TEACHING KATE
TEACHING KIDS ABOUT THE ENVIRONMENT

The Rock Cycle

Grade Level: 6-8 **Time Required: Nine 50-minute class periods.**

SC Science Standards

This lesson plan was correlated with only the grade level specified unless otherwise noted.

Grade 6:
- I. A. 1. c. 1
- I. A. 2. f
- I. A. 3. a
- I. A. 7 a

Grade 7:
- I. A. 1. c. 1
- I. A. 2. f
- I. A. 3. a
- I. A. 7. a
- III. A. 1. a

Grade 8:
- I. A. 1. c. 1
- I. A. 2. f
- I. A. 3. a
- I. A. 7. a
- III. B. 3. a
- III. B. 3. c-e

Purpose

Students will examine rocks. They will learn the three basic rock types. Students will investigate the processes responsible for forming igneous, sedimentary, and metamorphic rocks. They will learn to classify rocks. On completion of this unit, students will be able to simulate the changes rocks undergo through the Rock Cycle.

Skills

Cause and effect, classification, comparison and contrast, identifying, inference, interpretation of data, observation, prediction.

Concepts

Understanding structure of earth's crust; effect on rock formation of forces and processes inside and outside the Earth's crust; determinants of rock classification.

Materials Needed

6 egg cartons
mineral samples
manila paper
construction paper: black, white, pink
book
bread
jelly
balance and mass weights
calculator
aluminum foil
wooden clothespins
crayon sharpener
candle
ruler
scissors
oatmeal cookies
hand lenses
glue
flat toothpicks
paper plate
crunchy peanut butter
plastic knife
graduated cylinder
crayons
hammer
matches
2 blocks of wood (2x4x6)
aluminum pie pan
goggles
large resealable bags
6 rock samples of each: granite, rhyolite, gabbro, basalt (igneous); conglomerate, sandstone, shale, limestone (sedimentary); slate, schist, gneiss, marble (metamorphic)

Definition of Terms

Cementation	A process in which minerals act like cement to hold sediments together.
Chemical rocks	Sedimentary rocks made up of chemical sediments.
Clastic rocks	Sedimentary rocks that form from pieces of other rock.
Compaction	A squeezing process that causes pieces of rock to hold together.
Contact metamorphism	The process by which solid rocks come into contact with molten rock.
Evaporite	A chemical rock that has formed from mineral deposits left after a body of water has evaporated.
Extrusive rocks	Igneous rocks that form from lava.
Foliated rocks	Metamorphic rocks that have minerals arranged in bands or that are made up of layers.

Geode	A hollow rock with mineral crystals lining the inside surface.
Igneous rocks	Rocks formed from molten rock material that cools and hardens.
Intrusive rocks	Igneous rocks that form from magma.
Metamorphic rocks	Rocks that have been changed by heat and/or pressure.
Mineral	A naturally occurring inorganic material, either an element or a compound, with an orderly atomic arrangement.
Nonclastic rocks	Sedimentary rocks that are formed from dissolved minerals in water or from the remains of past life.
Nonfoliated rocks	Metamorphic rocks that do not have bands of minerals or layers.
Organic rocks	Metamorphic rocks made up of the remains of living things.
Porphyry	An igneous rock with both large and small mineral crystals.
Precipitation	A process by which dissolved minerals in water settle out of solution.
Recrystallization	The process of melting and recooling of rocks that forms metamorphic rocks with increased grain size.
Regional metamorphism	The process by which wide areas of rock are changed by great heat and pressure.
Rock	Solid materials that make up the earth's crust and are each composed of one or more minerals.
Rock cycle	The process of change that shows how the different types of rock are related and how rock material is used and reused.
Sedimentary rocks	Rocks formed from sediment.
Weathering	The changes that rocks undergo at or near the surface.

Before the Session

Make copies of the Definition of Terms and other worksheets for students. Gather materials for the different activities. Organize the materials for each cooperative group by putting the materials in large ziplock bags.

Background Information

Rocks are the solid materials that make up the earth's crust and are each composed of one or more minerals. Essential minerals always occur in a particular rock. Quartz and feldspar are essential to granite. Accessory minerals do not always appear in a particular rock. Mica and hornblende are accessory minerals to granite. Rock formers are the 12 most abundantly occurring minerals of all the minerals. These 12 minerals form over 90 percent of the Earth's rocks. Some rock forming minerals include plagioclase feldspar, orthoclase feldspar, quartz, augite, hornblende, and micas.

Rocks are classified into three groups based on how they form. Igneous rocks form from molten rock material as it cools and hardens. Sedimentary rocks form from small particles pressed together. Metamorphic rocks are formed from existing rocks that are changed by heat and/or pressure.

Igneous rocks form from molten rock. Magma is molten rock below the earth's surface. Lava is molten rock that reaches Earth's surface. Igneous rocks that form from lava are called extrusive rocks. Igneous rocks that form from magma are called intrusive rocks. Texture refers to the size of the mineral crystals in an igneous rock. Texture is determined by the rate of cooling. When an igneous rock cools fast, the mineral crystals are small, so the rock is fine-grained. When an igneous rock cools slowly, the mineral crystals can grow large, so the rock is coarse-grained. Extrusive rocks form from lava at the surface. Their texture is fine-grained. Examples of extrusive rocks are basalt, obsidian, scoria, and pumice. Intrusive rocks form from magma deep inside the earth. The texture is coarse-grained. Examples of intrusive rocks are peridotite, gabbro, diorite, and granite. A porphyry is an igneous rock with both small and large crystals. Porphyry initially begins to cool slowly inside earth. Then, it is thrown to the surface where it cools quickly.

Igneous rocks are classified according to texture and color. The texture will be fine-grained or coarse-grained. Color ranges from dark to light. Dark igneous rocks contain the minerals olivine and augite. Peridotite is an example. Light igneous rocks contain the minerals quartz, augite, and muscovite mica. Granite and rhyolite are examples.

Most of the rocks found on earth's surface are sedimentary. Sediment is made up of broken pieces of weathered rock. Weathering is the chemical and mechanical breaking down of rocks. Rocks are weathered by running water, the freezing of water, wind, and rain water dissolving

minerals in some rocks. Sedimentary rocks are formed by compaction and cementation. Compaction is pressure applied by the weight of overlying sediments, which squeezes out air and water from between the pieces of rock. When a layer of sediments harden, sedimentary rock is formed. Cementation is the cementing of sediments when the spaces between the pieces are filled with minerals. Quartz and calcite are common cementing materials. Sedimentary rocks made up of chemical sediments are called chemical rocks. Precipitation is a process by which dissolved materials settle out of solution. Calcite is a precipitate. Over time, an entire body of water may evaporate, leaving a deposit of minerals. These minerals are called evaporites. Gypsum and salt are examples of evaporites. Organic sediments are sediments made up of the remains of living things. Chalk is an example of organic sedimentary rock.

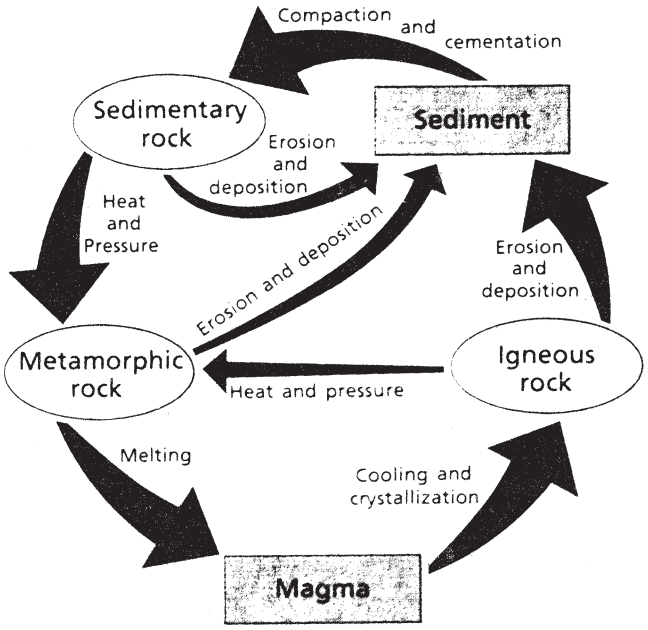
Sedimentary rocks are classified into two groups: clastic and nonclastic. Clastic rocks form from pieces of other rock. Conglomerates are sedimentary rocks that contain rounded pebbles of different sizes. Breccias contain angular pebbles of different sizes.

Sandstones are clastic rocks that contain sand-size sediments that are cemented together. The sediments are usually quartz, basalt, or calcite. Siltstone is similar to sandstone, but has smaller sediments. Shale is a clastic rock with the smallest sediments. It contains clay particles pressed together so tightly that water will not pass through. Shale is the most common type of sedimentary rock. Nonclastic rocks form from dissolved minerals and from the remains of past life. Precipitates and evaporites form from dissolved minerals. Examples are limestone, rock salt (halite), rock gypsum, and chert (quartz). Coal is one of the most important nonclastic rocks. Coal formed from plant material buried in swamps millions of years ago.

Rock changed by pressure and/or heat is called metamorphic rock. Under great heat and pressure, igneous and sedimentary rock can be changed into metamorphic rock. Heat causes rocks to recrystallize near magma. Pressure changes the shape of rock and can form lines or bands in rock. Processes that form metamorphic rock over a wide area is called regional metamorphism. When magma pushes its way into solid rock layers, high temperatures bake the rock. The metamorphism that occurs when solid rocks come into contact with molten rock is called contact metamorphism.

Metamorphic rocks that have minerals arranged in bands or layers are classified as foliated rocks. Granite changes to gneiss, and shale changes to schist, phyllite, or slate. Metamorphic rocks that do not have evidence of bands or layers are classified as nonfoliated rocks. Limestone and calcite change to marble, and quartz changes to quartzite. Marble and quartzite are nonfoliated.

The rock cycle shows how the different types of rocks are related and how rock material is used and reused. It shows the pathways rocks may follow when changing.



Suggested Lesson Plan

Day 1

1. Introduce rocks. Explain rocks, minerals, essential minerals, accessory minerals and rock formers. Introduce the three rock types: igneous, sedimentary and metamorphic. Show examples of each rock type and describe the general characteristics of each type, one at a time.

2. Activity: Place 4 samples of igneous rocks in compartments 1 - 4 of an egg carton. Number the rocks 1 - 4. Place 4 samples of sedimentary rocks in compartments 5 - 8 and number the rocks. Place 4 samples of metamorphic rocks in compartments 9 - 12 and number the rocks.

3. Pass out the egg cartons to the groups of students. Show and describe igneous rocks. Have the students take out rocks 1 - 4. Observe the characteristics of the rocks and identify the rocks, using rock and mineral guides. Repeat the same procedure with the sedimentary rocks 5 - 8, and then with the metamorphic rocks 9 - 12.

4. Ask students to volunteer to make oatmeal cookies with nuts, chocolate chips, and butterscotch morsels to bring to your next class meeting.

Day 2

1. Discuss the origin of igneous rock. Explain texture, intrusive rock, extrusive rock, and the formation of porphyries. Show examples of igneous rock formed from magma and lava. Point out and discuss the grain-size. Determine if the rocks cooled slowly or quickly. What is the evidence? (small and large crystals)

2. Activity: Exploring Cookies: (See attached sheet)

Day 3

1. Teach the classification of igneous rocks by texture and color. Again, look at and identify samples of igneous rock.

2. Review igneous rocks.

Day 4

1. Teach sedimentary rocks. Discuss sediment and weathering. Discuss the four ways sedimentary rocks form: compaction, cementation, chemically, and as organic sediment. Show examples of sedimentary rock. Discuss how each rock was formed and pass them around.

2. Activity: Crunch: (See attached sheet)

Day 5

1. Teach the classification of sedimentary rocks: clastic rocks and nonclastic rocks. Show samples of sedimentary rocks and identify the characteristics of each rock.

2. Activity: Sedimentary Sandwich: (See attached sheet)

Day 6

1. Teach metamorphic rock processes and characteristics. Show samples of metamorphic rocks. Explain the processes that changed the rocks and the rock from which the metamorphic rock came. Example: Granite changes to gneiss due to pressure. Compare granite and gneiss. You will see the presence of the same minerals. However, the gneiss will have lines or bands in the rock instead of large crystals like granite.

2. Activity: Rock ‘n Balance: (See attached sheet)

Day 7

1. Review the three rock types and how each forms.
2. Teach the rock cycle.
3. Have students draw the rock cycle.
4. Ask students to write a paragraph explaining the changes rocks may undergo in the rock cycle.

Day 8

1. Review the rock cycle.
2. Activity: The Rock Cycle Activity: (See attached sheet)

Day 9

1. Review rocks.
2. Activity: Granite

Objective: to show that all rocks are different even though they may be made of the same minerals

Materials:

manila paper	construction paper (white, pink, black)
glue	scissors

Procedure:

1. Demonstrate cutting the white paper into triangles to represent quartz.
2. Cut the pink paper into squares to represent feldspar.
3. Cut the black paper into rectangles to represent biotite mica.
4. Glue the different mineral colors on the manila paper beside each other and on top of each other to make a mass. (You now have an example of granite on paper.)
5. Issue the materials to the students.
6. Have them make granite on paper.

Application

Rocks are constantly changing over time. They are changing at the surface by the process of weathering. Rocks are also changing deep inside the earth due to heat and pressure.

1. Take a field trip to a site in the mountains that may have two or three rock types. Identify the rocks and the processes which may have formed them.
2. Identify the rocks used to construct your school building. Why, do you think, were these particular types of rocks used?

Extension

Investigate the quarrying of marble, slate, and granite. Find out where and how each rock is quarried. Visit a rock quarry if one is within close enough proximity.

Resources Available

Earth Science, 1990. Silver Burdett and Ginn, Inc.

Focus on Earth Science, 1984. Merrill Publishing Company.

Ruzeicki, Candy. Chester High School, Chester, SC.

West, Jane. Castle Heights Middle School. Rock Hill, SC

Prepared by: Jody Steele

Exploring Cookies

Objective:

Demonstrate that the earth acts somewhat like a cook, forming rocks and minerals with pressure and heat.

Materials:

Rocks (an assortment that clearly shows different crystals)
Cookies (two per student)
Hand lenses

Activity:

1. Each student should examine three rocks closely and list all the characteristics found in the rocks.

2. Each student should examine one of the cookies and list all the characteristics of the cookie.

3. Have each student break open the cookie and list any additional characteristics.

4. Have each student list all the ingredients in the cookie that are still recognizable after baking.

5. Have each student list all of the ingredients in the cookie that are not recognizable after cooking.

6. Have the students answer the question: “What has changed the characteristics in the cookie?”

7. Have the students compare the process of formation of rocks with that of baking a cookie.

8. Have each student look at both the rock sample and the cookie under a hand lens and draw what they see.

Crunch

Objective: Students will be able to demonstrate the formation of metamorphic rocks.

Materials:

Flat toothpicks
Book

Procedure:

1. Snap the toothpicks in half, but leave them connected.
2. Pile the toothpicks on a table.
3. Place the book on top of the toothpick pile and press down.
4. Remove the book and observe.

Results:

1. What happened to the toothpicks? Why?
2. Why did the toothpicks flatten?
3. What happens in nature?
4. Explain how metamorphic rocks are formed.

Sedimentary Sandwich

Objective: To demonstrate a sedimentary rock formation

Materials:

2 slices of bread
crunchy peanut butter
jelly
plastic knife
paper plate

Procedure:

1. Place one slice of bread on the paper plate.

2. Use the knife to spread a layer of peanut butter on the slice of bread.

3. Add a layer of jelly on top of the peanut butter layer.

4. Place a second slice of bread on top of the jelly layer.

Results:

1. What type of rock formation is similar to the sandwich?

2. _____ rocks are formed from loose particles that have been carried from one place to another and redeposited.

3. Rocks are usually deposited in a series of _____ similar to the layers in the sandwich.

4. Each layer can be distinguished by differences in _____, _____, and _____.

5. Where would the oldest layer and the youngest layer be found? _____, _____

6. The layers, over a period of time, become _____ and _____ together to form solid rock structures.

Sedimentary Sandwich

KEY

Objective: To demonstrate a sedimentary rock formation

Materials:

2 slices of bread
crunchy peanut butter
jelly
plastic knife
paper plate

Procedure:

1. Place one slice of bread on the paper plate.

2. Use the knife to spread a layer of peanut butter on the slice of bread.

3. Add a layer of jelly on top of the peanut butter layer.

4. Place a second slice of bread on top of the jelly layer.

Results:

1. What type of rock formation is similar to the sandwich? **sedimentary**

2. **Sedimentary** rocks are formed from loose particles that have been carried from one place to another and redeposited.

3. Rocks are usually deposited in a series of **layers** similar to the layers in the sandwich.

4. Each layer can be distinguished by differences in **color**, **texture**, and **composition.**

5. Where would the oldest layer and the youngest layer be found? **Bottom**, **Top**

6. The layers, over a period of time, become **compacted** and **cemented** together to form solid rock structures.

ROCK 'N BALANCE

Objective: Students will be able to find the mass, volume, and density of rocks.

Materials:

Balance and mass weight set
Graduated cylinder
Water
6 rocks

Activity:

1. Weigh each rock specimen on the balance.

2. Determine the volume of each rock specimen. Use the water displacement method.

3. Find the density of each rock specimen. (Density = Mass/Volume)

Specimen	Mass in grams	Volume in cm^3	Density gm/cm^3
A			
B			
C			
D			
E			
F			

THE ROCK CYCLE

1. Igneous Rocks

    a. form from magma - melted rock within the earth
    b. form from lava - magma that reaches the surface
    c. coarse-grained - cooled slowly
    d. fine-grained - cooled quickly
    e. Examples: granite, basalt, obsidian, pumice

2. Sedimentary Rocks

    a. form from sediment - pieces of broken rock such as mud, sand or gravel
    b. weathering breaks down the rock - water, ice, wind, chemicals, plants, animals
    c. formed by compaction - squeezing and pressure
    d. formed by cementation - minerals cement sediments
    e. sedimentary features: layers
       fossils
    f. Examples: conglomerate, breccia, sandstone, shale, limestone, rock salt

3. Metamorphic Rocks

    a. changed due to heat and pressure
    b. may show bands or layers
    c. may not show bands or layers
    d. Examples: gneiss, schist, slate, marble, quartzite

4. The Rock Cycle

    a. changes that rocks may undergo from magma, to rocks, and back to magma
    b. pathways rocks may follow when changing

THE ROCK CYCLE ACTIVITY

OBJECTIVES:

1. To investigate the processes responsible for forming sedimentary, metamorphic, and igneous rocks.
2. To investigate the changes that rocks go through in the rock cycle.

MATERIALS: (for each group)

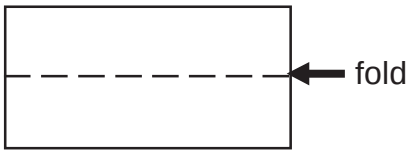
crayons	crayon sharpener
heavy duty aluminum foil	2 pieces of wood
hammer	candle
clothespin	aluminum pie pan
water	ruler
matches	goggles

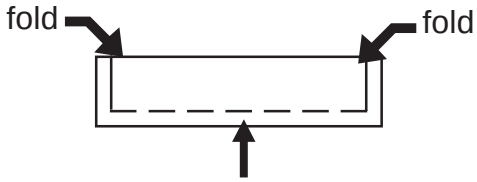
PROCEDURE:

1. For each group, cut a piece of heavy duty aluminum foil about 20 cm by 10 cm.

2. Make crayon shavings by sharpening crayons with a crayon sharpener over the aluminum pie pan. Use different colored crayons. You need enough crayon shavings of different colors to have a pile of "sediment" approximately 4 cm by 6 cm and 1 to 2 cm thick.

3. Place the crayon sediment inside the aluminum foil and fold over. Fold the edges in so that all of the crayon "sediment" is inside the foil and none can fall out.





4. Place the aluminum foil packet of crayon "sediment" between the two boards then hammer on the top board to compress the crayon shavings. The person hammering: BE SURE TO WEAR YOUR GOGGLES.

5. Open the foil packet and examine your crayon "sediment." (Record your observations. What type of rock does this represent?)

6. Rewrap the crayon “rock” and place it between the boards again. WEAR GOGGLES. Once again hammer the top board. Reexamine your crayon “rock.” Record your observations. What kind of “rock” have you made this time?

7. Rewrap your crayon “rock” and hold the foil packet over a candle with a clothespin. WEAR YOUR GOGGLES.

8. Heat the “rock” packet for 2 minutes. Let your “rock” packet cool for 3 minutes. Unwrap your “rock” and record your observations.

9. Record all your observations and answer all questions on your data sheet.

OBSERVATIONS/OUESTIONS:

See student data sheet

CONCLUSIONS:

Explain how what happened to your crayons relates to what happens in the rock cycle.

THE ROCK CYCLE
Data Sheet

Name_____

DIRECTIONS:

Fill in the data table below and answer all questions.

DATA TABLE:

	Description of Sediment/Rock	Type of Rock
Original Crayon Shavings		
Crayon Shavings After First Pressure		
Crayon Rock After Additional Pressure		
Crayon Rock After Melting		

OBSERVATIONS/ QUESTIONS:

1. How did you weather or break down the crayon rock?

2. What do the crayon shavings represent?

3. What had to happen to the crayon sediments before it could become rock?

4. What did the hammer represent?

5. What kind of crayon rock was made by pressing the crayon sediments together? (Circle one: igneous, sedimentary, or metamorphic).

6. Describe the difference between the first rock you made and the rock you made after applying pressure.

7. What kind of rock did you make when you added more pressure to your crayon rock? (Circle one: igneous, sedimentary, or metamorphic).

8. What kind of rock did you make by heating then cooling your crayon rock? (Circle one: igneous, sedimentary, or metamorphic).

9. How was this rock different from the other two?

10. A. Could you make new sediments from this rock?
    B. How would you make these sediments?
    C. What does this represent in nature?