Gems Rock!

STANDARD COURSE OF STUDY CORRELATIONS:

Science, Grade 4, Goal 2: The learner will conduct investigations and use appropriate technology to build an understanding of the composition and uses of rocks and minerals.

2.01 Describe and evaluate the properties of several minerals.

2.02 Recognize that minerals have a definite chemical composition and structure, resulting in specific physical properties including:
- Hardness.
- Streak color.
- Luster.
- Magnetism.

2.03 Explain how rocks are composed of minerals.

2.04 Show that different rocks have different properties.

2.06 Classify rocks and rock-forming minerals using student-made rules.

2.07 Identify and discuss different rocks and minerals in North Carolina including their role in geologic formations and distinguishing geologic regions.

Science, Grade 6, Goal 3: The learner will build an understanding of the geological cycles, forces, processes, and agents which shape the lithosphere.

3.03 Explain the model for the interior of the earth.

3.04 Describe the processes which form and the uses of earth materials.
- Rock cycle.
- Minerals.
- Characteristics of rocks.
- Economic use of rocks and minerals.
- Value of gems and precious metals.
- Common gems, minerals, precious metals and rocks found in North Carolina.

Earth/Environmental Science, Goal 2: The learner will build an understanding of lithospheric materials, tectonic processes, and the human and environmental impacts of natural and human-induced changes in the lithosphere.

2.03 Investigate and analyze the processes responsible for the rock cycle:
- Analyze the origin, texture and mineral composition of rocks.
- Trace the path of elements through the rock cycle.
- Relate rock formation to plate tectonics.
- Identify forms of energy that drive the rock cycle.
- Analyze the relationship between the rock cycle and processes in the atmosphere and hydrosphere.

Earth/Environmental Science, Goal 3: The learner will build an understanding of the origin and evolution of the earth system.

3.02 Evaluate the geologic history of North Carolina.

INTRODUCTION FOR TEACHER: Students will examine and categorize different rocks. They will also study how rocks are classified by physical properties and perform tests on rocks using the physical properties as parameters.

BACKGROUND FOR TEACHER:
North Carolina has a rich geological history that includes numerous collisions between the continents of old North America and old South America; rifting of the continents; and collisions with volcanic island arcs. A collision of North America with Africa

MATERIALS
- Handouts:
  - "Materials from the Earth" and "Makeup—A Wealth of Minerals" (1 per student),
  - Properties for Identifying Minerals (1 per pair of students)
  - Rock Sorting Activity (1 per group of 3-4)
- A varied selection of rock samples
- Chart paper
- Poster board (1 per pair of students)
- Markers

PREPARATION
- For the rock sorting activity, you may either provide the rocks or have students bring samples of rocks from home. You could also scour the school grounds with students to assemble a collection.
- For the testing activity, you may use homemade materials or supplies from the science lab. Suggested materials: hand lens, triple beam balance, graduated cylinder, water, streak plates, mineral identification chart, Mohs hardness scale, magnets, vinegar or dilute hydrochloric acid.

For a follow-along viewing guide for students, see Viewing Guide 9.

Emerald photograph from istockphoto.com.

sandwiched the island arcs between those two continents. Erosion in the form of mechanical weathering (wind, water and ice), chemical weathering (acid precipitation) and biological weathering (small plant roots wedging apart pieces of rock, followed by larger plants growing in the crevices) formed many of the rock fields that we see in the mountains today. The weathered materials are carried down the mountains to fill in low-lying areas. Much pressure, melting, bending and folding of rocks is evident in North Carolina. These ingredients are necessary to form crystal gemstones and precipitate gold from the earth.

Igneous rocks are formed from cooling bodies of molten magma. Sedimentary rocks form when rocks are weathered and eroded. The particles settle into beds and are compressed and cemented together. Metamorphic rocks are formed when the rocks are buried, heated and highly compressed.

Gold in North Carolina was concentrated by superheated hot water from volcanoes stripping out minerals from the rocks. As water moves from the heated area and cools, it precipitates minerals such as gold and quartz. Due to the great weight of gold, it can be separated from the materials around it. Likewise, crystals of sapphires and rubies are much heavier than other rocks. They are six-sided and make a distinctive noise when hit. The Mohr hardness scale is one way to identify minerals, with rubies and sapphires being less dense than diamonds, but more dense than most other rocks.

Many properties can be used to identify minerals. The properties should be used in conjunction with one another, rather than relying on a single test. The student handout provides general information. Additional Resources includes links to valuable teaching aids.

engage Introduce the importance of minerals in our everyday lives by having students read Handouts 1 and 2. Have students choose their three favorite products made using minerals and write a paragraph about how their lives would be different without these products.

explore

1. Divide class into groups of three or four students. Distribute copies of assignment sheets. For each group, place a collection of rocks in a pile on a piece of chart paper. Draw a circle around the pile of rocks. Have students choose two criteria by which the rocks can be sorted into two distinct piles. Then have them divide the pile and draw circles around the two new piles they created. Have them label each pile with the appropriate criterion. Next, have students examine the new piles closely and determine two additional criteria for sorting each. Have them continue sorting until each rock is in a single category. When they are finished, have them create and label their own sorting diagram.
2. Have the groups of students share with one another the criteria they used for sorting rocks.
3. Introduce new rocks to each group of students. Have the students classify each of the samples according to the sorting diagram they created.

   After doing the activity, show Chapter 1 of the video.

explain Discuss the physical processes (described in the video) that helped shape the different geologic regions of North Carolina. Make a list of the processes on chart paper. Introduce the concept of the rock cycle and the three basic types of rocks: igneous, sedimentary and metamorphic. Emphasize that over millions of years, rocks can cycle from one type to another. Discuss what processes formed each of the three rock types.

Have students evaluate various rocks from the sorting activity and decide whether the samples are igneous, sedimentary or metamorphic. Students should describe

BEYOND THE CLASSROOM
Plan a field trip to Reed Gold Mine, Hiddenite or another gem mine in North Carolina.

- **Emerald Hollow Mine** • http://hiddenit.ipower.com/index.html
- **Reed Gold Mine** • http://www.nchistoricsites.org/reed/reed.htm

Additional Resources

How to teach about igneous, sedimentary and metamorphic rocks • http://mineral.galleries.com/rocks/default.htm

How to teach about elements and how they influence colors of rocks • http://mineral.galleries.com/minerals/property/color.htm • http://mineral.galleries.com/minerals/physical.htm

Rock descriptions • http://www.moorlandschool.co.uk/earth/

North Carolina Geological Survey's Geo Fact-Pack • http://www.geology.enr.state.nc.us/proj_earth/Geo_Fact_Pack.html • Downloadable resources for earth science teachers and students.

U.S. Geological Survey Science Education • http://education.usgs.gov/

"Birth of the Mountains: The Geologic Story of the Southern Appalachian Mountains" • http://pubs.usgs.gov/gip/birth/birth.pdf

Tips on collecting and identifying rocks • http://pubs.usgs.gov/gip/collect1/collectgip.html

Women in Mining Educational Foundation • http://www.womeninmining.org • Teacher tools and activities on rock identification and other earth science topics.

Carpenter, P.A. III. 1999. *Gold in North Carolina.* NCGS Information Circular #29. Raleigh, N.C.: N.C. Department of Environment, Health and Natural Resources. (Order from http://ncmaps.stores.yahoo.net/ncinci29goin.html)

Stewart, Kevin G., and Roberson, Mary-Russell. 2007. *Exploring the Geology of the Carolinas: A Field Guide to Favorite Places from Chimney Rock to Charleston.* Chapel Hill, N.C.: UNC Press.

reasons for their choices. For example, if a rock has horizontal layers with no crystals, it is classified as sedimentary.

Show Chapters 2-5 of the video.

elaborate

- Have students work in pairs to research how rocks are classified by physical properties. Distribute Handout 3 for reference. Each pair should investigate one of the properties and learn how to determine if it is present in a rock sample. Have them make a poster depicting how that property is measured and present their findings to the class.
- Have students choose three to five physical characteristics that have been described by their classmates for which testing supplies are available. Have them test eight rock samples for each of those characteristics. Have them write a report describing the materials used and testing procedures, including a data table outlining the results.

evaluate Check for comprehension by having students describe ways minerals can be identified. Also discuss how geologists perform tests to help them to differentiate one mineral from another.

Teacher's Notes:

Physical Properties of Minerals

Makeup–A Wealth of Minerals

by Donna Boreck and Liane Kadnuck

Have you ever read the list of ingredients in makeup, shampoo or toothpaste? It might surprise you. Many personal care products contain a wealth of mineral materials taken from the earth. Take, for example, eye shadow. One of the first ingredients listed in eye shadow is usually **talc**—a magnesium silicate mineral. Its platy crystal habit is in part the reason why talc has been an important ingredient in cosmetics since 3500 B.C. The plates glide smoothly across each other, allowing makeup to be applied easily. They lie across the pores in the skin and lessen the chance of clogging pores, while providing texture to the skin. Yet they are translucent enough not to be seen.

Talc is resistant to acids, bases and heat and tends to repel water. In addition to eye shadows, talc is used in loose and pressed powders and blushes, as a filler in some deodorants and as an addition to lotions and creams. Talc can also be found in chewing gum and pharmaceuticals.

Mica, a mineral widely used in eye shadows, powder, lipstick and nail polish, is added to give luster or pearlescence to a product. Mica is resistant to ultraviolet light, heat, weather and chemical attack and adheres to the skin. Like talc, it has excellent slip characteristics and may be used to replace talc in makeup. When coated with iron oxide, mica flakes sparkle with a gold tint.

Kaolin, a clay, is added to makeup to absorb moisture. It covers the skin well, will stay on the skin, and is resistant to oil. Kaolin and another clay, **bentonite**, are added to the earth-based face masks or packs predominately for their cleansing effects. Clays are also used as fillers in different products.

Powdered calcite, a calcium carbonate, absorbs moisture. Because of this, calcite and a **magnesium carbonate**, processed from dolomite, are added to powders to increase the ability of the makeup to absorb moisture.

When it comes to makeup, color is the name of the game. Minerals provide the color to eyes, cheeks, lips and nails. **Iron oxide**, one of the most important color minerals, was used by Cleopatra in the form of red ochre as rouge.

Today, iron oxides give red, orange, yellow, brown and black tones to makeup. Chrome oxides are used for greens; manganese violet for purple; and ground lapis lazuli for blue. Ultramarine blue and pink colorings are made from a mixture of kaolin, soda ash, sulfur and charcoal. Even gold has historically been used as a colorant. Ancient Egyptians used gold to color skin and hair. Gold can still be found in powders and makeup, adding a rich golden sheen to the skin.

As an artist starts a painting with a bright white canvas to give the colors brightness and intensity, **titanium dioxide** is added to brighten and intensify the color of makeup and to create whiteness and opacity. Titanium dioxide is also a natural sunblock and, like talc, iron oxides and gold, it has been used for centuries. Titanium dioxide can be found in any makeup—shadow, blush, nail polish, lotions, lipstick and powders. Titanium dioxide also makes Oreo cookies frosting extra-white and is the "M" on M&M's candy.

Minerals also find their way into health care products we use daily. **Salt** is effective in treating skin disease and is used in some soap. **Fluorite**, processed for fluoride, is added to toothpaste and drinking water to help prevent tooth decay.

Calcium carbonate (calcite) and baking soda (**nahcolite**) are abrasives in toothpaste. A borax and beeswax mixture is added to cleansing creams as an emulsifier to keep oil and water together. **Boric acid** is a mild antiseptic and is added to powder as a skin buffering agent.

Zinc oxide is added to creams to allow the cream to cover more thoroughly. Zinc oxide ointment, which contains approximately 20 percent zinc oxide, is used to heal dry, chapped skin. When an unlucky hiker encounters poison ivy, calamine-based lotions are often used to soothe the itchy skin. Calamine is another name for **hemimorphite**, a zinc silicate mineral.

As you can see, minerals are found in many things we use. So the next time you are in the supermarket, take a moment to acquaint yourself with the multitude of minerals that are a part of our daily lives.

The authors are geologists at the USBM Denver Research Center, Colorado. Distributed by the Women in Mining Education Foundation (www.womeninmining.org).

http://www.geology.enr.state.nc.us

Materials from the Earth:

Rock and Mineral Products in the Asheville-Buncombe County Area

North Carolina Geological Survey, Geologic Note No. 3. November 2006.

Crushed stone, sand and field stone are mined in the Asheville area, with recent production valued at more than $15 million annually. Crushed stone is necessary for all types of road construction, from driveways to interstate highways, and in any construction that requires the use of concrete. Construction costs are lower where crushed stone is readily available.

The Asheville area is fortunate to have an abundant supply of crushed stone. The nation's leading producer, Vulcan Materials, operates a quarry west of Asheville in Enka. Grove Stone and Sand Company operate two quarries: one north of Asheville on the French Broad River, near Alexander, and the other one east of Asheville near the North Fork of the Swannanoa River, between Black Mountain and Swannanoa. The abundance of suitable rock in the Asheville area can yield a reliable supply of this important building material for the future. Two small companies remove sand from river bottom deposits of the French Broad and Swannanoa Rivers. This mineral commodity is also used in the construction industry.

Field stone gathered by property owners and stonemasons, quarried by a few independent entrepreneurs, is incorporated into the design of many homes and businesses in the area, providing a truly unique and local architectural element to these buildings. The Civic Center on Haywood Street and the original Grove Park Inn are prominent examples of the use of locally collected stone.

Other valuable and useful mineral commodities are produced in the region surrounding Asheville and Buncombe County. Avery County and the Spruce Pine area of Mitchell County lead the nation in the production of ***feldspar, mica, and ultra-high purity quartz***. Much of the feldspar is used in manufacturing glass and ceramics (whiteware). Produced as a co-product, mica is used in

cosmetics, paint, plastics, wallboard (drywall), joint cement and oil well-drilling fluids used to prevent blowouts and gushers. Ultra-high purity, electronic-grade quartz is the other important mineral commodity from the Spruce Pine area. This highly refined, pure quartz product is used in the production of microchips, transistors and other high-tech electronic devices.

Other mineral commodities mined near Asheville include ***olivine***, a heat-tolerant material used to line industrial furnaces and to make molds for casting metal, and, from the Fletcher area, ***dolomitic marble*** used both as ordinary crushed stone and as a durable, white, decorative stone. In the past, other mineral commodities were mined in the Asheville-Buncombe area. These included ***kaolin, vermiculite, chromite, halloysite, iron ore, gemstones, dimension stone, talc or soapstone, industrial garnet, lime, brick-clay and gravel***.

More information on the mineral resources in the Asheville-Buncombe area is available from the North Carolina Geological Survey at 2090 U.S. Highway 70, Swannanoa, N.C. 28778. Telephone: (828) 296-4500.

Properties for Identifying Minerals

Many properties can be used to identify minerals. The properties should be used in conjunction with one another, rather than relying on a single test. **Color** is often the property that first attracts a person to minerals. The color alone is often misleading when trying to identify minerals. Other qualities such as **luster**, the way light interacts with a crystal's surface, should also be explored. Another feature of minerals is **transparency**. When light interacts with the surface of a mineral, it can pass straight through (transparent), pass through in a distorted fashion (translucent) or not penetrate the surface of the mineral at all (opaque).

In addition to light interactions with the minerals, mineral **shape** is also important. Crystals often form specific geometric patterns that can be quite useful in identification. Shapes can include twinning, cleavage along a flat plane, and fracturing.

Hardness can be measured using the Mohs hardness scale. This scale of 1-10 denotes the relative hardness of minerals dependent on which mineral scratches another mineral. The hard mineral will always scratch the softer mineral.

The **specific gravity**, the mass divided by the volume of the mineral then compared to the density of water, is also helpful in discerning which mineral you are working with.

Streak color, the color of a streak when rubbed against a white, unglazed tile, is another mineral property. It can often have surprising results. The mineral powder residue of the streak may not be the same color as the mineral. The color of the streak is characteristic of specific minerals, however.

Associated minerals are often used to identify minerals because often minerals are found only in close proximity to other minerals.

Notable localities are places where minerals are found in abundance.

Important physical properties for mineral identification:

- Color
- Luster
- Transparency (or diaphaneity)
- Crystal systems
- Technical crystal habits
- Descriptive crystal habits
- Twinning
- Cleavage
- Fracture
- Hardness
- Specific gravity
- Streak
- Associated minerals
- Notable localities

Additional properties and characteristics:

- Fluorescence
- Phosphorescence
- Triboluminescence
- Thermoluminescence
- Index of refraction
- Double refraction
- Birefringence
- Dispersion
- Pleochroism
- Asterism
- Chatoyancy ("cat's eye" effect)
- Parting
- Striations
- Magnetism
- Odor
- Feel
- Taste
- Solubility
- Electrical properties
- Reaction to acids
- Thermal properties
- Phantoms
- Inclusions
- Pseudomorphs
- Radioactive minerals

Assignment

Rock Sorting Activity

1. Place all the rock samples in a pile.
2. Work as a class or in groups. Draw a circle around the pile of rocks. Choose criteria for sorting the rocks into two separate piles.
3. Divide the rocks into two new circles. Label with the criteria used to sort the rocks.
4. Examine the new piles closely. Choose two new criteria for sorting the piles again.
5. Continue sorting until each rock is in a single category.

SAMPLE DIAGRAM: