CHESTERFIELD COUNTY PUBLIC SCHOOLS

Curricular Planning Resource (CPR)
Science 4
GEOLOGY
SOL 4.8c,d
SOL 5.7

STRAND/UNIT/TOPIC: **Resources / Earth Patterns, Cycles, and Change**
PACING: Refer to Pacing Guide

STANDARD(S) AND COMPETENCIES:

4.8c,d The student will investigate and understand important Virginia natural resources. Key concepts include

c) minerals, rocks, ores, and energy sources
d) forests, soil, and land

5.7 The student will investigate and understand how the Earth's surface is constantly changing. Key concepts include

a) the rock cycle including the identification of rock types;
b) Earth history and fossil evidence;
c) the basic structure of the Earth's interior;
d) plate tectonics (earthquakes and volcanoes);
e) weathering and erosion; and
f) human impact.

RELATED STANDARDS/COMPETENCIES: K.10, 1.8, 2.8, 3.10, 3.11
K.8, K.9, 1.6, 2.7, 3.8, 3.9, 4.1, 4.7

UNDERSTANDING THE STANDARD/OVERVIEW:

4.8c,d Virginia has a rich variety of resources. These provide the raw materials for our daily lives and sustain our economy. Natural resources are finite and must be used wisely to insure their continued availability. This concept of natural resources is introduced in 1.8 and extended in 6.9. It is intended that students will actively develop scientific investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

5.7 This standard focuses on the constantly changing nature of the Earth's surface and builds on concepts learned in standards 4.6 and 4.8. Among the important ideas presented in this standard are the rock cycle, fossil evidence of change over time, energy from within the Earth that drives tectonic plate movement, shifting tectonic plates that cause earthquakes and volcanoes, weathering and erosion, and human interaction with the Earth's surface. This standard can be related to several ideas found in science standard 5.6. It is intended that students will actively develop scientific investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

OVERVIEW (TESTED MATERIAL)

4.8c,d The concepts developed in this standard include the following:

- **Virginia is rich in a wide variety of natural resources including** forests, arable (farmable) land, **coal, sand and aggregates (rocks)**, wildlife and aquatic organisms, clean water and air, and beautiful scenery.

5.7 The concepts developed in this standard include the following:

- Rocks move and change over time due to heat and pressure within the Earth and **weathering** and **erosion** at the surface. These and other processes constantly change rock from one type to another.
- Rocks have properties that can be observed, tested, and described. Composition, grain size and textural features, color, and the presence of fossils help with identification. Classification keys (5.1) can aid this process.
- Depending on how rocks are formed, they are classified as **sedimentary** (layers of sediment cemented together), **igneous** (melting and cooling, lava and magma), and **metamorphic** (changed by heat and pressure).
- Scientific evidence indicates the Earth is very ancient (approximately 4.6 billion years old). The age of many rocks can be determined very reliably. Fossils provide information about life and conditions of the past.
- Scientific evidence indicates that the Earth is composed of four concentric layers (crust, mantle, inner core, and outer core), each with its own distinct characteristics. The outer two layers are composed primarily of rocky material. The innermost layers are composed mostly of iron and nickel. Pressure and temperature increase with depth beneath the surface.
- The Earth's heat energy causes movement of material within the Earth. Large continent-sized blocks, (plates) move slowly about the Earth's surface, driven by that heat.
- Most earthquakes and volcanoes are located at the boundary of the plates (faults). Plates can move together (convergent boundaries), apart (divergent boundaries), or slip past each other horizontally (sliding boundaries, also called strike-slip or transform boundaries).
- Geological features in the oceans (including trenches and mid-ocean ridges) and on the continents (mountain ranges, including the Appalachian Mountains) are caused by current and past plate movements.
- Rocks and other materials on the Earth's surface are constantly being broken down both chemically and physically. The products of weathering include clay, sand, rock fragments, and soluble substances. Weathered rock material can be moved by water and wind and deposited as sediment.
- Humans have varying degrees of impact on the Earth's surface through their everyday activities. With careful planning, the impact on the land can be controlled.

ESSENTIAL KNOWLEDGE, SKILLS, OR PROCESSES: (TESTED MATERIAL)

4.8c,d In order to meet this standard, it is expected that students should be able to:

- recognize the importance of Virginia's mineral resources including coal, limestone, granite, and sand and gravel.

5.7 In order to meet this standard, it is expected that students should be able to:

- apply basic terminology (underlined in overview) to explain how the Earth surface is constantly changing.
- draw and label the rock cycle and describe the major processes and rock types involved.
- compare and contrast the origin of igneous, sedimentary, and metamorphic rocks.

- identify rock samples (granite, gneiss, slate, limestone, shale, sandstone, and coal) using a rock classification key.
- make plausible inferences about changes in the Earth over time based on fossil evidence. This includes the presence of fossils of organisms in sedimentary rocks of Virginia (the Appalachians, Piedmont, and Coastal Plain/Tidewater).
- describe the structure of Earth in terms of its major layers (crust, mantle, and inner and outer cores) and how the Earth's interior affects the surface.
- differentiate among the three types of plate tectonic boundaries (divergent, convergent, and sliding boundaries) and how these relate to the changing surface of the Earth and the ocean floor (5.6).
- compare and contrast the origin of earthquakes and volcanoes and how they affect the Earth's surface.
- design an investigation to locate, chart, and report weathering and erosion at home and on the school grounds. Create a plan to solve erosion problems that may be found.
- differentiate between weathering and erosion.
- design an investigation to determine the amount and kinds of weathered rock material found in soil.
- describe how people change the Earth's surface and how negative changes can be controlled.

SAMPLE STRATEGIES:

THE ROCK CYCLE INCLUDING THE IDENTIFICATION OF ROCK TYPES

- Touch, smell, and look at rock samples to discover more about their composition.
- Scratch several minerals to determine hardness.
- Identify common minerals found in Virginia.
- Describe rocks by the properties of weight, size, and appearance.
- Break apart and classify the ingredients in a man-made rock.
- Observe the layers of sediment that form in a vial.
- Observe that matter previously dissolved in water will often form crystals when water evaporates.
- Use vinegar to determine the presence of calcite in different rock samples,
- Listen to the book Two Bad Ants, which is about sugar crystals, to reinforce science vocabulary, make observations, and draw conclusions.
- Develop a poster that shows a rock moving through the rock cycle.
- Pretend you are a rock and describe your journey through the rock cycle.

EARTH HISTORY AND FOSSIL EVIDENCE

- Make a mold and cast fossil using plaster of Paris.
- Observe, describe, and interpret fossil remains to identify the animal they represent.
- Construct a geologic timeline.
- Read and listen to stories about the James River.
- Write an article for a journal acting as the first explorer to reach the Fall Line of the James.

BASIC STRUCTURE OF THE EARTH'S INTERIOR

- Experiment with layers of bread and peanut butter and jelly to represent the earth's layers and the effects of different types of movements.
- Mindmap the layers of the earth.
- Explore facts about the inside of the earth by reading The Magic School Bus

- Inside the Earth and Could You Ever? Dig a Hole to China.

PLATE TECTONICS

- Create the continents and oceans on a hard-boiled egg and then crack the egg to observe the effect of plate tectonics.
- Use sponges to discover what happens at a fault.
- Cut out the continents and put them together like a puzzle to explain continental drift.
- Use a tank of water to simulate the ripple effect of an earthquake.
- Use a graph of past earthquakes to predict future earthquakes.
- Use a shoebox, rubber bands, and paper clips to construct a seismograph.
- Listen to a book about volcanoes or earthquakes and apply the information learned to music, science, and math.
- Write and illustrate a song describing geological processes.

WEATHERING AND EROSION

- Formulate a model to demonstrate how freezing water can cause rocks to break up.
- Study a table and determine why a monument changed faster in New York City than Cairo.
- Infer from a model that rocks become rounded from interactions with running water.
- Demonstrate chemical weathering by pouring vinegar on chalk.
- Observe signs of weathering in your neighborhood and determine what caused the weathering.
- Construct a model of sand, gravel, and dirt. Explore the effect of water on the model.
- Rub rocks together to produce the same results as wind blowing sand against rocks.
- Observe that faster moving water carries more sediment than slower moving water.

HUMAN IMPACT

- Go on a scavenger hunt to identify and collect everyday items made from minerals, rocks, petroleum, and coal.
- Read and listen to stories about the James River and write an article for a journal acting as the first explorer to reach the Fall Line of the James.
- Research minerals mined in Virginia.
- Find ways that weathering around the school can be fixed.

RESOURCES

- Identify common minerals found in Virginia.
- Make a map of Virginia and identify the regions. Make flags to identify what resource(s) is found in each region. (This can be done in a group or as an individual.
- Research the most profitable resource in Virginia and write a report on that resource.
- Have students work together in groups to make a poster of a region. On that poster include, the resources found in that region, the characteristics of that region, reasons people should visit that region, and an illustration depicting the region.
- Dig soil samples from different areas around the school. Separate the samples and see if there are any identifiable resources in the soil.

SAMPLE RESOURCES:

- Books

Rocks and Minerals, Neil Morris, Crabtree Publishing Company, 1998

Let's Go Rock Collecting, Roma Gans, HarperCollins Children's Books, 1997

Rocks and Minerals (Spotlights), Neil Curtis, Oxford University Press, 1998

The Magic School Bus Inside the Earth, Joanna Cole, Scholastic, 1987 ISBN 0-590-40760-0

Everybody Needs a Rock, Byrd Baylor, Aladdin Paperbacks, 1974

What Happens to Rock? Fred Biddulph, The Wright Group Publishing, Inc., 1995

Is There a Dinosaur in Your Backyard? Spencer Christian, John Wiley & sons, Inc., 1998

Milo and the Magical Stones, Marcus Pfister, North-South Books, Inc., 1997

My Ol' Man, Patricia Polacco, PaperStar, 1999

The Best Book of Fossils, Rocks, and Minerals, Chris Pellant, Larousse Kingfisher Chambers Inc., 2000

On My Beach There Are Many Pebbles, Leo Lionni, Mulberry Books, 1995

The Worry Stone, Marianna Dengler, Northland Publishing Company, 1996

Discover Rocks & Minerals, Joel E. Arem, Publications International, 1991

The Earth & Beyond, Chris Oxlade, Heineman Library, 1998

Janice Van Cleave's A+ Projects in Earth Science: Winning Experiments for Science Fairs and Extra Credit, Janice VanCleave, John Wiley & sons, Inc., 1998

Planet Earth, Time-Life Student Library, Jean Crawford, Time Life, 1999

Rocks & Fossils, (Nature Company Guide), Arthur Busbey, Time Life, 1996

Everybody Needs a Rock, Byrd Baylor, Aladdin Paperbacks, 1987

Rocks & Minerals (Eyewitness Books), Dr. R.F. Symes, Dorling Kindersley Publishing, Inc., 2000

Rocks and Minerals (Eyewitness Explorers), Steve Parker, Dorling Kindersley Publishing, Inc., 1997

America's Top 10 Natural Wonders, Edward Ricciuti, Blackbirch Marketing, 1998

The Big Rock, Bruce Hiscock, Aladdin Paperbacks, 1999

The Grand Canyon: Exploring a Natural Wonder, Wendell Minor, Scholastic Inc., 1998

The Pebble in My Pocket: A History of Our Earth, Meredith Hooper, Viking Children's Books, 1996

Volcanoes! Mountains of Fire, Eric Arnold, Random House, Inc., 1997

A Yellowstone ABC, Cyd Martin, Roberts Rinehart Publishing, 1992

"Science With a Song: Rocks," The Mailbox (Primary), June/July 2000, pages 35-38

"Whole Lot of Quakin' Goin' On: Earthquakes!" The Mailbox (Intermediate), February/March 2000, pages 38-43

THE ROCK CYCLE INCLUDING THE IDENTIFICATION OF ROCK TYPES

- Earth Beneath Your Feet, Pages 12 – 32, Pages 36 – 37
- Geology, Chesterfield County Guide, Hands-on Geology Kit, Lessons 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, and 15
- *Windows on Science*, "This Planet Really Rocks," Earth Science, Volume 1, Chapter 24, Pages 1 – 319, Videodisc Frames 23690 – 33766
- Earth Science Interactive Teaching Kit from Luck Stone and the Virginia Department of Education
- Teacher's Anthology Classroom Library Lessons, Macmillan/McGraw-Hill Science, Page 4, 5, 6, and 7
- Rocks and Minerals by Dr. R. F. Symes, Eyewitness Book

EARTH HISTORY AND FOSSIL EVIDENCE

- Geology, Chesterfield County Guide, Hands-on Geology Kit, Lesson 24
- *Windows on Science*, "Fossils, Dinosaurs, and Geologic Time Travel," Earth Science, Volume 1, Chapter 4, Pages 1 – 31, Videodisc Frames 793 –10138
- Fossil Hunter, Kids Discover Magazine
- Fossil by Paul D. Taylor, Ph.D., Eyewitness Book
- Life Story, Virginia Lee Burton, 1962, ISBN 0395520177 This book chronicles life development on Earth; the beginning of the universe and formation of rocks to the advent of man. Reviews geological time (eras).
- From This Earth, William Russel, 1994, ISBN 0865933588 Fossils are featured.

BASIC STRUCTURE OF THE EARTH'S INTERIOR

- Earth Beneath Your Feet, Pages 60 and 61
- Geology, Chesterfield County Guide, Hands-on Geology Kit, Lesson 22
- *Windows on Science*, "The Puzzle of Plate Tectonics," Earth Science, Volume 1, Chapter 11, Pages 3 – 6, Videodisc Frames 12707 – 12719
- The Nature and Science of Rocks, J. Burton, 1998 ISBN 0836819454 Explores aspects of rocks such as their location, how they are formed, what they are made out of, their appearance, how they can be dated, and their changing nature (rock cycle).
- From This Earth-Gold and Silver, William Russell, 1994 ISBN 0865933596 From ore through jewelry, money and geologists.
- From This Earth-Oil, Coal and Gas, William Russell, 1994 ISBN 086593357x Information of Fossil fuels.

PLATE TECTONICS (EARTHQUAKES AND VOLCANOES

- Earth Beneath Your Feet, Page 40, Pages 56 – 57
- Geology, Chesterfield County Guide, Lessons 20, 21, 22, and 23
- *Windows on Science*, "The Puzzle of Plate Tectonics," Earth Science, Volume 1, Chapter 11, Pages 3 – 6, Videodisc Frames 12707 – 12719
- *Windows on Science*, "The Puzzle of Plate Tectonics," Earth Science, Volume 1, Chapter 11, Pages 1 – 18, Videodisc Frames 11156 – 14222
- Volcano and Earthquake by Susanna Van Rose, Eyewitness Book
- Earthquakes and Volcanoes by Fiona Watt, Scholastic Publication
- Volcano by Patricia Lauber
- Teacher's Anthology with Classroom Library Lessons, Macmillan/McGraw-Hill Science, Page 8
- Earthquakes, Kids Discover Magazine
- Volcanoes, Kids Discover Magazine

WEATHERING AND EROSION

- Earth Beneath Your Feet, Page 40, Pages 26 – 35
- Geology, Chesterfield County Guide, Hands-on Geology Kit, Lessons 9, 10, 11, and 18
- *Windows on Science*, The "Weathering and Erosion, Volume 1, Chapter 33, Pages 1 – 27, Videodisc Frames 33882 – 42084

HUMAN IMPACT

- Earth Beneath Your Feet, Page 35
- Oceans of Air, Pages 22 and 23 (Greenhouse Effect)

RESOURCES

- Harcourt Horizons – Virginia – social studies text – pages 215, 217, 238-239, 252, 305
- Project Tree activities
- Morefield Gem Mine—13400 Butlers Road, Amelia, VA 23002,
  phone: (804) 561-3399, FAX (804) 561-4799

TECHNOLOGY CONNECTIONS:

- Sunburst "Real World Science Series" video tapes: Rocks and Minerals (17 minutes). Tapes are located at the Fulghum Center and should be requested through your school's librarian.
- www.pen.k12.va.us The state offers strategies for every content area at all grade levels.
- Geo-Mysteries. http://www.childrensmuseum.org/geomysteries/index2.html Rex the Dino Detective from the Children's Museum of Indianapolis wants to teach your students about rocks, fossils, and minerals. These items may help them solve three different geo-mysteries about a floating rock, a broken necklace and a golden cube. Rex offers an illustrated geologic timeline that allows visitors to study the development of the dinosaurs and our planet.
- Morefield Mine website: www.toteshows.com/morefield.html
- Virginia Department of Forestry: www.vdof.org
- http://geology.usgs.gov
- http://www.nrcs.usda.gov/feature/education/ Website giving activities and experiments for teachers and students.
- http://www.vanaturally.com/guide.html - Virginia's Natural Resources Education Guide - Information, Activities, and Resources for Elementary Teachers
- http://www.sciencenetlinks.com/index.cfm
- http://www.ext.vt.edu/resources/ Virginia Cooperative Extension responds to the needs of individuals, families, groups and organizations with educational programs in the three broad areas of agriculture and natural resources, family and consumer sciences & community initiatives, and 4-H youth development.
- http://www.dcr.state.va.us/ - Virginia Department of Conservation and Recreation
- Department of Conservation and Recreation www.dcr.state.va.us
- Mountain, Eyewitness video, 35 minutes
- Amazing Earth, Discovery Channel video
- Rocks and Minerals, video, 18minutes
- Rock and Mineral, Eyewitness video, 35 minutes
- Natural Disasters, Eyewitness video, 30 minutes
- Volcano, Eyewitness video, 35 minutes
- Volcano, National Geographic, 60 minutes
- In the Path of a Killer Volcano, NOVA, 60 minutes
- Volcano of the Deep, NOVA, 60 minutes

- Earthquake, NOVA, 60 minutes
- Fossils, Mac/Win CD-ROM, Tom Snyder Productions
- Hidden in Rocks, Mac/Win CD-ROM, Tom Snyder Productions
- The Earth, Mac/Win CD-ROM, CLEARVUE/eav, Inc. and Zane Publishing, Inc.
- http://volcano.und.nodak.edu/vw.html Volcano World
- http://www.zoomdinosaurs.com/subjects/dinosaurs Zoom Dinosaurs
- http://www.volcanoes.com Volcanoes.Com
- http://volcano.und.nodak.edu/vwdocs/msh/msh.html Mount Saint Helens
- http://www.smm.org/museum/idea_activities/top.html Thinking Fountain

ASSESSMENTS:

- Teacher made rubric for dioramas/models
- Teacher observation of group work and demonstrations
- CCPS SOL science assessments
- CCPS Space Curriculum Guide assessments
- Released tests with DOE website
- Specific Flanagan tests (Tests For Higher Standards)
- Alternative methods such as good project ideas (learning by doing)
- Virginia SOL Blueprint (ex; Force, Motion, Energy and Matter 25%)

CROSS-CURRICULAR CONNECTIONS:

ROCK CYCLE INCLUDING THE IDENTIFICATION OF ROCK TYPES

Language Arts

- Language Arts and Social Studies – Ask students to pick their favorite gem and investigate the areas of the world where it is mined, describe the mining operation, the cost of production and product, the markets, and how long this gem has been mined. Suggest that they create a buyer's guide to the gem.
- Ask students to put the name of a mineral on one side of a 3 x 5 card and on the reverse side put its uses, listing as many as possible.
- A small group of students could design a game board for a player to move from an initial station that might be called "Discovery in the Earth" to "Sale in the Department Store" at the end. Another group might think of some deterrents such as cards in the stack that might read "Go Back to the Mine" or "Your Distributor Didn't Have Enough Money to Ship" or "The Freighter Carrying Your Goods Sank."
- Read "Rocks" and "Marbles," poems by Valerie Worth.
- Read the poem "Gravel Paths" by Patricia Hubbell.
- Read the poem "Beach Stones" by Lillian Moore.
- Read the folktale "The Shiny Black Wall" by Wayland D. Hand, which is about a lost gold mine.

Math

- Math Make a mobile of the crystal shapes. Cut out, fold, and glue the tabs to make models. Models can be obtained from Crystal World, a publication from the Science Museum of Virginia.
- List for students the following minerals and their hardness based on the Mohs scale.
  Galena 2.5 Magnetite 5.5 Talc 1 Pyrite 6.5 Sulphur 1.5 Gypsum 2
- Have students list the minerals in order from softest to hardest.

- Have students create a spreadsheet using Excel and enter the data into the spreadsheet.
- Have students create a bar graph to compare the data.

EARTH HISTORY AND FOSSIL EVIDENCE

Language Arts
- Have students choose one period of geologic time to study in detail and summarize for other students. Make each researcher, "Expert of the Day."
- Fossil fuels are coal, gas and oil. Divide the class into groups representative of the three fuels and ask them to research each type in terms of its availability, renewability, cost and related pollution.

Art
- Using pipe cleaners, construct the skeletons of several dinosaurs and place them in a museum box for display.

Math
- Have students choose one period of geologic time to study in detail and summarize for other students. Make each researcher, "Expert of the Day."

BASIC STRUCTURE OF THE EARTH'S INTERIOR

Language Arts
- Read Could You Ever? Dig a Hole to China by Dr. David Darling. Ask students to write an explanation, describing Earth's layers, that tells why this is an impossible feat.
- Read The Magic School Bus Inside the Earth by Joanna Cole. Have students pretend that they are aboard the magic bus and write a story telling about their adventures in each of the Earth's layers.

Art
- Have students draw a cross section of the earth showing its different layers. Ask the students to label each layer by name and thickness, indicating which layer contains the plates.

PLATE TECTONICS (EARTHQUAKES AND VOLCANOES)

Language Arts
- Have students write a ballad about the eruption of a famous volcano.
- Write a letter to the local Office of Civil Defense and inquire about the safety measures necessary in case of an earthquake. Make a chart on the findings.
- Read "Hot Volcanoes," a poem by Myra Cohn Livingston.

Social Studies
- Have students use encyclopedias and atlases to learn about and locate these well-know igneous rock locations: El Capitan in Yosemite National Park, California; Mount Rushmore in South Dakota; Rocky Mountain National Park in Colorado; Stone Mountain in Georgia; Craters of the Moon National Monument in Idaho; and the entire state of Hawaii.

Art
- Build a model of a volcano from paper mache or clay. An eruption in the cone can be caused by adding a pinch of baking soda to a small container of vinegar placed inside the cone.

WEATHERING AND EROSION

Language Arts and Social Studies
- Have students write a poem about some changes in rocks they saw in their neighborhood.
- Have students research and write a report about a structure built by an ancient culture that still stands today
- despite weathering. The pyramids of Egypt, ruins in Zimbabwe, the Great Wall of China, and the ruins

of Tikal in Guatemala are just a few examples.

- Read the book The Big Rock by Bruce Hiscock. Have students write a short story about the things a rock they've found has been through. How has it changed?

Math

- Give the students the average temperature in winter for New York City and Cairo, and the average yearly rainfall for New York City and Cairo.

New York City	Average temperature in winter -6° C (2° F)	Average Rainfall 99 cm (39 in)
Cairo	Average temperature in winter 13° C (56° F)	Average Rainfall 0 -10 cm (0 - 4 in)

- Discuss why changes occur faster in New York than in Cairo. Have students create a table to show this information.

HUMAN IMPACT

Language Arts

- Language Arts – Ask students to find articles on the greenhouse effect and/or acid rain. Ask them to write a position paper on one of these causes of air and water pollution and chemical weathering. Students can submit their papers to a local newspaper or school newspaper for publication.
- Here are three topics that students can explore and write about that combine feelings and information.
- Water----------more precious than diamonds
- Soil----------the soul of the food chain
- Ten things every student can do to preserve renewable resources

FYI (FOR YOUR IDEAS):