creates coastal plains.	Ch 14.1-.4; Ch 15.1-.3 Prentice Hall Ch 6

Minerals Study Guide

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

a) hardness, color and streak, luster, cleavage, fracture, and unique properties; and
b) uses of minerals.

A mineral is a, naturally occurring, inorganic, solid with a definite chemical composition and crystalline structure.

Crystals are solids with regularly repeating geometric pattern.

A native mineral is made of only one element, such as copper, gold, or silver.

Most minerals are compounds made of 2 or more elements in a definite proportion. Variations of mineral composition do occur in small difference and these differences often give a mineral its unique color.

The first most easily observed mineral characteristic is color.

Streak is the color of the mineral's powder.

Luster is the way a mineral reflects light. A mineral can metallic luster, non metallic luster, or no luster.

Cleavage is the way a mineral breaks along the crystal pattern in such a way as to produce a flat plane. Some minerals break with fracture without a smooth plane.

Hardness is the measure of a mineral's resistance to being scratched. Moh's scale is used to rate hardness. A diamond is the hardest material known with a moh's scale of 10. It will scratch everything. Talc is a hardness of 1 and can be scratched by everything else. Industrial diamonds are used in drill bits and saws.

A hardness of 5 will be scratched by any higher number, 6, 7, 8, 9, or 10. A hardness of 5 will scratch a 4, 3, 2, or 1.

Density is the mass divided by the volume. All matter had mass, volume, and density. Volume can be calculated using V=Length X height X width. If the object is not a regular geometric, then volume by displacement can be used. Fill a graduate to a water level, for example, 50ml. Place the object in the liquid and record the higher water level. The difference between the second level with the object and the first level without the object is the volume of the object itself.

The most abundant element in earth's crust is oxygen followed by silicon therefore the most abundant rocks on earth are silicates, combinations of oxygen and silicon.

Surface Forces

ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include

a) processes of soil development;
b) development of karst topography;
c) identification of groundwater zones including the water table, zone of saturation, and zone of aeration;
d) identification of other 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.

The hydrosphere and the geosphere interact in the rock cycle in the processes of weathering, erosion, deposition, cementation and lithification.

Water moves through its cycle by interacting with the atmosphere and geosphere in the processes of evaporation, condensation, precipitation, infiltration, transpiration and run off.

Rock material is constantly changing. On the surface mechanical forces break rock into smaller pieces increasing surface area. Chemical agents act on increased surface area and further alter rock material. When organic matter mixes with weathered rock, soil is formed. Erosion is the process by which weathered rock material is transported by the action of: running water, ice, wind, waves, and biological forces. These agents of erosion create landform patterns such as canyons, alluvial fans, and deltas. The latter two are created when running water reaches base level, slows down and drops the sediment load.

When water falls to earth's surface in the form of rain, hail, sleet or snow, it shapes a watershed. A watershed is all the land that drains into a body of water. It is separated from adjacent watersheds by a divide, the high elevation land that separates the drainage patterns of watersheds. Water erodes a path over the land it travels and based on changes in elevation can form a variety of features including: waterfalls, meanders, oxbow lakes, potholes. Almost all watersheds eventually flow into the earth's ocean basins.

In the United States, the Rocky Mountains form the continental divide which separates river systems flowing into the Atlantic basin from those flowing into the Pacific basin. In Virginia, the Blue Ridge forms the headwaters of the major rivers: James, York, and Rappahannock. The Shenandoah River flows northward through the Valley and Ridge province joining the Potomac at Harper's Ferry.

Gravity pulls water off the earth's continents into the ocean basins. Because the lithosphere of continental crust (granite) is less dense than oceanic lithosphere (basalt), continents ride higher on the asthenosphere and thus create the gradient down which water flows on earth's surface. Estuaries are formed where water flowing from earth's surface (rivers) interacts with ocean water. These boundaries where fresh water meets

salt water provide habitat for the reproduction of many marine species including two emblematic of the Chesapeake Bay: oysters and blue crab.

The Chesapeake Bay like many other estuaries on earth is suffering the polluting effects of nutrient rich run off. These materials applied to farm lands and ornamental plantings trigger a sequence of events that end in a dead zone, large areas of ocean die offs. The Nitrogen load carried in run off first triggers an algal bloom. These organisms become profuse and block sunlight from reaching the ocean bottom where grasses typically grow. These plants die off and eventually so too do the algae. Their ultimate decay consumes the remaining oxygen. With the die off of photosynthetic plants on the ocean floor and the top water algae, large columns of water become hypoxic and thus deadly to any organism that wanders in. Reducing runoff is a simple way to mitigate this effect.

Water that does not run off can become part of ground water through infiltration. Water moves through the pore spaces of soil and rock. The greater the pore spaces, the higher the porosity and thus the greater ease through which water can flow in these materials. The zone of saturation is the zone within the crust in which the pore spaces are filled with water. The top of the zone of saturation is called the water table and it rises and falls with use of groundwater resources through well usage. Lack of precipitation can also cause the water table to drop. The zone above the water table is called the zone of aeration since air fills the pore spaces instead of water. Groundwater interacts with rock composition and in some areas will combine with CO2 to form carbonic acid which in limestone formations can create caverns and karst topography.

When water arrives at the ocean it carries with it traces of all the materials it has passed over or through. Small amounts of salts are carried from their rock sources into the oceans. As water evaporates from ocean surfaces, salts remains behind. Salinity is the measured of dissolved salts in seawater. The average salinity is 35 parts per thousand. Salinity however can fluctuate based on several factors: 1) high temperatures and evaporation, low precipitation = higher salinity; 2) ice melting in warm ocean currents = lower salinity; 3) ice forming at polar regions = higher salinity; 4) river meeting ocean = lower salinity.

The ocean floor is geologically active and features are found at divergent boundaries of rifting and ridges. Convergent subduction boundaries also create deep trenches.