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ABSTRACT

This activity guide, developed to provide environmental education through a series of hands-on activities geared to Medoc Mountain State Park in North Carolina, is targeted for grades 4, 5, and 6 and meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included: pre-visit, on-site, and post-visit. The on-site activity is conducted at the park, while pre- and post-visit activities are designed for the classroom. Major concepts included are: composition of rock, chemical and mechanical forces on rocks and minerals, formation or ridges and mountains, properties of rocks and minerals, use of geology field equipment, and uses of rocks and minerals. Includes a vocabulary list, scheduling worksheet, parental permission form, North Carolina Parks and Recreation program evaluation, and information about Medoc Mountain State Park. (MKR)

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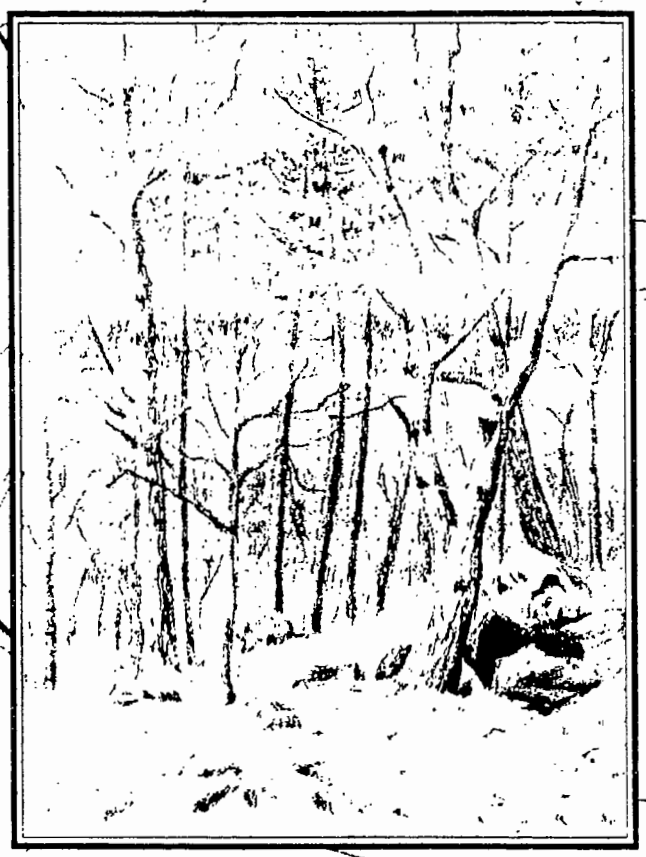

THE RIDGE

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Medoc Mountain State Park

An Environmental Education Learning Experience

Designed for Grades 4-6

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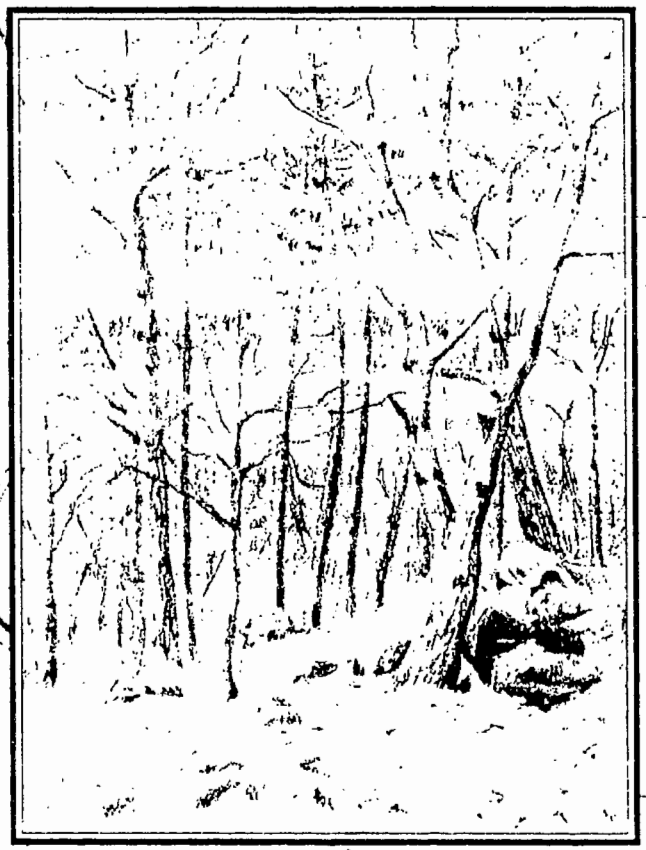

THE RIDGE

Medoc Mountain State Park

An Environmental Education Learning Experience

Designed for Grades 4-6

I am the mountain
Come and know
Of how, ten million years ago,
Great forces, moving plates of earth,
Brought, to an ancient land, rebirth;
Of how the planet's faulted crust
Was shifted, lifted, tilted, thrust
Toward the sky in waves of change
To form a newborn mountain range.

– Diane Siebert, *Sierra*

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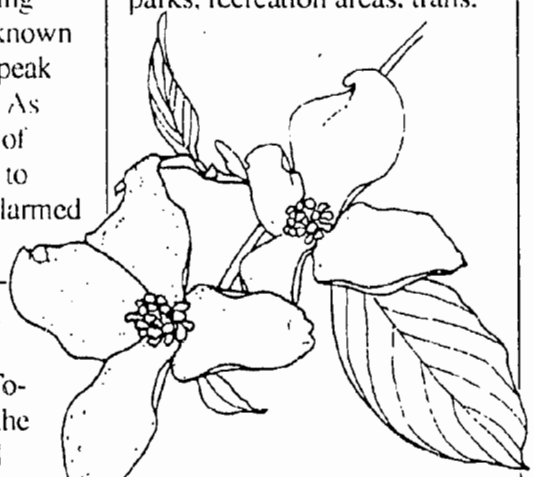
Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park.

That was in 1915. The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.



As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

N.C. Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181

Introduction to Medoc Mountain State Park

Medoc Mountain State Park is located in Halifax County, southwest of Roanoke Rapids near the town of Hollister. The park supports a variety of plant species rarely found in this part of North Carolina, like galax and mountain laurel. Several of North Carolina's wild orchids can be seen here, including the pink lady's slipper and the cranefly orchid.

Along the creek bottoms, the well-known jewelweed can be found. Another name for this plant is touch-me-not since the ripe seed pods will throw seeds several feet in the air, when touched. This plant has been used as a topical treatment for poison ivy. During the spring, these low-lying moist areas are decorated with the showy blooms of the Atamasco lily, or wild Easter lily, and the umbrella-shaped May apple.

There are four distinct types of forest in Medoc Mountain State Park. The first, the pine forests, are what remain of former pine plantations. The second forest, the mixed forest, contains both pines and a mixture of hardwood trees, like oak and hickory, together with an understory of small shrubs. Most of the trees in this forest type are still in the early stages of growth. Eventually, the slower growing hardwood will dominate, naturally thinning out the pines. The third type, the lowland hardwood forest, is characterized by trees such as river birch, swamp chestnut oak, sweet gum and ironwood which are fairly water tolerant. Finally, the upland hardwood forest is found in the more well-drained areas of the park, such as on exposed slopes and ridgetops. Some of the trees in this type of forest are 40 to 75 years old and measure 18 inches in diameter. The chestnut oak of these areas is considered unusual, since it is not normally found east of Vance, Granville or Wake counties.

The large number of plant communities in the park contribute to a diverse wildlife population. Mammals such as deer, fox, raccoons, opossums and groundhogs make their homes in the park. On rare occasions, a black bear will pass through looking for a new

Medoc Mountain State Park Illustration by Thomas R. Yelverton

home. Other elusive animals include the river otter and beaver. However, signs of their presence may be found along Little Fishing Creek and Bear Swamp Creek.

Raptors, or meat-eating birds, found in the park include barred, great horned and screech owls, as well as red-tailed and red-shouldered hawks. When the sun goes down in the spring, the famous whip-poor-will and chuck-will's-widow echo their monotonous calls through the forest. Warblers, sparrows and woodpeckers, including the crow-sized pileated, are some of the more prominent bird species found in the park.

Several species of snakes also call Medoc Mountain State Park home. These include the black rat snake and the cornsnake. The only poisonous snake in the park is the copperhead, but it is rarely encountered by park visitors.

Medoc Mountain State Park is dedicated to the protection and preservation of North Carolina's natural and cultural resources. One of the ways to guarantee the well-being of these resources is through environmental education. The park staff offers a wide variety of environmental education programs including hikes, slide shows, talks and hands-on activities. They will make every effort to accomodate persons with disabilities.

Programs are geared for different grade levels and include topics such as geology, animal adaptations, soil conservation and predator/prey relationships. Groups are also welcome to visit the park for self-guided expeditions. Facilities include restrooms, picnic areas, trails and family and group camping.

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration and environmental education programs and activities.

Scheduling a Trip:

1. To make a reservation, contact the park at least two weeks in advance.

2. Please complete the scheduling worksheet provided at the back of the activity packet.

Before the Trip:

1. Visit the park without the participants. This will give you a chance to become familiar with the facilities and park staff, as well as provide you with an opportunity to identify potential problems.

2. Discuss behavior expectations with the adult leaders and students. Discuss the park rules and emphasize safety.

3. Inform the group about poison ivy, ticks and chiggers. You may want to use insect repellant from early spring to late fall.

4. Inform your group to dress appropriately for the season. Summer weather can be hot and humid.

5. Everyone should wear a name tag. Please color-code tags (for groups) and establish a buddy system for the students.

6. Group leaders are responsible for obtaining a parental consent form for each participant. Be sure that health considerations and medical needs are noted. A parental permission form is available on page 8.2.

7. *If you will be late or need to cancel your trip, please notify the park as soon as possible.*

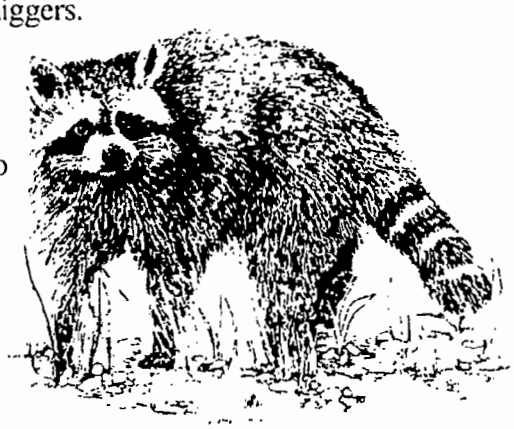
8. Research activity permits may be required for activities which require samples to be taken from the park.

9. Complete the pre-visit activity "Hard Rock Crayola" if your class is doing the Environmental Education Learning Experience.

While at the Park:

1. Be as quiet as possible to get the most out of the experience and to increase your chance of seeing wildlife.

2. On hikes, walk behind the leader at all times. Stay on trails; running is not permitted.



3. All plants and animals within the park are protected. Picking plants and harming or removing animals is prohibited in all state parks. This allows future visitors the same opportunity to enjoy our natural resources.

4. Picnic in designated picnic areas only. Help keep the park clean and natural; do not litter.

5. Swimming is not permitted in the park.

6. In case of accident or emergency, contact the park staff immediately.

Following the Trip:

1. Complete the post-visit activity in the Environmental Education Learning Experience packet.

2. Build upon the field experience and encourage participants to seek answers to questions and problems encountered at the park.

3. Relate the experience to classroom activities and curriculum through reports, projects, demonstrations, displays and presentations.

4. Give tests, or evaluations, if appropriate, to determine if the students have gained the desired information from the experience.

5. File a written evaluation of the experience with the park staff. Evaluation forms are available on page 8.3.

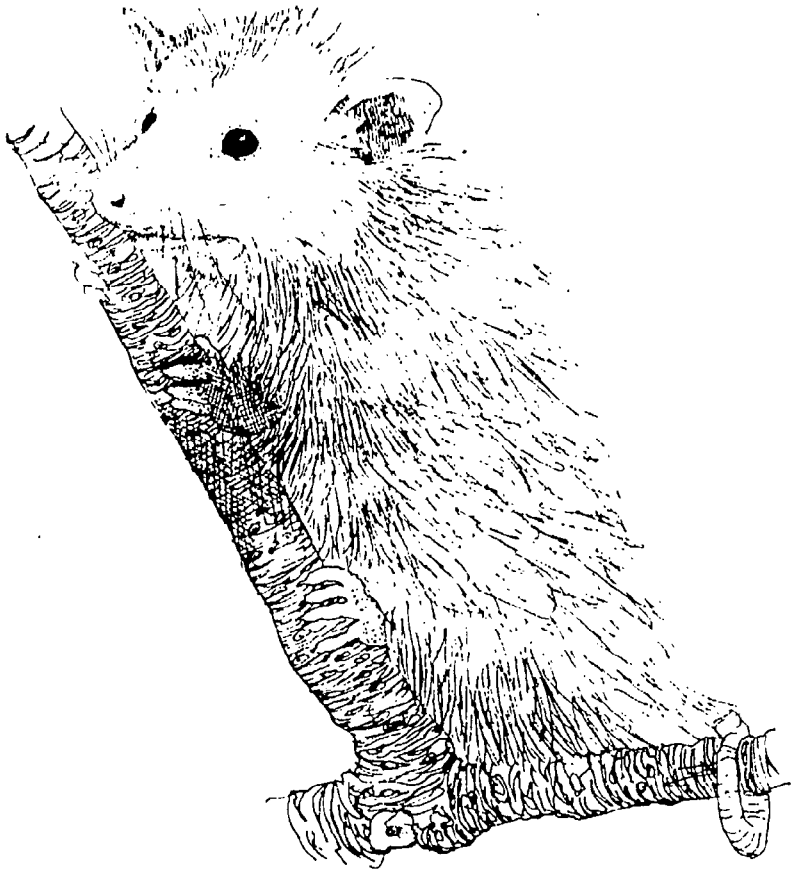
6. Reinforce to the students the idea that the future of our natural resources is in their hands.

Park Information:

Medoc Mountain State Park
P.O. Box 400
Hollister, NC 27844
Tel: 919-445-2280

Hours of Operation:

Nov-Feb	8:00 a.m.- 6:00 p.m.
Mar, Oct	8:00 a.m.- 7:00 p.m.
Apr, May,Sept	8:00 a.m.- 8:00 p.m.
Jun-Aug	8:00 a.m.- 9:00 p.m.



Introduction to the Activity Packet for Medoc Mountain State Park

NOTE: On-site activities may require hiking which could expose the students to hot, humid conditions and ticks. Accessibility to some of these areas may be difficult for persons with special needs.

The Environmental Education Learning Experience, "Rockin' on the Ridge," was developed to provide environmental education through a series of hands-on activities geared to Medoc Mountain State Park. This activity packet, targeted for grades 4, 5 and 6, meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included:

1) Pre-visit activity
2) On-site activity
3) Post-visit activity

The on-site activity will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom. These activities may be performed independently or in a series to build upon the students' newly gained knowledge and experiences.

This Environmental Education Learning Experience, "Rockin' On The Ridge," will expose students to the following major concepts:

- **Composition of rock**
- **Chemical and mechanical forces on rocks and minerals**
- **Types of rocks and minerals**
- **Formation of ridges and mountains**
- **Properties of rocks and minerals**
- **Use of geology field equipment**
- **Uses of rocks and minerals**

The first time a vocabulary word is used in each of these activities it is indicated in **bold** type. These words and their definitions may be found in the vocabulary list at the back of the activity packet. A list of the reference materials used in developing the activities follows the vocabulary list.

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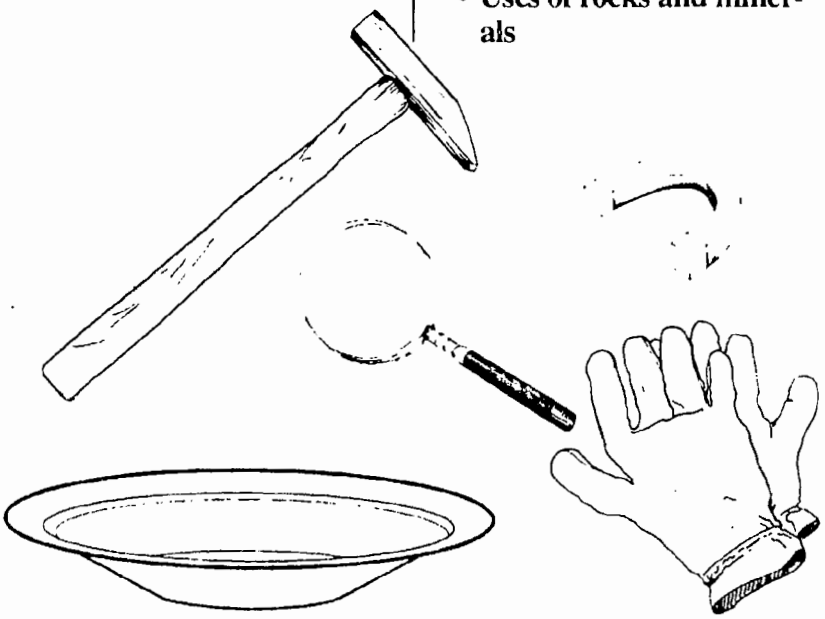


Introduction to the Geology of Medoc Mountain State Park

Medoc Mountain State Park is a wonderful place to learn about **geology**, the study of the earth. Geologists learn about the history of the earth by studying **rocks** and **minerals**. At Medoc Mountain, you can observe over 300 million years of earth history.

About 300 million years ago, strange occurrences were taking place in this country. It was a time when giant dragonflies, some with wings two feet across, were flying through forests of tree-ferns and giant horsetails. This time in geological history is known as the Paleozoic Era. Also, during this era, a high ridge began to form in an area which is now known as eastern North Carolina.

Deep beneath the earth's surface, hot liquid rock, called **magma**, began to rise to the earth's surface. This magma pushed its way towards the surface, where it cooled and solidified, forming an **igneous rock**. Igneous simply means a rock which has formed when magma cools. Over millions of years, this area of igneous rock proved more **resistant** to **erosion** than any of the other rocks around it. The 325 foot high ridge of today is a result of volcanic activity 300 million years ago, combined with 300 million years of erosion and **weathering**.

This area of Medoc Mountain is a great place to study the earth's history because it is located on a fall line. A fall line is a narrow boundary between two areas with different geological histories. This fall line marks the edges of the Piedmont and the Coastal Plain.

The Piedmont rocks were formed when volcanic and **sedimentary** materials were deposited between 800 million and 500 million years ago. Over these millions of years, the materials were buried and changed by heat and pressure to form **metamorphic rocks**, such as **gneiss** and **schist**. Magma forced its way into some of these metamorphic rocks and cooled extremely slowly to form the igneous rock, **granite**. The rock formations you see today in the Piedmont are the result of millions of years of weathering and erosion.

Many of the sediments eroded from the Piedmont were carried into the Coastal Plain in streams and rivers. Some may even have been blown in by fierce winds. The Coastal Plain is made of layer upon layer of sedimentary deposits such as sand, clay, marl and **limestone**. In addition to being laid down by ancient rivers, these sediments also came from the shallow seas that formed as the ocean moved back and forth across the continental margin. Such changes in sea level were caused by the gradual sinking of the land and the differing amounts of water being frozen in the Earth's polar ice caps. Like the formation of rocks, sea level change generally takes thousands, or even millions of years. The Coastal Plain sediments form a wedge-like mass that overlies crystalline rocks, like those of the Piedmont. The wedge is very thin at the fall line, but is nearly 10,000 feet, or two miles, thick at Cape Hatteras. These rocks are fairly young, when compared to the age of the rocks in the Piedmont. The average age range of a Coastal Plain rock is "only" 10,000 to 100,000,000 years old.

Some of the kinds of rocks you can find at Medoc Mountain include granite and **quartz**. The granite mass underlying Medoc Mountain is about 300 million years old. **Feldspar**, quartz and mica combined to form the granite. Quartz, the most common mineral, is made from silicon and oxygen, and

Quartz

is abundant in the park. Quartz veins are found in the granite and surrounding metamorphic rocks. These veins were formed when molten rock moved into fractures and zones of weakness in surrounding rocks. As it cooled, the silicon settled out and formed quartz. Quartz veins are not found in the sedimentary rocks of the coastal plain, so we know that the veins formed before the sedimentary rocks, but later than the Piedmont rocks. Quartz is very resistant to both chemical and mechanical weathering. The plentiful quartz lying on the ground, called float, indicates that quartz veins are just beneath the surface.

Molybdenum, a metallic element, is valued as an alloy because of its properties of high strength and low weight. It is found in the mineral molybdenite. Molybdenite was found at this site in 1936. Molybdenite is a steel-blue or silver colored flaky mineral found in some quartz veins and in portions of granite. **Pyrite**, or fool's gold, is often found with molybdenite.

The United States Bureau of Mines conducted a sampling and core drilling investigation of the area during and after World War II as part of a program to discover and evaluate strategic materials. Exploration by the U.S. government and private mining companies continued until about 1970. Molybdenum would be strategically important, especially during a war, because it is used in airplane manufacturing. Although this is one of the largest molybdenite deposits in the southeastern United States, it has never been necessary to mine it, as it is small compared to the deposits in the western United States.

Trails

The best way to learn about the geology of Medoc Mountain is to actually observe the different rock formations. Each of the trails in the park will lead you to an interesting geological discovery.

Summit Trail

This three-mile loop trail originates at the Park Office and includes Little Fishing Creek and the "peak" of Medoc Mountain.

Quartz float can be seen along the trail as it winds down the slope to the creek. As the slope becomes steeper, blocks of dark colored, fine-grained rock are scattered along the surface of the trail and in the

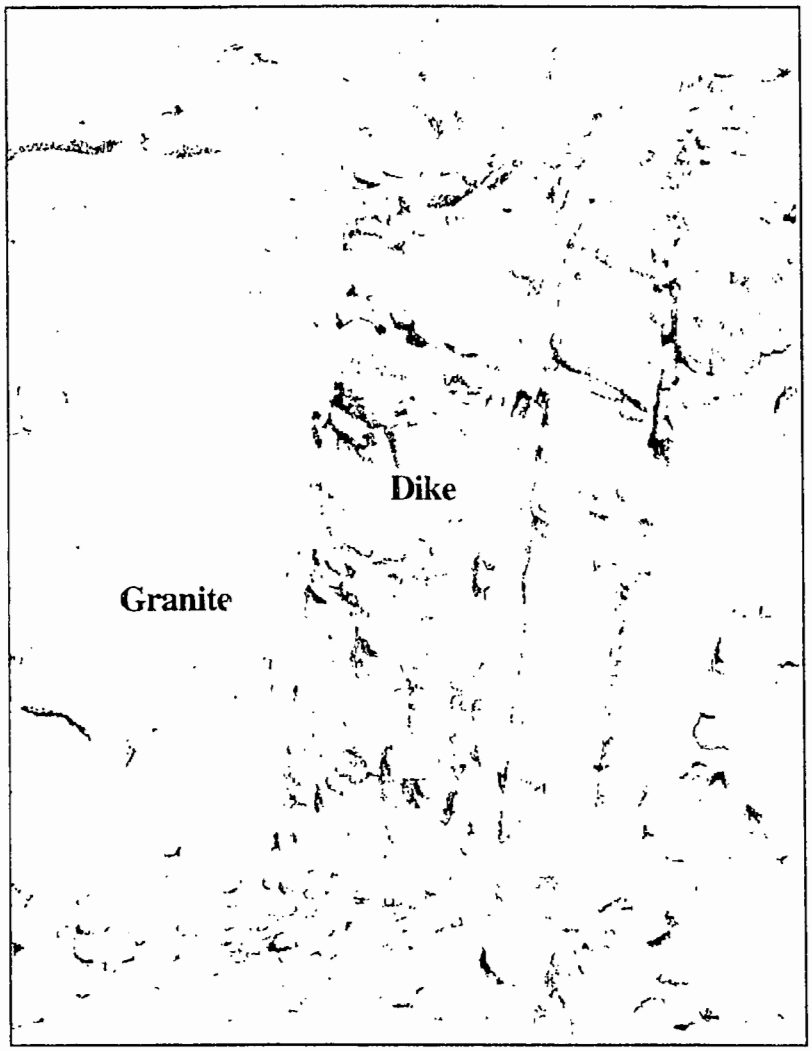


Illustration by Thomas R.Yelverton adapted from photograph in *A Geologic Guide To North Carolina's State Parks*, Albert P. Carpenter, editor.

adjacent woods. This rock is a type of igneous rock called **diabase**. The blocks can be traced in a straight line and indicate that the rock is a sheet-like, vertical feature a few feet wide known as a **dike**. Diabase dikes intruded rocks in the Piedmont approximately 200 million years ago when North America and Africa drifted apart to form the Atlantic Ocean.

Geologists measure the magnetic intensity of rocks in order to study and map rocks that cannot be seen on the Earth's surface. Magnetic maps are also useful in mineral exploration and interpreting the structure of rocks. Because diabase contains a relatively large amount of the magnetic mineral magnetite, it is usually seen as a magnetic "high" on magnetic maps.

Farther along on Little Fishing Creek, a large **outcrop** of granite rises adjacent to the trail. The granite is cut by numerous quartz veins. Molybdenite and pyrite are visible in a few of the veins. Look for areas where the quartz has a yellowish stain on its surface. The stain is an oxide or weathering by-product of the molybdenite. The reddish coating on much of the outcrop is similarly formed by the weathering of hematite and other minerals, like pyrite, which contain iron. Near the base of Medoc Mountain, red-stained quartz float is abundant. Some of the quartz has a honeycomb texture. The open spaces result from the weathering of pyrite that once filled the spaces. The size of the quartz boulders along this segment of the trail and along the road leading south from the peak indicate some of the veins may be as large as several feet thick.

Dam Site Loop Trail

The Dam Site Loop is a one-mile-long trail that follows Little Fishing Creek a short distance upstream from the sharp bend. Along this trail, Little Fishing Creek bends sharply where the creek encounters the granite that forms Medoc Mountain. The granite, reinforced by the many quartz veins, deflected the stream from its easterly course to one that moves south along the western edge of the granite. Where the tributary enters Little Fishing Creek, a mound of gravel, called a gravel bar, has built up near the north bank of Little Fishing Creek. Gravel bars form in streams and rivers where the water slows down and the water flow is too weak to carry the sand and gravel. This commonly occurs on the inside of bends or where a tributary enters a larger stream.

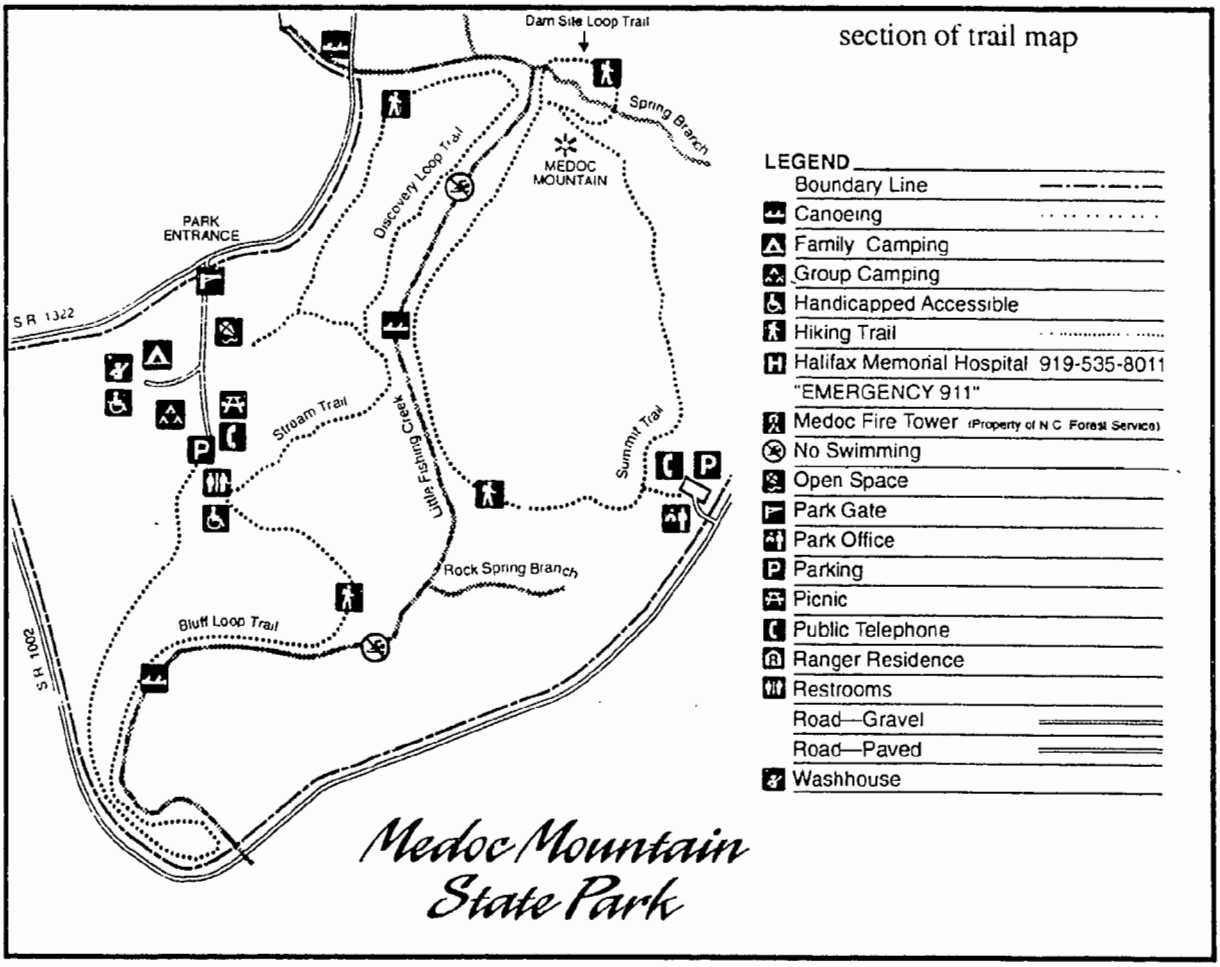
Illustration by Thomas R.Yelverton adapted from photograph in *A Geologic Guide To North Carolina's State Parks* Albert P. Carpenter, editor.

Bluff Trail

The Bluff Trail is a three-mile-long trail originating at the picnic shelter on the east side of Little Fishing Creek. Where the trail climbs the bluff at Little Fishing Creek, there are good exposures of metamorphic rock. In places along the top of the bluff, soft, flaky material lies on the surface. The flaky material is float from a mudstone that is mixed with the metamorphic rock. Both types of rock are exposed at the south end of the bluff where the trail descends back to river level. The outcrop here is also cut by a few quartz veins. Along the hilltops, rounded pebbles and cobbles of quartz lie on the surface. The cobbles and pebbles are from a gravel deposit that caps the hill crossed by the trail. The pebbles and cobbles along the trail have been moved gradually down the slope by a process known as slope wash. During this process, gravity slowly moves the cobbles downhill as erosion washes away fine grained material around the cobbles.

Stream Trail

The Stream Trail (one mile long) originates at the picnic area. Rock exposures are difficult to find along the Stream Trail. When the bedrock was cut away by the erosive action of Little Fishing Creek, silt, sand and clay were deposited in its place. One bedrock exposure is in a river at the first part of the trail. The outcrop is metamorphic rock which has broken or fractured along planes called joints. Note the parallel nature of the joints. There are two main directions of jointing. One direction is to the northeast and the other direction is the northwest. By studying measurements of the joint directions, geologists are able to understand the forces that caused the rock to fracture. This helps them interpret the geologic history of the area.



Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activity

#1 Hard Rock Crayola (page 3.1.1)

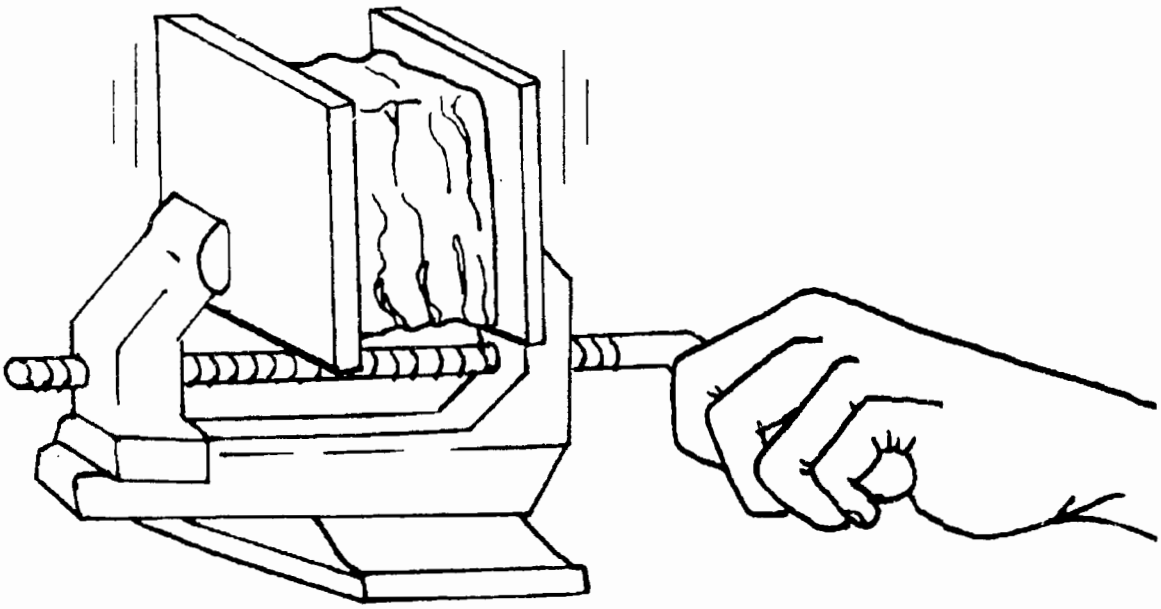
Students will learn the differences between the three major rock types: igneous, metamorphic and sedimentary, with the use of crayons.

Major concepts:

- Rock cycle
- Mechanical weathering
- Sedimentary rock formation
- Metamorphic rock formation
- Igneous rock formation

Objectives:

- List the three main rock types.
- Describe how these three rock types are formed.
- Explain the rock cycle.
- Describe four processes by which one rock type changes into another.
- Name a metamorphic and an igneous rock found in the park.



II. On-Site Activity

#1 Gee! What is a Geologist? (page 4.1.1)

In this activity, the students will learn about the work of a geologist by visiting three stations. One station will focus on the tools used by a geologist in the field. The second station will focus on the 300 million year history of Medoc Mountain. The third station will demonstrate some geological forces that are currently acting on Medoc Mountain.

Major Concepts:

- Geology field equipment
- Types of rocks and minerals
- Formation of ridges and mountains
- Mechanical and chemical forces on rocks and minerals
- Rock composition
- Properties of rocks and minerals

Objectives:

- Identify three tools used by a field geologist.
- Be able to identify three rocks or minerals found in Little Fishing Creek.
- Learn how mountains and ridges are formed.
- List three minerals that compose Medoc Mountain.
- List two forms of chemical weathering and two forms of mechanical weathering.
- Describe three properties of rocks and minerals such as shape, color and texture.

III. Post-Visit Activity

#1 Everyday Geology (page 5.1.1)

Every day of our lives we use rocks, minerals and elements in some form or fashion, whether we realize it or not. Students will learn some of the "everyday" products we use, thanks to the science of geology.

Major concepts:

- Uses of rocks, minerals and elements
- Classification of rocks, minerals and elements

Objectives:

- Name eight examples of products that come from rocks, minerals and elements.
- Using references, classify five samples as rock, mineral or element.

Pre-Visit Activity #1 Hard Rock Crayola

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational and school safety
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary, viewing and study skills using environmental sources
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational and home safety
- Science: earth science
- Social Studies: organize and analyze information, draw conclusions, locate and gather needed information

Location:
Classroom/science lab

Group Size:
30 students or less, divided into six groups

Estimated Time:
Two to four hours

Credits:
This activity has been adapted from "Color Me Metamorphic" by Donald L. Birdd, *The Science Teacher*, April 1990, pp. 21-26.

Materials:
Provided by the educator:
Per group: hot plate, oven mittens, petri dish or finger bowl, aluminum foil (45cm x 45cm), three aluminum foil pie trays, wax paper, a metal or wooden trivet, newspapers
Per student: Rock Cycle and Hard Rock Crayola worksheets, safety goggles, pencil sharpener or carrot peeler, candles or four to six crayons of the same color (red, green, blue or yellow), envelope
Per class: one or more vises with two boards (12.5cm x 20cm), rock samples.

Special Considerations:
Take proper safety precautions. The hot plate and hot crayon wax can cause burns. The vise can pinch/crush fingers.

Major Concepts:

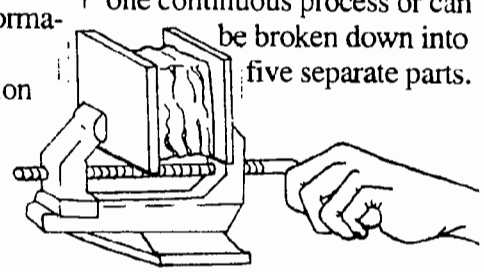
- Rock cycle
- Mechanical weathering
- Sedimentary rock formation
- Metamorphic rock formation
- Igneous rock formation

Objectives:

- List the three main rock types.
- Describe how these three rock types are formed.
- Explain the rock cycle.
- Describe four processes by which one rock type changes into another.
- Name a metamorphic and an igneous rock found in the park.

Educator's Information

Many students have a difficult time understanding the abstract concept of the **rock cycle**, the process by which **sedimentary, metamorphic** and **igneous rocks** are transformed into and from one another. The students can see **rock** examples in the classroom; the difficulty lies in their inability to visualize just how these rock samples were formed. The following activity will give the students the opportunity to "see" the rock cycle through a series of simulations of mechanical **weathering,** erosion, and formation of sedimentary, metamorphic and igneous rock. The activity can be done as one continuous process or can be broken down into five separate parts.



Student's Information

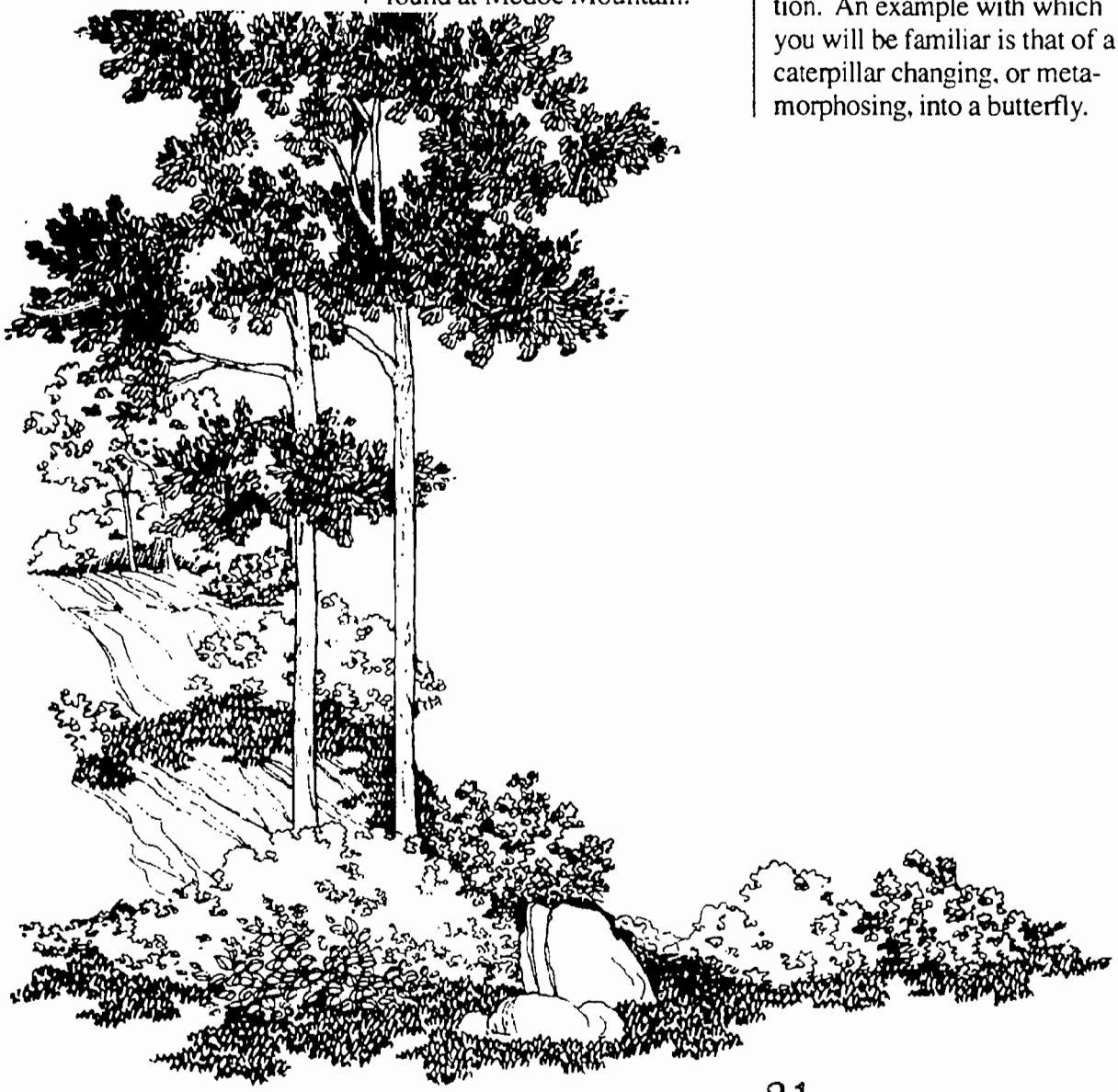
There are three basic **rock** classifications:

1) **Sedimentary rock** - rock that is composed of particles of sand, clay or other rocks that were deposited in layers on land or on the bottom of lakes, rivers or oceans. Over time, the extreme pressure from the weight of the layers above pressed the materials into rock. Examples are **limestone**, sandstone and mudstone.

2) **Igneous rock** - rock which has solidified from a molten state. Igneous rocks form deep within the earth in **magma** chambers embedded in solid rock. They may be **intrusive** or **extrusive** in nature. Magma which cools and stays within the earth is intrusive. Magma which is spewed out by **volcanoes**, lava, is extrusive. **Granite** is an intrusive igneous rock found at Medoc Mountain.

3) **Metamorphic rock** - sedimentary or igneous rock that was changed deep inside the earth by extreme heat and pressure over a long period of time into a harder rock with different qualities. Examples of metamorphic rock in the park are **gneiss**, **schist** and mylonite.

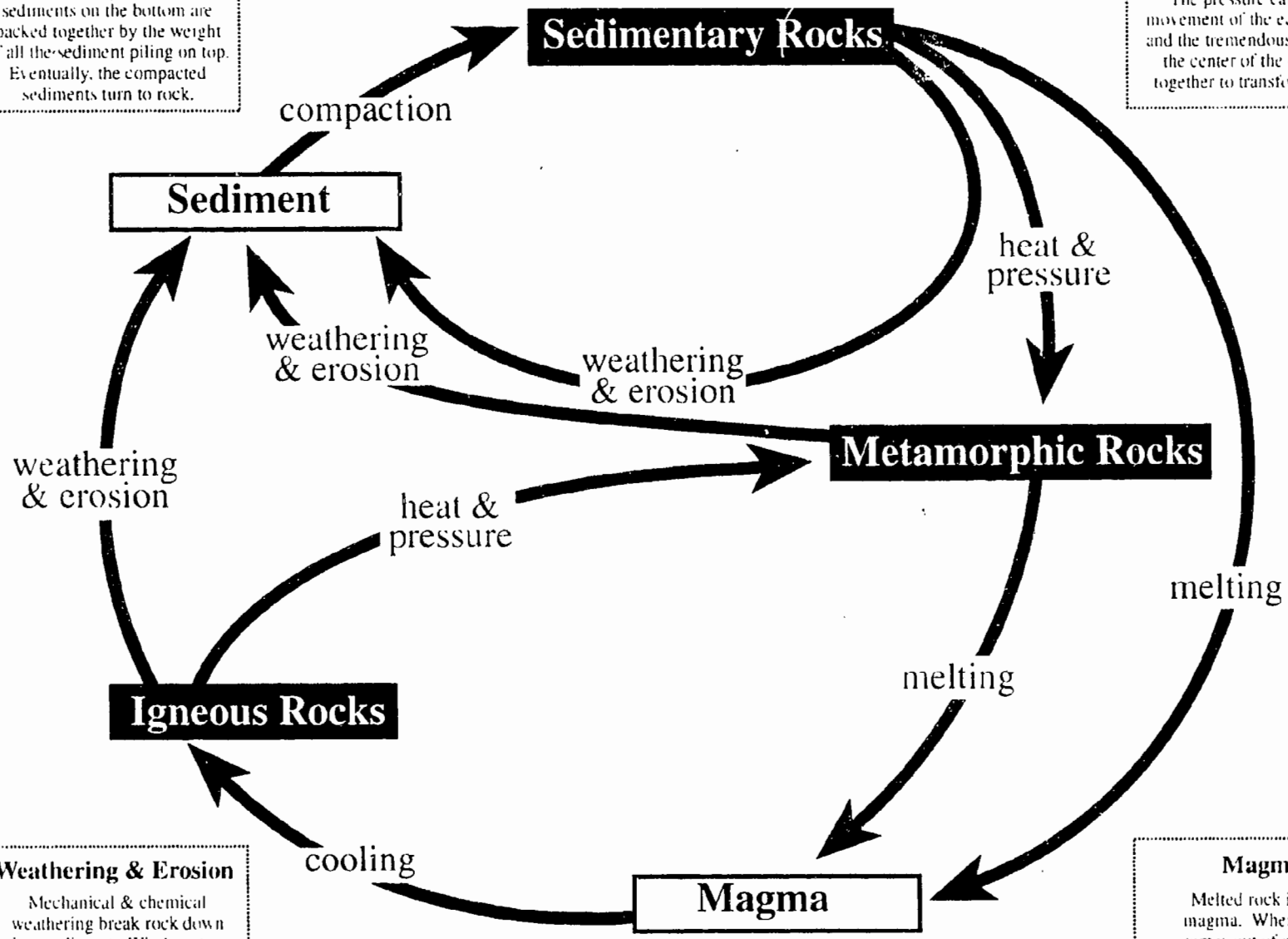
Metamorphosis means a transformation, a marked change in appearance or condition. An example with which you will be familiar is that of a caterpillar changing, or metamorphosing, into a butterfly.



Rock Cycle Worksheet

Compaction
As sediments pile up, those sediments on the bottom are packed together by the weight of all the sediment piling on top. Eventually, the compacted sediments turn to rock.

Heat and Pressure
The pressure caused by movement of the earth's crust and the tremendous heat from the center of the earth act together to transform rocks.



Weathering & Erosion
Mechanical & chemical weathering break rock down into sediment. Wind, water, ice and snow cause erosion.

Magma
Melted rock is called magma. When magma comes out of a volcano, it is called lava.

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Instructions:

Set the stage by asking students to describe local rocks and/or rock formations, or ones they have seen during walks along a lake or river's edge, near or on a mountain or during drives along highways that were built through road cuts. On the chalkboard, write down all the names and characteristics the students can remember about the rocks. Be sure to have several local rock samples distributed around the room.

Ask the students questions such as, "Have you ever wondered just how these rocks formed?" "Are new rocks forming at this moment?" Be sure to go over the Rock Cycle diagram. Discuss the three kinds of rocks with the students.

Part A: Weathering

Cover all desk tops with newspaper. Give each student a sheet of wax paper, a pocket pencil sharpener or carrot peeler and a candle or four to six crayons of the same color. The candles/crayons represent rock material and the carrot peelers/pencil sharpeners represent weathering agents. Students should carefully shave each of the candles/crayons, keeping all of the fragments in a small pile. As they are "weathering" their candles/crayons onto the wax paper, call their attention to the size and shape of the fragments.

"Are they all the same size and shape?" (No.)

"Why or why not?" (They are not the same size and shape due to varied weathering forces upon them, i.e., how the sharpener or crayon are held, etc.)

"What are some of nature's weathering forces?" (Rain, flowing and freezing water, glaciers, and wind.)

When the "weathering" is complete, the students should wrap their "sediments" in their wax paper and place each color in a separate envelope, unless you plan to do Part B of this activity right away.

Part B: Erosion and Sedimentation

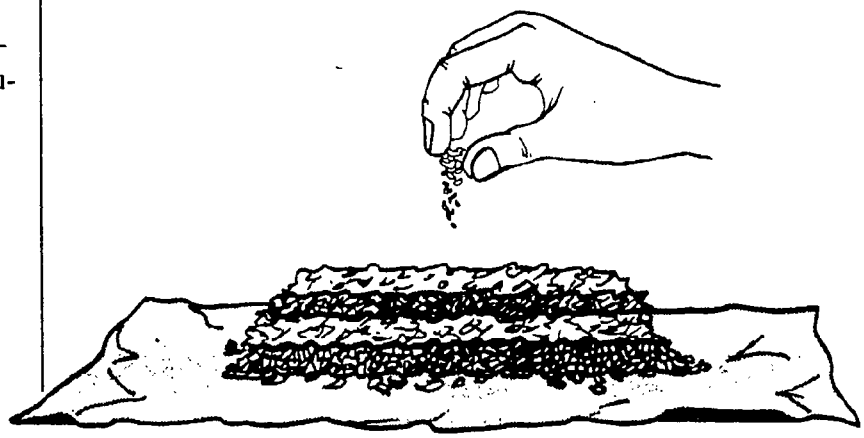
Once rock fragments have been created, they are usually moved by some force of nature. Here, the students act as the erosive force. Ask the students what this force of movement is called, and what some of its causes are. (Erosion. It is caused by gravity, moving water, glaciers and wind.)

Place all the weathered "rock" fragments in four separate piles, one color to a pile. Divide the class into four (or eight) groups, and give each group a sheet of aluminum foil (45cm x 45cm). Next, a student from each group should carefully transfer some "weathered sediments," of one color, to the center of the foil. Spread the fragments into a 1cm thick layer. Repeat with the remaining colors, layering the colors one on top of another.

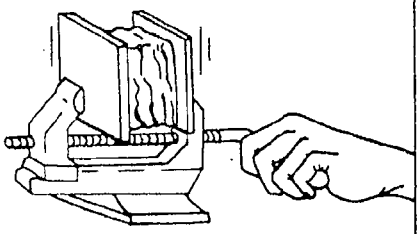
Students should record their observations of their layered "weathered sediments" on the "Hard Rock Crayola" worksheet. Fold the foil over the layered "sediments", allowing for a 1cm space all around the fragments and then carefully fold the edges to seal the packages. If you are breaking the activity into sections, have the students label their foil packages by their group numbers and stop here.

Part C: Sediments/Sedimentary Rock Simulation

Unless you have more than one vise, this step will take some time and will require some patience. Each group



will place their folded foil package between two boards. The "sandwich" should then be placed in the vise. Apply light pressure with the vise to



compress the "sediments." Once the "rock sandwiches" have been mildly compressed, remove them from the vise. Students should then carefully open their packages and observe the new product. Call their attention to the central region which is more tightly compressed. The students should lift this portion from the non-compressed, or more loosely packed "sediments" and carefully break it into two parts. Have the students look at the broken edges, then draw and describe the layers on the worksheet.

How do they compare with the original loose "sediments" layers? (They're similar, but much thinner.)

What happened to the spaces between the "sediments"? (Pressure from the vise forced the "sediments" closer together, eliminating the spaces.

Each group should transfer a few of their loose "sediments" and the smaller piece of "sedimentary rock" into a pie pan. Place the rest of the fragments in an envelope, (for part E). The pieces in the pie pan will be used for comparisons with the other "rocks" the students will produce during this activity. Return the larger piece of "sedimentary rock" to the aluminum foil package and wrap it up again. If you are breaking the activity into sections, stop here.

Part D: Metamorphic Rock Simulation

Place the foil package with the "sedimentary rock" in it between the two boards and put it into the vise again. Tell the students to apply as much pressure to the vise as they can. This part of the activity demonstrates the need for great pressure to cause a rock to metamorphose. In reality, as the pressure deep within the earth increases, temperatures increase as well. A temperature change is probably occurring in this activity but is difficult to measure. (The heat associated with the formation of metamorphic rock is not a part of this activity.) Remind the students that metamorphic rock may become contorted in appearance. It may actually flow like a plastic material in response to the pressure from the rock load above and movement of the earth's crust.

Have the students release the compression on the vise,

remove the foil package and open it carefully to examine the newly formed "metamorphic rock." They should carefully break this "rock" into two parts and examine it, noting what happened to the thickness and fragment shape. The students should write down their observations on their worksheet. (The different colored "rock fragments" or crayons will be squeezed together.)

Place the smaller piece of newly-made "metamorphic rock" with the "weathered sediments" and the "sedimentary rock" previously saved. If you are breaking the activity into sections, stop here.

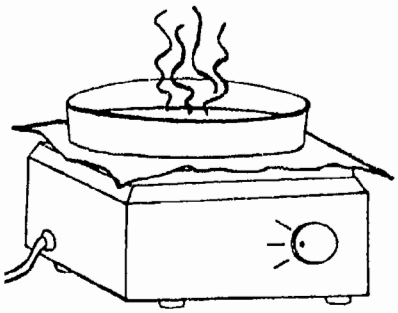
Part E: Igneous Rock Formation

SAFETY NOTE: This portion of the activity requires that the students be especially safety conscious as they will be working with a hot plate and melted wax.

Each group should line their last tray with aluminum foil.

For the "igneous rock" simulation, the groups should place the "sediment" fragments they set aside in envelopes and the larger piece of "metamorphic rock" into their aluminum tray. **Be Especially Careful Here!** This part of the activity requires a hot plate as a heat source. **Students Should Avoid Dropping Wax Fragments on the Hot Plate Surface or Themselves.** The students or teachers doing this portion of the activity should

wear protective oven mittens to avoid being burned. Cover each hot plate surface with a layer of foil before you turn it on. This will diffuse the heat from the coils of the hot plate so the crayons will not burst into flames. Each group should place their tray of "weathered sediments" and "metamorphic rock" on the hot plate and turn the hot plate



temperature to medium. Melt the wax, being careful that the melting process does not occur so rapidly that the molten wax splatters or burns. When most of the "rock" and "sediments" are molten, turn the hot plate off and carefully remove the tray, using the oven mittens. There is enough heat energy in the molten wax to melt the remaining solid mass. **Caution: Do not let the wax heat to the splattering point!**

While the wax is still in the molten state, a student from each group, or the teacher, should **Carefully** place the pan on the trivet.

Students should make observations of their tray, then draw and write these down on their worksheet. Comparisons should be made between these "igneous rocks" and the "rocks" and "sediments" made in the previous sections of this activity.

Set aside all "igneous rock" trays until the next day's class; the materials must sit overnight. This will allow the wax to cool. The next day, have the students carefully remove the "igneous rock" from the tray. Be sure to look at the lower surface of the "rock."

As a class, be sure to discuss the effects of "lava" flowing directly onto the land in a temperate zone, such as Mt. St. Helens in Washington, as opposed to magma cooling under the earth's surface.

Remind the students of the igneous rocks common to this area and the park, such as granite. Also mention that all conditions for rock formations cannot be simulated. In fact, geologists have never "seen" intrusive rocks form. However, they are able to look at all of the available evidence, simulate some of the conditions in the laboratory, and arrive at results similar to those found in nature.

Reiterate the concept of the rock cycle by reminding them of the "rocks" (crayons or candles) that were weathered down into "sediments," compressed into "sedimentary" and then "metamorphic rocks" and then melted into "igneous rocks."

Worksheet for Pre-Visit Activity #1 Hard Rock Crayola

1. Describe and draw the "weathered sediments" you made. Note the sizes and shapes of the "sediments."

2. Make a colored drawing of the "rock fragments" after light pressure has compacted these "sediments" into "sedimentary rock." Describe the broken edge and the layers that are formed.

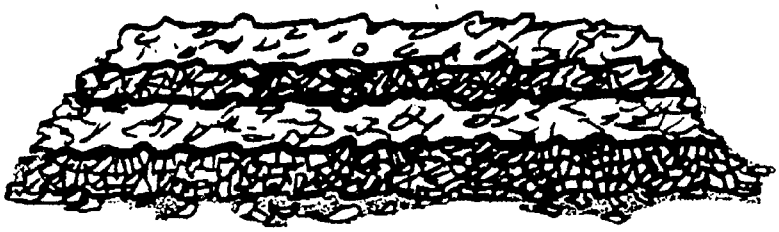
3. Make a colored drawing of the "sedimentary rock" after heavy pressure has compacted it into "metamorphic rock". Describe the broken edge and the layers that are formed. How have they changed with the addition of heavy pressure?

4. Draw the melted wax formation created in Part E.

5. Write a comparison between the "weathered rock fragments," "sedimentary rocks," "metamorphic rocks" and "igneous rocks" formed in this activity. Compare and contrast them as to color, crystal size, texture, form and formation.

Answer Sheet for Pre-Visit Activity #1 Hard Rock Crayola

1. Describe and draw the "weathered sediments" you made. Note the sizes and shapes of the "sediments."



2. Make a colored drawing of the "rock fragments" after light pressure has compacted these "sediments" into "sedimentary rock." Describe the broken edge and the layers that are formed.

3. Make a colored drawing of the "sedimentary rock" after heavy pressure has compacted it into "metamorphic rock". Describe the broken edge and the layers that are formed. How have they changed with the addition of heavy pressure?

4. Draw the melted wax formation created in Part E.

5. Write a comparison between the "weathered rock fragments," "sedimentary rocks," "metamorphic rocks" and "igneous rocks" formed in this activity. Compare and contrast them as to color, crystal size, texture, form and formation.

The "weathered rock fragments" will vary in size and shape depending on the implement used: pencil sharpener, potato peeler, etc. The "sedimentary rocks" will be bound together very loosely and individual "rock fragments" can be oriented (up/down or right/left) in any direction. In "metamorphic rocks" the space between fragments is very small and the orientation of "fragments" is now flattened (right/left). The thickness is much thinner, but each layer of rock (color) can still be seen. The "igneous rock" is grayish-black (melting and mixing of different "rock fragments") with a variety of forms depending on how the separate groups are cooled. ***(The different methods of cooling are not intended to simulate real rock formations; they do, however, give the students the understanding that different cooling conditions will create different rocks.)***

On-Site Activity #1 Gee! What is a Geologist?

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: evaluate the importance of familiar jobs, competency for interacting with others
- Healthful Living: school and recreational safety
- Science: weather and climate
- Social Studies: gather, organize and analyze information; draw conclusions; participate effectively in groups

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: evaluate the importance of familiar jobs; competency for interacting with others
- Healthful Living: recreational safety
- Science: earth science; environment
- Social Studies: gather, organize and analyze information; draw conclusions; participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: evaluate the importance of familiar jobs; competency for interacting with others
- Healthful Living: recreational safety; how people effect the environment
- Science: how science helps us
- Social Studies: gather, organize and analyze information; draw conclusions; participate effectively in groups

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
20 to 30 minutes

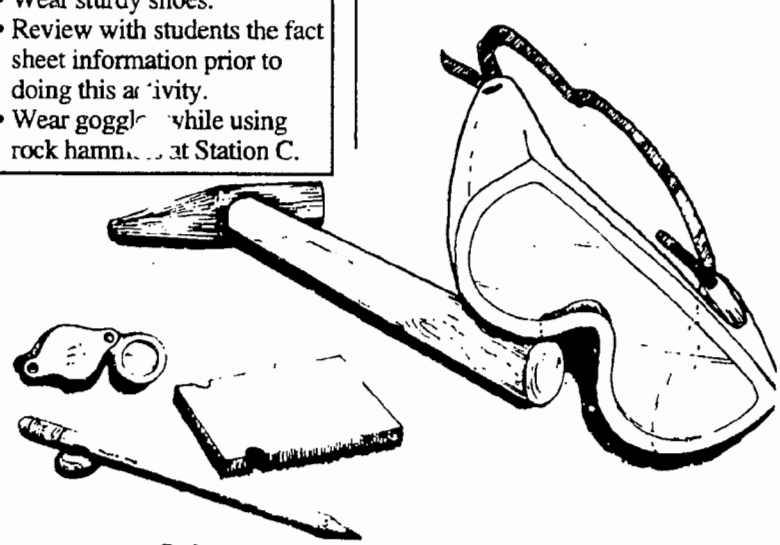
Appropriate Season: Any

Materials:
Provided by the park:
Model of Medoc Mountain, water, mineral samples, hydrochloric acid, limestone samples, glass vial, eye protection, 3 rock hammers, pyrite samples, streak plates, clipboards
Per Student: pair of goggles, magnet, safety helmet, gold pan
Provided by the educator:
Per Student: "Making of a Monadnock" worksheet, "Portrait of a Geologist" worksheet

Special Considerations:
- Students must wear eye protection at Station B when acid is being used.
- Wear sturdy shoes.
- Review with students the fact sheet information prior to doing this activity.
- Wear goggles while using rock hammers at Station C.

Major Concepts:
- Geology field equipment
- Types of rocks and minerals
- Formation of ridges and mountains
- Mechanical and chemical forces on rocks and minerals
- Rock composition
- Properties of rocks and minerals

Objectives:
- Identify three tools used by a field geologist.
- Be able to identify three rocks or minerals found in Little Fishing Creek.
- Learn how mountains and ridges are formed.
- List three minerals that compose Medoc Mountain
- List two forms of chemical weathering and two forms of mechanical weathering.
- Describe three properties of rocks and minerals such as shape, color and texture.



Educator's Information:

During this activity, the students will be divided into three groups to experience what it is like to be a field geologist. The different groups will rotate through three stations, each focusing on a particular aspect of being a geologist.

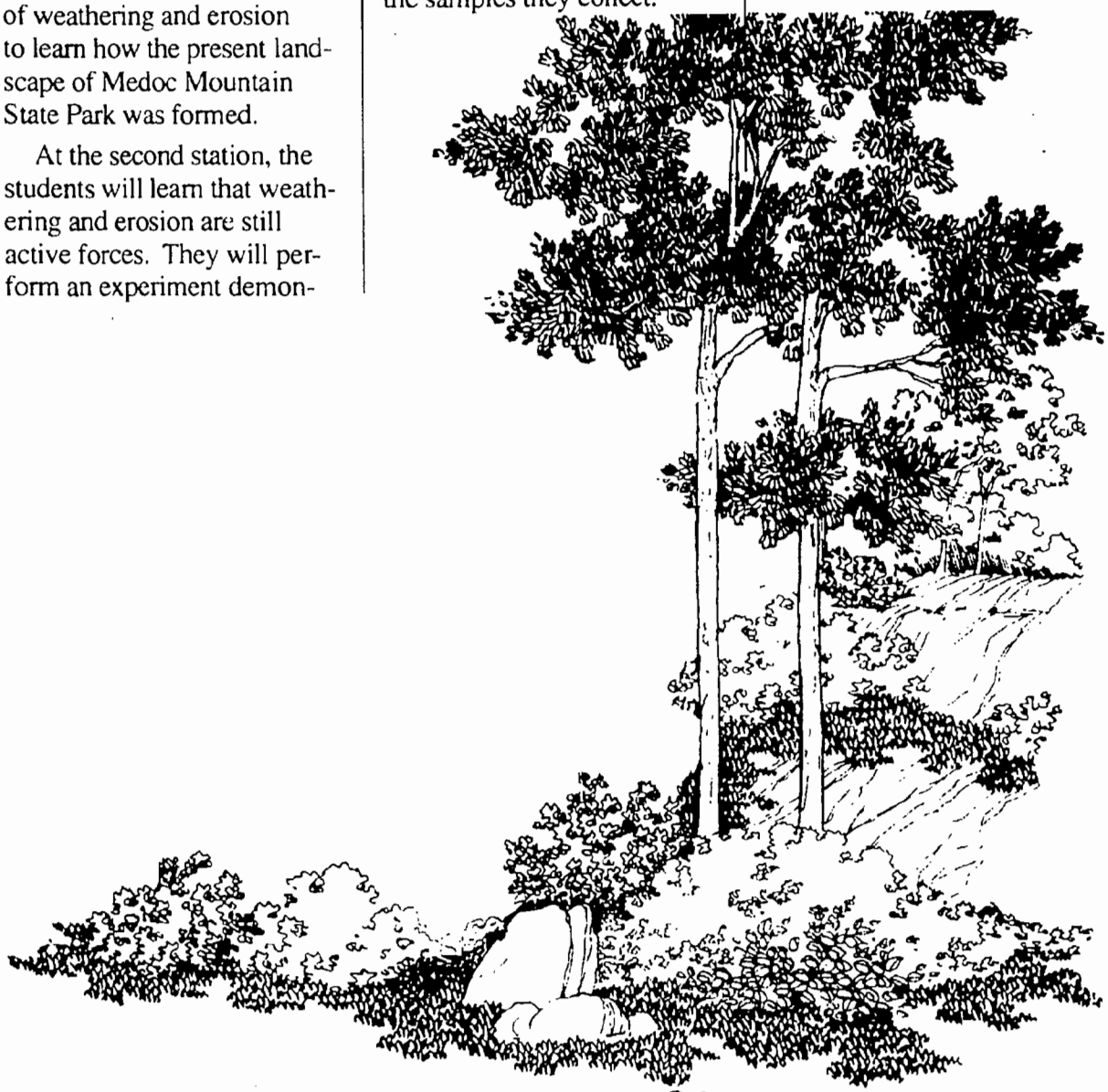
One station will emphasize geology's search for the past. At this station, the students will recreate 300 million years of weathering and erosion to learn how the present landscape of Medoc Mountain State Park was formed.

At the second station, the students will learn that weathering and erosion are still active forces. They will perform an experiment demonstrating chemical weathering – the breakdown of rock by chemi l action, such as acid rain or ichens. They will also observe evidence of mechanical weathering, such as freezing and thawing or the intrusions of plant roots.

Finally, the third station gives the students an opportunity to become field geologists. After panning for rocks and minerals in Little Fishing Creek, the students will study the samples they collect.

Instructions:

Divide the class into three groups, with at least one adult in each group. These groups will rotate between the three stations every 35 minutes. Park staff will show you the location of each station.



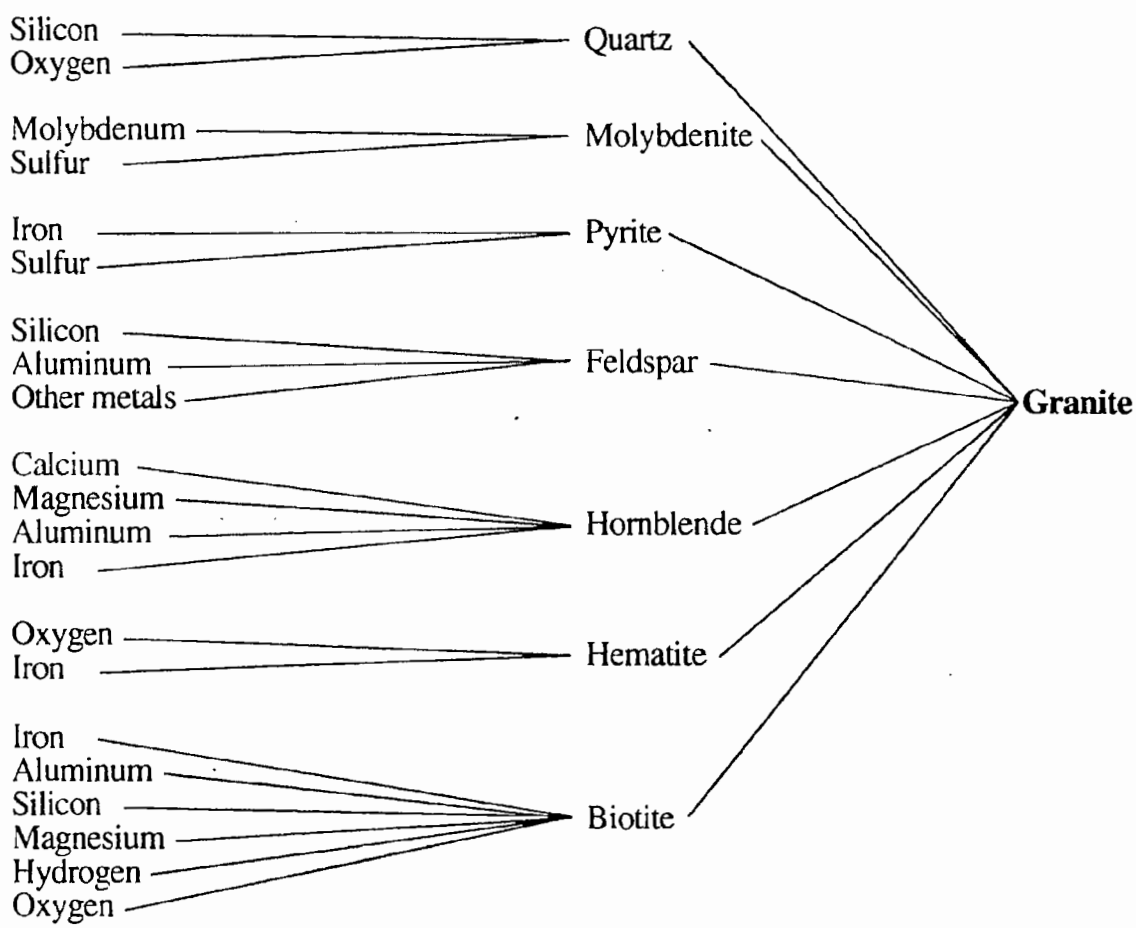
Student's Information

Geologists are scientists who study the origin, history and structure of the earth. **Rocks** serve as a record of that history. By knowing how the different kinds of rocks are formed, a geologist can often tell what the conditions were like on earth when that particular rock was formed. Geologists have identified about 2000 kinds of rocks, each with its own characteristics. Rocks are classified into three main groups: **igneous**, **sedimentary** and **metamorphic**. There are examples of each of these groups at Medoc Mountain State Park.

Rocks are combinations of one or more **minerals**. The three geological terms, rock, mineral and **element**, are often lumped together. However, each is a different thing.

An element is a substance that cannot be broken down any further. Everything on the earth is made up of some combination of the 103 known elements. Elements occur as solid, liquid or gas. A mineral is a **composite**, or combination, of one or more elements. It is usually a solid with a crystalline form. The proportion of elements in a particular kind of mineral is constant. Finally, a rock is a combination of one or more minerals. Unlike minerals, the proportion and types of minerals in a particular kind of rock can vary depending on its location

Medoc Mountain Granite



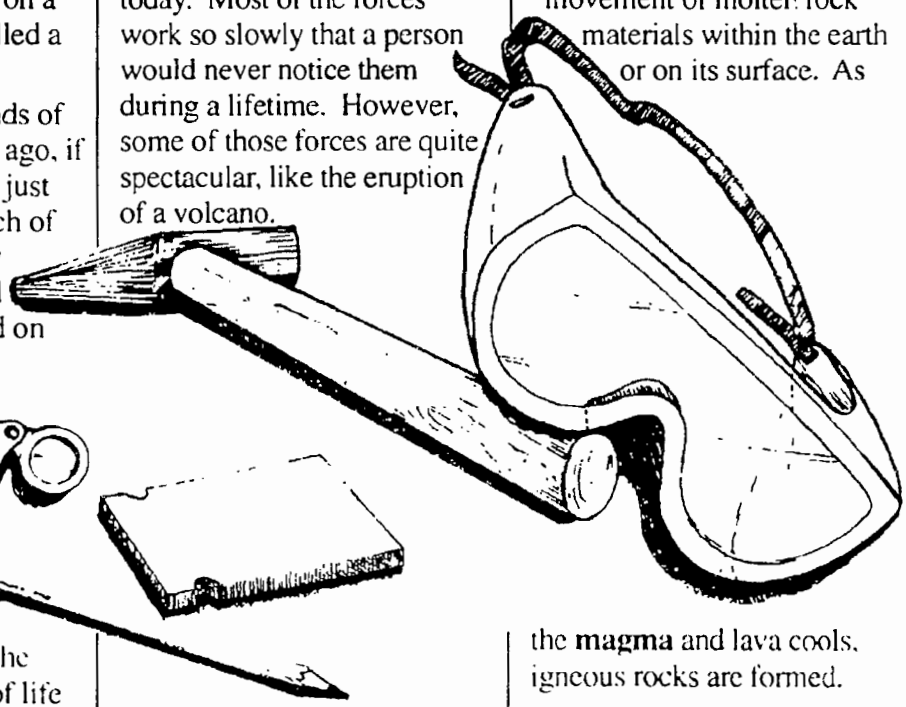
and other factors. One of the most common rocks at Medoc Mountain is **granite**. The chart illustrates the relationship between elements, minerals and rocks.

To identify rocks, geologists look at the specific characteristics of the rock sample. These may include color, layering and the color that the rock leaves when it is rubbed on a special porcelain tile, called a streak plate.

Fossils are special kinds of rocks. Millions of years ago, if a plant or animal died in just the right conditions, much of its body was replaced by rock. Fossils are studied to learn how life evolved on this planet.

Geologists have determined that the earth is about 4.6 billion years old–that is 4600 million years! By studying about the history of the earth and the evolution of life during the last 4.6 billion years, geologists have learned many things that help us live our lives today. They are able to predict where valuable mineral resources such as gas, oil, gold, aluminum, silver and uranium are located. Geologists have also developed new ways to explore and extract these resources. Other geologists study earthquakes. They help predict where earthquakes are likely to occur. This helps the people in those areas build their buildings and highways in ways which minimize damage when an earthquake hits. Studying the structures of the earth, like mountains and canyons, and how they were formed is also the job of a geologist.

All the forces that created the mountains and valleys are still happening to the earth today. Most of the forces work so slowly that a person would never notice them during a lifetime. However, some of those forces are quite spectacular, like the eruption of a volcano.



There are three major forces that shaped and are shaping the earth: **weathering** and **erosion**, tectonism and volcanism. Each of these forces plays a role in the **rock cycle**.

The surface of the earth is constantly affected by weathering and erosion, the wearing away and removal of soil and rock fragments by wind, water, and ice. The materials worn away by these processes eventually form soil and sedimentary rocks.

Tectonism refers to all of the movements of the earth's crust. These are responsible for earthquakes and the formation of mountains, among other things. The pressure caused by the different parts of the crust pressing against each other is one factor in making metamorphic rocks.

Finally, volcanism refers to movement of molten rock materials within the earth or on its surface. As the **magma** and lava cools, igneous rocks are formed.

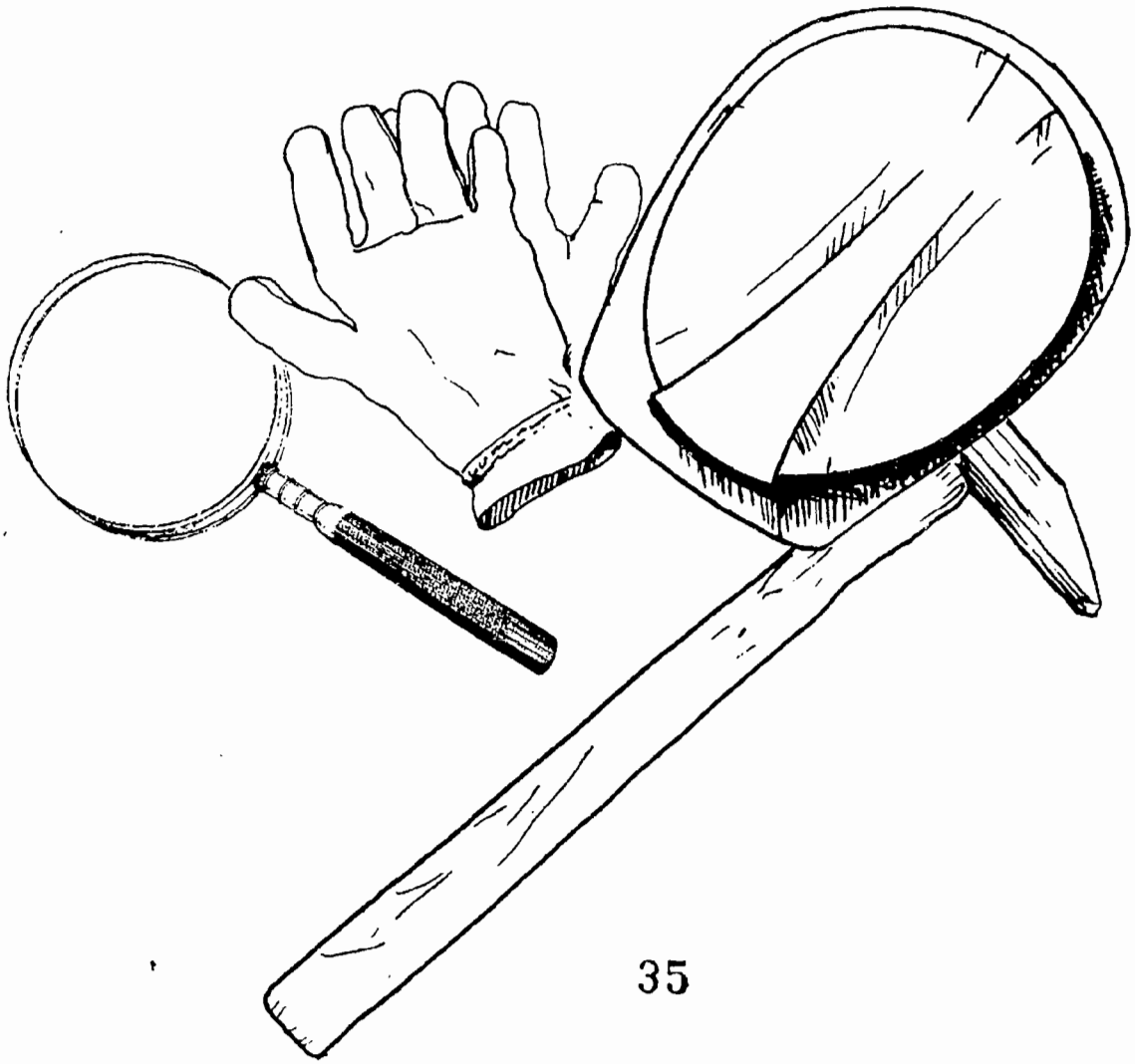
We know each of these forces has effected Medoc Mountain since igneous, sedimentary and metamorphic rocks are all found here.

Besides studying the past and helping the present, geologists can predict what will happen to an area in the future. In the distant future (millions of years), Medoc Mountain will be flat because of the forces of weathering and erosion.

To learn everything they need to know, geologists have to study many other branches of science. Astronomy, the study of the stars and planets, helps geologists understand how the earth was first formed. Chemistry, the study of matter, helps geologists understand the interactions of different kinds of material on and in the earth. For example, when iron interacts with oxygen, rust is formed. A geologist must also study biology, the study of life, to understand fossils and the history of life on earth.

When a geologist becomes very specialized, he or she uses some complex equipment to conduct experiments. However, most of the tools used in field **geology** are simple to use and easily obtained. Some of this equipment includes a hard hat, gloves, rock hammer and a magnifying glass. Can you guess what this equipment would be used for? Geologists need to protect themselves as they are collecting rock samples. They also need equipment to extract the rocks and minerals. After the rocks have been obtained, they need other equipment to study their samples. It is very important for a geologist to take careful notes where each of the rocks was collected.

During your visit to Medoc Mountain State Park, you will become a field geologist. You will learn to use certain tools to explore what types of rocks are in the park. You will also study the past 300 million years of history of Medoc Mountain. In addition to seeing what forces affected the area in the past, you will witness some of the forces affecting the area today.



Station A: Making of a Monadnock

Educator's Information:

Medoc Mountain is a 300 million year old ridge which reaches a height of about 325 feet above sea level and stands approximately 170 feet above the surrounding terrain. Medoc Mountain is actually a **monadnock**, which is the geological term for a formation of **resistant rock** rising above the surrounding land.

The ridge was formed when magma, a hot, molten material, rose from deep below the earth's surface, then cooled and solidified near the surface. As the years went by, weathering and erosion stripped the ridge top of all the highly erodible rock substances, leaving behind the more resistant underlying rock. Over time, plant life started colonizing the rock ridge, and through **natural succession**, today's mixed hardwood-pine forest developed.

Instructions:

1. Have the students stand in a circle around the sandbox. In the middle of the box, the students will see a model of Medoc Mountain as it looked prior to any erosion taking place.

2. Explain to the students that this stage will represent how Medoc Mountain looked millions of years ago.

3. Have the students draw a picture of the mountain in the first block of the worksheet.

4. Have a student sprinkle water on the model with a watering can. This water will represent rain.

5. As the mountain begins to change, have the student stop the water when he or she begins to see rock protruding through the sand. Then have the students draw a picture of the new formation in the second block on the worksheet.

6. Have the student pour more water on the mountain until most of the sand has eroded away. Have the students draw a picture of the mountain in the third block of the worksheet. This will represent Medoc Mountain as it appears today.

7. Discuss the following questions:

- What did the rain do to the mountain? (It eroded the softer material away.)
- Why didn't the rock that was left exposed erode away? (The rock is more resistant to erosion than the softer material.)
- If it rained on the mountain for millions of years more, will this resistant rock stay the same? (No, eventually even these harder, more resistant rocks will erode away. It just takes a lot longer.)

Making of a Monadnock Worksheet

Draw the changes observed duing the activity.

Beginning – Represents how Medoc Mountain looked millions of years ago before erosion took place.

Stop 1 – Represents millions of years later as erosion shaped the land.

Stop 2 – Represents present time.

In a short paragraph, explain how and why Medoc Mountain looks the way it does.

_____

_____

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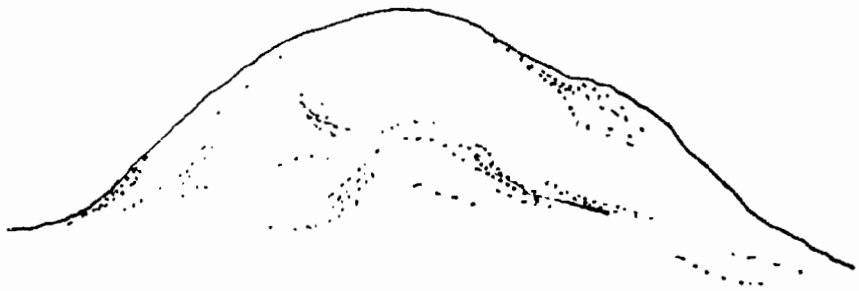
Making of a Monadnock Answersheet

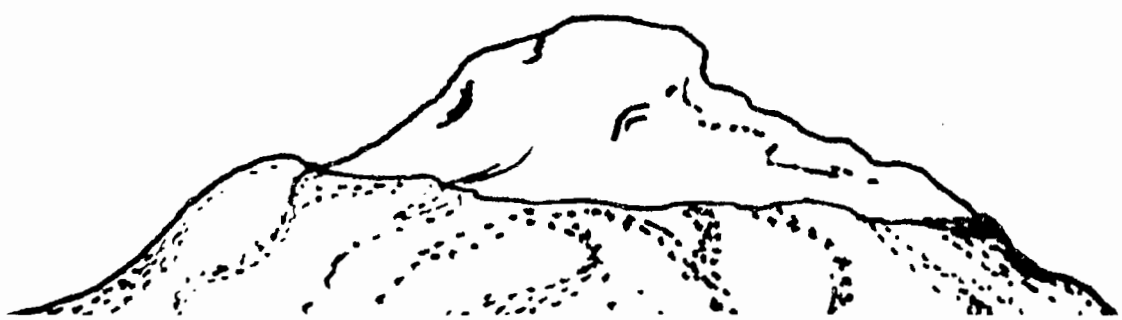
Draw the changes observed duing the activity.

Beginning – Represents how Medoc Mountain looked millions of years ago before erosion took place.



Stop 1 – Represents millions of years later as erosion shaped the land.

Stop 2 – Represents present time.



In a short paragraph, explain how and why Medoc Mountain looks the way it does.

Over time, the softer materials were weathered and eroded away, exposing a ridge of igneous rock which was resistant to the weathering process.

Station B: Outcrop Observations

Educator's Information:

The group participating in "Outcrop Observations" will be taken to a large rock outcrop located on the Summit Trail. This outcrop, located near the base of Medoc Mountain, overlooks Little Fishing Creek. (It will take about 10 minutes to walk from the parking area on top of the summit, to this study area.)

Upon the students' arrival at the rock outcrop, they will study mechanical and chemical weathering processes as it relates to geology and affects Medoc Mountain State Park.

Instructions:

1. Discuss the processes of mechanical and chemical weathering with the students. Be sure to discuss the following points:

- **Mechanical weathering**: This is the breaking down, or disintegration of a rock by mechanical processes. Several examples of mechanical weathering include:

a) Glaciers eroding rocks while moving across rock formations.
b) Freezing and thawing of water in rock crevices, called **ice wedging.**
c) When plants take root in rock crevices, the roots will grow larger, thus forcing the crevices apart.
d) Wind blown sand will slowly break rock down.
e) Rocks tumbling down a stream.

- **Chemical weathering**: This is the disintegration of a rock by chemical action. Examples of chemical weathering would include:

a) "Human-caused" events such as acid precipitation. Automobiles and some factories discharge sulfur dioxide and nitrogen oxides which react with water vapor in the atmosphere creating forms of sulfuric acid and nitric acid. These acidic forms of precipitation can slowly disintegrate rock materials.
b) Lichens secrete a mild acid which disintegrates rock. Lichens are unique, non-flowering plants which are actually composed of both a fungus and an algae. Lichens are found almost everywhere on earth – from deserts to the Arctic, and even in water. Lichens grow very slowly, usually between 1 mm and 1 cm per year. Scientists use the size of a lichen to estimate how old it is. There are lichens in the Arctic that are estimated to be about 4,500 years old.

2. Have the students stand at the base of the rock outcrop. Inform them that they are looking at a large granite rock that has been exposed due to erosion. Ask the following questions:

- What types of erosion could have exposed this granite face? (Wind and rain are the primary forces.)
- How did this granite formation get here? (Magma rose toward the earth's surface and cooled. Once this magma cooled, it solidified.)
- Is this granite rock a) Igneous, b) Metamorphic or c) Sedimentary? (It is igneous. Remember, igneous rock is formed when magma cools and solidifies.)

3. Have the students study the rock outcrop and look for places where mechanical weathering has taken place. Give them about five minutes to do this. Have the students regroup at the base of the rock and ask them the following questions:

- What types of mechanical weathering have taken place? (A. Ice wedging–Cracks in the rocks are getting larger due to the freezing and thawing of water; B. Plants taking root in cracks are forcing the cracks wider apart; C. People climb-

ing on the rock are slowly breaking down the rock.)

- Is mechanical weathering occurring now? (Yes. The students just weathered the rock mechanically when they climbed on it. Also, the plants are almost continuously growing, thus the roots are slowly breaking apart the rock.)

4. Remind the students that weathering also takes place in chemical form. When certain elements combine in certain ways they form acids and some of these acids will disintegrate rock material.

5. Discuss the following question:

- Where would acids come from to chemically weather rocks? (From automobile and industrial emissions, lichens.)

6. Point out to the students some examples of lichens which are attached to the rock outcropping. Explain that these lichens are gradually secreting mild acids on the rock and this slowly disintegrates the rock. (A staff member will assist the teachers in finding and identifying lichens.)

7. A simulation of chemical weathering will be demonstrated at this point:

A ranger or teacher will take a piece of limestone, and drop it into a vial of dilute sulfuric acid. Limestone is a soft rock that reacts quickly to a strong acid such as sulfuric acid. This combination will be used so the students can witness chemical weathering. The acids lichens produce are so mild, disintegrating hard rock such as quartzite or granite so slowly, the students would not be able to witness "natural" chemical weathering take place.

8. Discuss the following questions:

- What changes are taking place with the limestone? (The students will notice the rock, when dropped in the acid, start bubbling. Here, the acid is disintegrating the limestone. Explain that this is similar to what the acids secreted by the lichens are doing to the rock outcrop.)
- Why can we not see this happening while we watch the lichens? (The acids lichens produce are much milder than the acid we are using in the simulation. We are speeding up the process by using a much stronger acid.)

Explain that pollutants we are currently putting into the atmosphere through vehicle exhaust and factories are the cause of acid precipitation. This acid precipitation also disintegrates rock. There are famous stone statues and monuments around the world which are being deformed due to acid precipitation, or chemical weathering.

Station C: Tools of the Trade

Educator's Information:

The students will be using certain tools of the trade that geologists use in their field studies. From the banks of Little Fishing Creek, the students will collect rocks and minerals and make a variety of observations on their findings. The following equipment will be used by the "Junior Geologists:"

- Safety helmet: These are sturdy metal or plastic hats designed to protect a geologist from falling rocks.
- Safety goggles: These are used to protect the eyes from flying rock particles while the geologist breaks rocks open.
- Magnifying glass: This is used to observe rocks and minerals up close. It provides a better look at the luster and texture of the sample.
- Rock hammer: This tool has a pick on one end of the head and a hammer on the other end. It is designed to split or break rocks open. Breaking rock open sometimes exposes minerals such as pyrite and molybdenite.
- Gold pan: This is a shallow metal or plastic pan, usually about 12 to 16 inches in diameter. The inside edges of the pan usually have ridges, called "cheater riffles," which are designed to keep the heavier gold particles in the pan. (Since the students will not be looking for gold, the cheater riffles will not be pertinent to this activity.) A geologist will dig out a scoop of rock and sand from the bottom of a creek or river with the pan, swirl out the "trash" such as leaves and other debris and study the remaining substances left in the pan. A ranger will demonstrate the proper use of the gold pan.
- Magnet: Sometimes geologists will use a magnet to test if any of the rocks or minerals have magnetic properties. There is a chance the students will find a material that looks like black sand while they pan the creek. If they use their magnet, and this substance is attracted to it, they will have found titanium.
- Streak plate: This is a piece of unglazed porcelain. When you rub a rock on the streak plate, it will leave a streak of color. Some rocks leave a very characteristic streak color. This is one of the tests used to identify certain rocks.

While the students are breaking open creek rocks with their rock hammers, some of them will probably discover a gold colored mineral embedded in a piece of quartz.

GOLD!

GOLD!

GOLD! the student may shout! Or is it? Chances are that this substance is pyrite, or fools gold. Pyrite consists of two elements, sulfur [S] and Iron [Fe]. Pyrite leaves a gray streak on a streak plate, but gold leaves a gold streak.

Instructions:

This activity will take place on Little Fishing Creek, near the rock outcrop. You will use tools to study rocks and minerals in the creek, which are the same tools that a field geologist uses. A park staff person, dressed up like a geologist, will explain the different tools and equipment used in this profession (gold pan, safety goggles, safety helmet, rock hammer, streak plate and magnet).

1. Proceed to the study site on Little Fishing Creek. By using gold pans, students will pan Little Fishing Creek for different rocks and minerals. During the activity, ask the students to comment on the following observations:

- Why are the edges of some rocks smooth? (The longer the rocks stay in the creek, the smoother they will get. The movement of the water and smaller sand and rock particles eventually erode the rough edges off the rocks, making them smooth.)
- Are you finding any "soft" rocks? (If you can scratch a rock with your fingernail, that rock would be classified as "soft." You probably will not find too many soft rocks in the creek.)
- Why is that? (Naturally, the softer the rock, the faster it will erode away.)
- Is anything in the pan attracted to the magnet? (The students may find a substance

in the bottom of the gold pan that looks like black sand. This is a form of ilmenite, a combination of titanium and iron oxide. Titanium is used as an alloy in aircraft metals because it is very light and very strong.)

2. Have the students bring some rock samples from the creek. Be sure everyone has put on safety goggles, then let students take turns breaking open some of the rocks with the rock hammer while the rest of the students observe.

3. Have the students examine the broken fragments and discuss their observations. (Quartz, pyrite and molybdenite will be the most obvious minerals they might find. Explain that these minerals combined like this to form the rock they just broke open.)

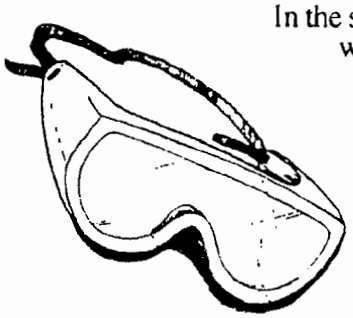
4. If anyone was fortunate enough to find a sample that looks like gold, test to see whether the sample is gold or pyrite (fool's gold). One method would be to strike the sample with a rock hammer, pyrite will shatter, whereas gold will flatten out. However, by using a streak plate the sample will be preserved. Remember, gold will make a gold streak and pyrite will make a gray streak. Pyrite is used to make sulfuric acid.

5. Now that the students have experienced part of the work of being a field geologist, have them complete the "Portrait of a Geologist" worksheet. After they have completed the worksheet, discuss the answers with them.

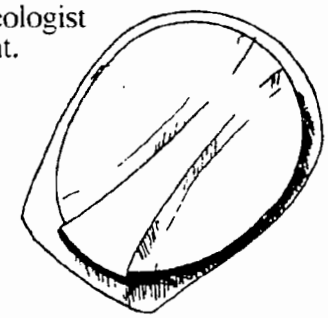
6. Encourage the students to keep a geology notebook. When observing or collecting rocks, it is very important to keep careful notes on the area where the sample was located. Remind the students that they may not keep any rocks found in a state park. Any rocks that are collected should be returned to the place where they were found.

Portrait of a Geologist Worksheet

In the space provided describe how a geologist would use each piece of equipment.

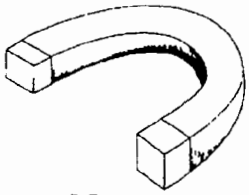


Safety Goggles



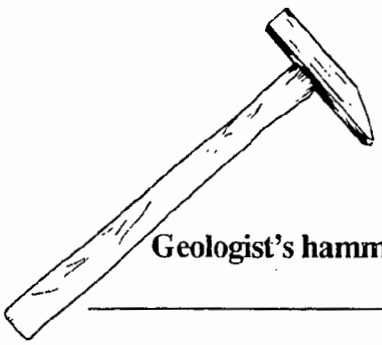
Safety Helmet

Magnifying Glass



Magnet

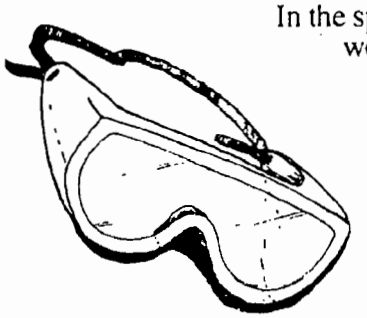
Gold Pan



Geologist's hammer

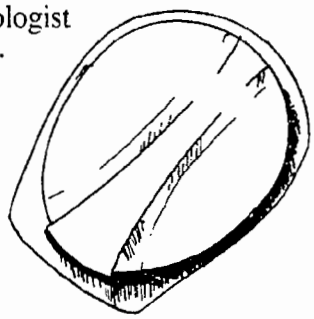
Portrait of a Geologist Answersheet

In the space provided describe how a geologist would use each piece of equipment.



Safety Goggles

Used to protect the eyes from flying rock particles while the geologist breaks rocks open.

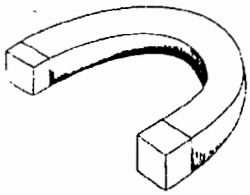


Safety Helmet

These sturdy metal or plastic hats are designed to protect a geologist from falling rocks.

Magnifying Glass

This is used to observe rocks and minerals up close. It provides a better look at the "luster", and "texture" of the sample.

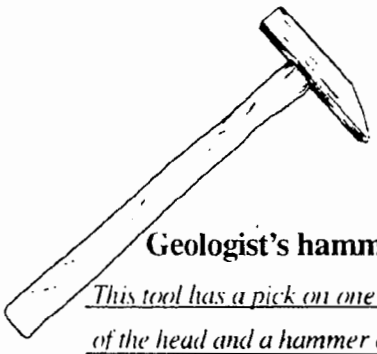


Magnet

Sometimes geologists will use a magnet to test if any of the rocks or minerals have magnetic properties.

Gold Pan

A geologist will dig out a scoop of rock and sand from the bottom of a creek or river with the pan, swirl out the "trash" and study the remaining substances left in the pan.



Geologist's hammer

This tool has a pick on one end of the head and a hammer on the other end. It is designed to split or break open rocks.

Post-Visit Activity #1 Everyday Geology

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Library/Media Skills: work independently and creatively in preparing assignments
- Guidance: importance of familiar jobs
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Library/Media Skills: work independently and creatively in preparing assignments
- Guidance: importance of familiar jobs
- Science: earth science; environment
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Library/Media Skills: work independently and creatively in preparing assignments
- Guidance: importance of familiar jobs
- Science: how science helps us
- Social Studies: gather, organize and analyze information; draw conclusions

Special Considerations:
Students must have completed pre-visit and on-site activities.

Location: Classroom

Group Size:
30 or smaller, class size.

Estimated Time: 45-60 minutes

Appropriate Season: Any

Materials:
Provided by the educator:
Access to reference books (Example: Encyclopedia),

Major Concepts:
- Uses of rocks, minerals and elements
- Classification of rocks, minerals and elements

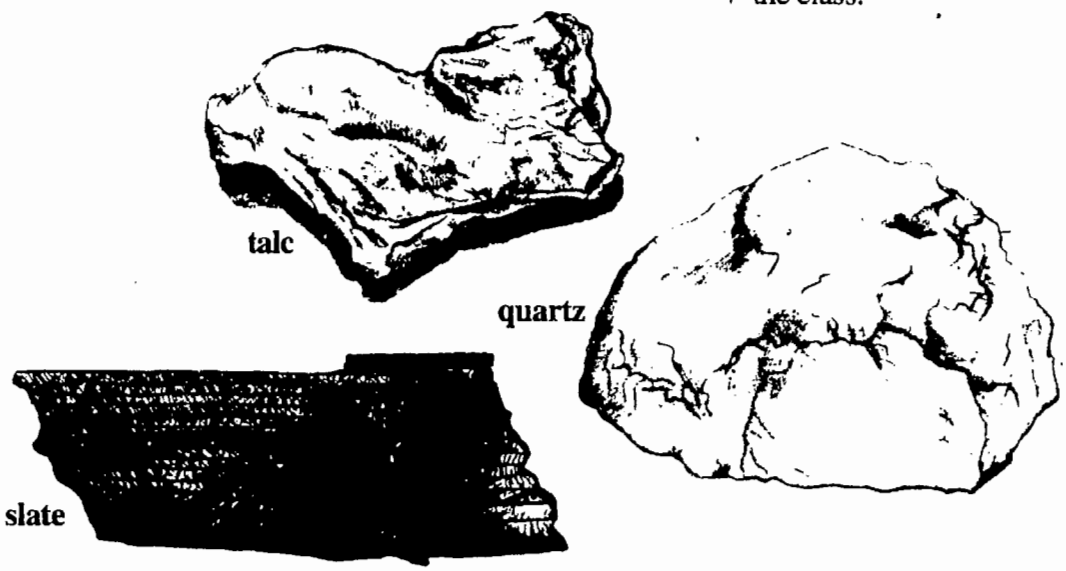
Objectives:
- Name eight examples of products that come from rocks, minerals and elements.
- Using references, classify five samples as rock, mineral or element.

Educator's Information:

This activity will show the students that a variety of "everyday" products are derived from rocks, minerals and elements.

Extension:

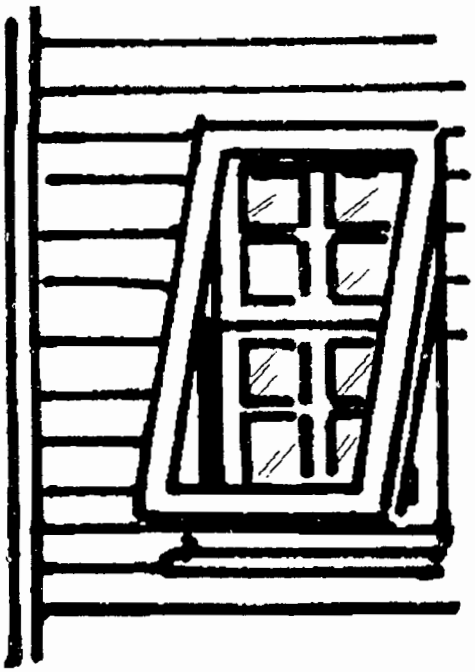
Have each of the students select a rock or mineral, research it and give a report to the class.

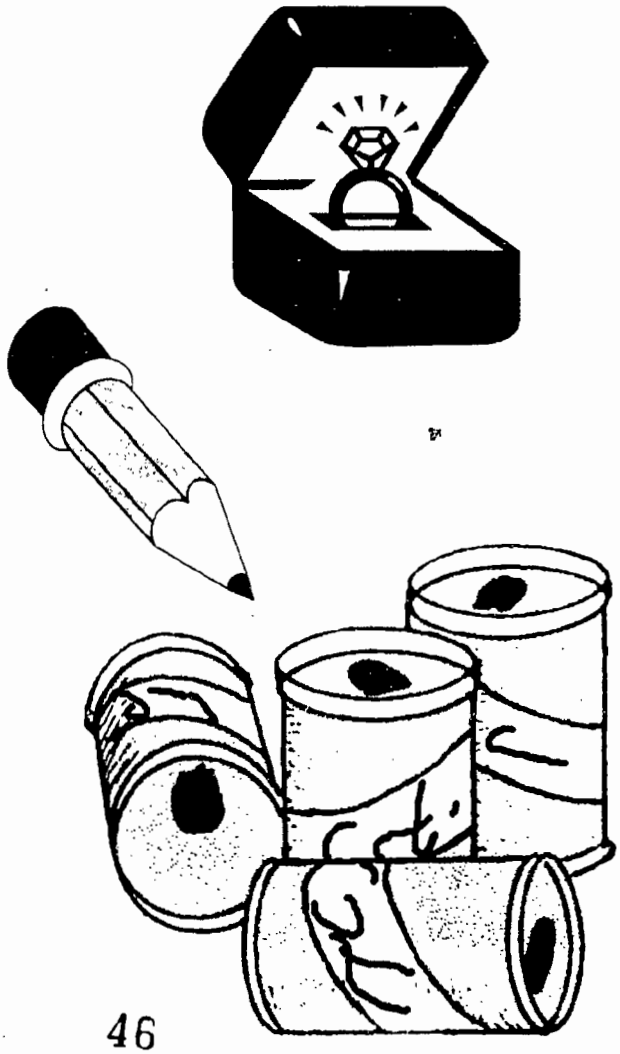


Student's Information

Many items we see and use everyday are composed of **rocks**, **minerals** and **elements**. Some of these rocks, minerals and elements are mined right here in North Carolina. For example, during the 1940s, there was some exploratory digging for **molybdenum** on the land that is now Medoc Mountain State Park. Presently, there are a variety of companies doing some exploratory drilling for **titanium** around Medoc Mountain. This titanium is used to make items such as airplane parts and hip joints because it is very strong and does not rust. Mining in North Carolina provides jobs and provides us with useful products.

Unfortunately, we must affect the environment in order to get the resources we need. It takes time, sometimes years, even decades and longer, for the earth to recover from some human activities. This makes it even more important to preserve areas of park land that will not be severely affected by damaging human activities. Can you perform mining operations and protect the natural resources such as forests and wildlife at the same time? Think about it!





Everyday Geology Worksheet

Instructions:

- Using reference books, decide whether each item in the left-hand column is a rock, mineral or element.
- Match the rock, mineral or element with the correct item or items under the "Product" column. This may require some research through reference books.
- Can you think of other examples of how rocks, minerals or elements are used?

Rock, Mineral or Element	Product
____ Titanium	Pencil
____ Quartz	Tooth Fillings
____ Pyrite	Window
____ Aluminum	Cosmetics
____ Molybdenum	Airplane
____ Gold	Chalk
____ Slate	Wedding Ring
____ Limestone	Sulfuric Acid
____ Graphite	Chalk Board
____ Talc	Hip Joint
____ Diamond	Soda Can

Definitions:

Element - A substance that cannot be broken down by mechanical or chemical means into simpler substances. Though rare in nature, some elements can occur in their pure form and technically can also be called minerals or even rocks. Gold and diamond are examples.

Mineral - A naturally occurring substance composed of specific elements in known proportions.

Rock - A naturally formed mass of mineral material.

Everyday Geology Answersheet

Instructions:

- Using reference books, decide whether each item in the left-hand column is a rock, mineral or element.
- Match the rock, mineral or element with the correct item or items under the "Product" column. This may require some research through reference books.
- Can you think of other examples of how rocks, minerals or elements are used?

Rock, Mineral or Element	Product
E Titanium	Pencil
R,M Quartz	Tooth Fillings
M Pyrite	Window
E Aluminum	Cosmetics
E Molybdenum	Airplane
E Gold	Chalk
R Slate	Wedding Ring
R Limestone	Sulfuric Acid
M,E Graphite	Chalk Board
M Talc	Hip Joint
M,E Diamond	Soda Can

Definitions:

Element - A substance that cannot be broken down by mechanical or chemical means into simpler substances. Though rare in nature, some elements can occur in their pure form and technically can also be called minerals or even rocks. Gold and diamond are examples.

Mineral - A naturally occurring substance composed of specific elements in known proportions.

Rock - A naturally formed mass of mineral material.

VOCABULARY

Biotite - A black or dark colored mineral of the mica group.

Composite - A material made up of two or more distinct complementary substances combining to produce functional or structural properties not present in any individual component. A mineral is a composite of two or more elements.

Diabase (dye-a-base) - A dark-gray to black, fine-textured igneous rock composed mainly of feldspar and pyroxene (pie-rok-seen).

Diamond - The hardest natural substance known, consists of pure carbon atoms. It can be classified as an element, mineral or rock.

Dike - An intrusive, more or less vertical, thin sheet of igneous rock.

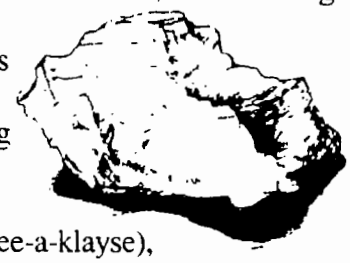
Disintegration (mechanical weathering) - The physical breakup of rock at, or near, the surface of the earth without altering the chemical composition of the rock.

Element - One of the 103 basic substances of the universe that cannot be broken into a more simple substance by either chemical or physical means. Molybdenum is an element: however, like nearly all elements, it is never found in its pure state in nature. Gold and diamonds are examples of elements with pure forms.

Erosion - The transportation of bits of weathered rock by wind, water and glacial action. Water is the most active agent of erosion in our area.

Essential mineral - A mineral that must be present in order to label an igneous rock; for example, granite must contain feldspar and quartz.

Feldspar - A group of abundant, rock-forming minerals occurring primarily in igneous and metamorphic rocks and consisting primarily of silicon and aluminum. Plagioclase (play-gee-a-klayse), an essential mineral of Medoc granite, is a type of feldspar.



Geology - The scientific study of the origin, history and structure of the earth.

Gneiss (nice) - A banded or foliated metamorphic rock, usually of the same composition as granite, in which the minerals are arranged in layers.

Granite - An intrusive igneous rock that contains quartz, feldspar and one or more silicates, such as biotite or hornblende.

Hematite - A mineral composed of iron and oxygen. A principal source of iron. Hematite is the substance which gives clay its red color.

Ice wedging - A type of weathering where the freezing and thawing of water can break rocks into smaller pieces.

Igneous rock - Rock formed by the cooling of hot molten rock. Medoc granite is an igneous rock.

Ilmenite (ill-meh-nite) - A mineral containing titanium and iron oxide. At Medoc Mountain, it is found in the sands of Little Fishing Creek.

Intrusive igneous rock - The type of igneous rock that forms when magma cools inside the earth. Usually contains course-grained mineral crystals. The granite making up Medoc Mountain is intrusive igneous rock.

Limestone - A sedimentary rock consisting of calcium carbonates.

Magma - A hot liquid rock below the earth's surface. When magma reaches the surface, it is called lava.

Metamorphic rock - Rocks that have been altered chemically and/or physically by great heat and pressure.

Mineral - A naturally occurring substance composed of one or more elements in known proportions. Though rare in nature, some elements such as gold and diamond, can occur in pure form and technically can also be called rocks and minerals. Quartz, containing the elements silicon and oxygen, is a common mineral found in the park.

Molybdenite - The principal ore for molybdenum. Some of the igneous rocks at Medoc Mountain contain molybdenite.

Molybdenum - A hard, silvery-white, metallic element often mixed with iron to produce a steel that is hard, strong and erosion resistant. The alloy is used in aircraft and missile parts.

Monadnock - A hill of highly resistant rock left as a residue of erosion that stands above the surrounding area. Medoc Mountain is a monadnock.

Natural succession - The change in animal and plant life by which one population or community is replaced by others.

Outcrop - The part of a geologic formation that sticks up above the earth's surface.

Pyrite - Fool's Gold. A brassy-yellow mineral consisting of iron and sulfur.

Quartz - A common mineral consisting of silicon and oxygen. Disintegration of quartz produces the sediment, sand. It is among the hardest and most resistant of all minerals.

Resistant rock - Rock that weathers and erodes more slowly than other rocks in the same area.

Rock - Substances made up of one or more minerals.

Rock cycle - The process whereby one rock type changes into another.

Schist (shist) - Any of various medium-to-coarse-grained metamorphic rocks composed of laminated, often flaky, parallel layers of chiefly micaceous minerals.

Sedimentary rock - Rock made by the compaction and cementing of sediments. Examples are limestone, shale and mudstone.

Titanium - A strong, highly corrosion-resistant, metallic element. Occurs widely in igneous rock, and is used as an alloy in aircraft metals. See Ilmenite.

Weathering - Any of the chemical or mechanical processes by which rocks exposed to the weather decay to soil. In the broadest sense, any of the destructive forces that wear down rocks, causing them to fragment, crack or crumble. Examples include heat, chemicals, wind and water. Weathering differs from erosion in that erosion loosens and carries away debris created by weathering.

References

Carpenter, P. Albert, editor. 1989. *A Geological Guide to North Carolina State Parks.* Raleigh, NC: NC Geological Survey Section, Division of Land Resources, PO Box 27687, Raleigh, NC 27611.

Larson, Edwin E. and Peter W. Bickeland. 1982. *Putnam's Geology,* Fourth Edition. New York, NY: Oxford University Press, Inc.

Mottana, Annibale, Rodolfo Crespi and Giuseppe Liborio. 1978. *Guide to Rocks and Minerals,* The Simon and Schuster Field Guide Series. New York, NY: Simon and Schuster, Inc.

Park files. Stevenson, H. Alice and Charles J. Fausold. 1976. "Medoc Mountain Environmental Impact Study." Medoc Mountain State Park, PO Box 400, Hollister, NC 27844-0400.

Pough, Frederick H. 1988. *A Field Guide to Rocks and Minerals,* The Peterson Field Guide Series. Cambridge, MA: Riverside Press.

Rhodes, Frank H. T. 1972. *Geology,* A Golden Guide. Racine, WI: Western Publishing Company.

Sorrell, Charles A. 1973. *A Guide to Field Identification of Rocks and Minerals.* New York, NY: Golden Press.

Stuckey, Jasper L. and Warren G. Steel. 1953. *Geology and Mineral Resources of North Carolina,* Educational Series #3. For information, contact Division of Mineral Resources, North Carolina Department of Environment, Health and Natural Resources, PO Box 27687, Raleigh, NC 27611.

SCHEDULING WORKSHEET

For office use only:
Date request received_____ Request received by_____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____
(Note: A maximum of 30 participants is recommended.)

8) Number of chaperones _____
(Note: One adult for every 10 students is recommended.)

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)_____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____

12) Are parental permission forms required? _____ If yes, please use the Parental Permission form on page 8.2.

I, _____, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: Medoc Mountain State Park
P.O. Box 400
Hollister, NC 27844-0400

PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at _____. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____
   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____
   _____

3. What part(s) did you find the least interesting and useful? _____
   _____

4. What can we do to improve the program(s)? _____
   _____
   _____

5. General comments _____
   _____
   _____
   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____
   If not, why? _____
   _____

Please return the completed form to park staff. Thank you.

Medoc Mountain State Park
P.O. Box 400
Hollister, NC 27844-0400