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ABSTRACT

Stone Mountain State Park's environmental education learning experience, Our Changing Land, introduces the student to the geology of the Blue Ridge Mountains, with emphasis on Stone Mountain, through a series of hands-on activities. The learning experience is designed for grades 4-6 and meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. It introduces students to concepts such as the rock cycle; geologic time; weathering; erosion; sedimentary, metamorphic and igneous rocks; and stewardship of natural resources. On-site activities are conducted at the park, while previsit and postvisit activities are completed in the classroom. The previsit activity introduces students to the three different rock types: igneous, sedimentary, and metamorphic. On-site activities give students an understanding of the origin of Stone Mountain, weathering, and erosion. Postvisit activities reinforce concepts, skills, and vocabulary learned. In the packet, the first occurrence of a vocabulary word used in an activity is indicated in bold type. This document includes definitions, reference materials used in developing the activities, and field trip and program evaluation forms. Contains 29 references. (KS)

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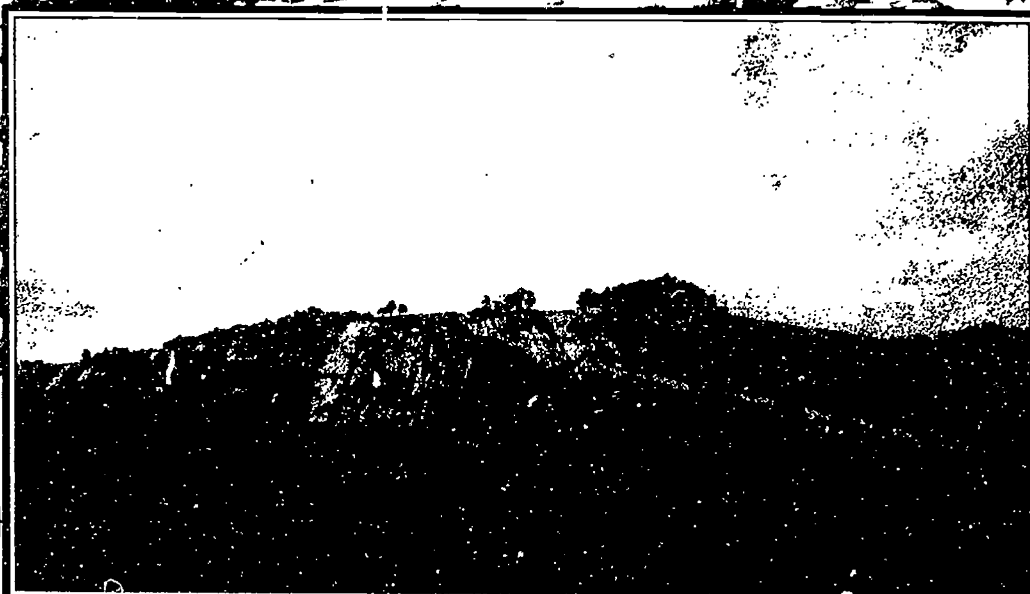

CHANGING

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An Environmental Education Learning Experience

Designed for Grades 4-6

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OUR

CHANGING

LAND

Stone Mountain State Park

An Environmental Education Learning Experience

Designed for Grades 4-6

This Environmental Education Learning Experience
was developed by

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Lead Interpretation and Education Ranger
Stone Mountain State Park

N.C. Division of Parks and Recreation
Department of Environment, Health and Natural Resources

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"I am the child.
You hold in your
hand my destiny.
You determine, largely,
whether I shall succeed or fail.
Give me, I pray you, those
things that make for happiness.
Train me, I beg you, that I
may be a blessing to the world."

- Mamie Gene Cole

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CP&L

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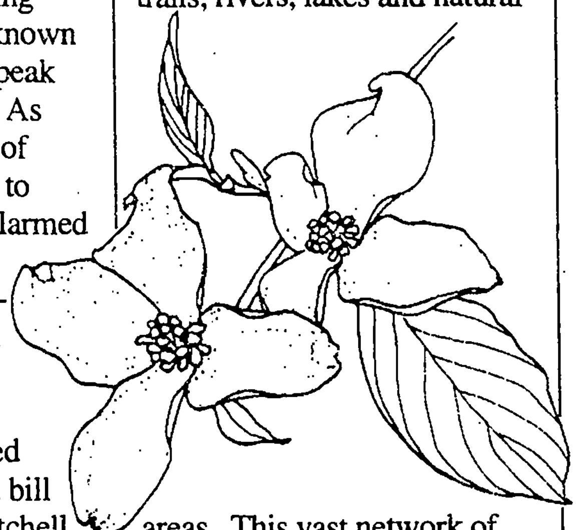
Introduction to the North Carolina State Parks System

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 of North Carolina. 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 Stone Mountain State Park

Stone Mountain State Park is located on the eastern edge of the Blue Ridge Mountains in North Carolina. The park lies in the extreme northern portion of Wilkes County and extends into the southeastern part of Alleghany County. Stone Mountain is the second largest state park in North Carolina, consisting of approximately 13,400 acres.

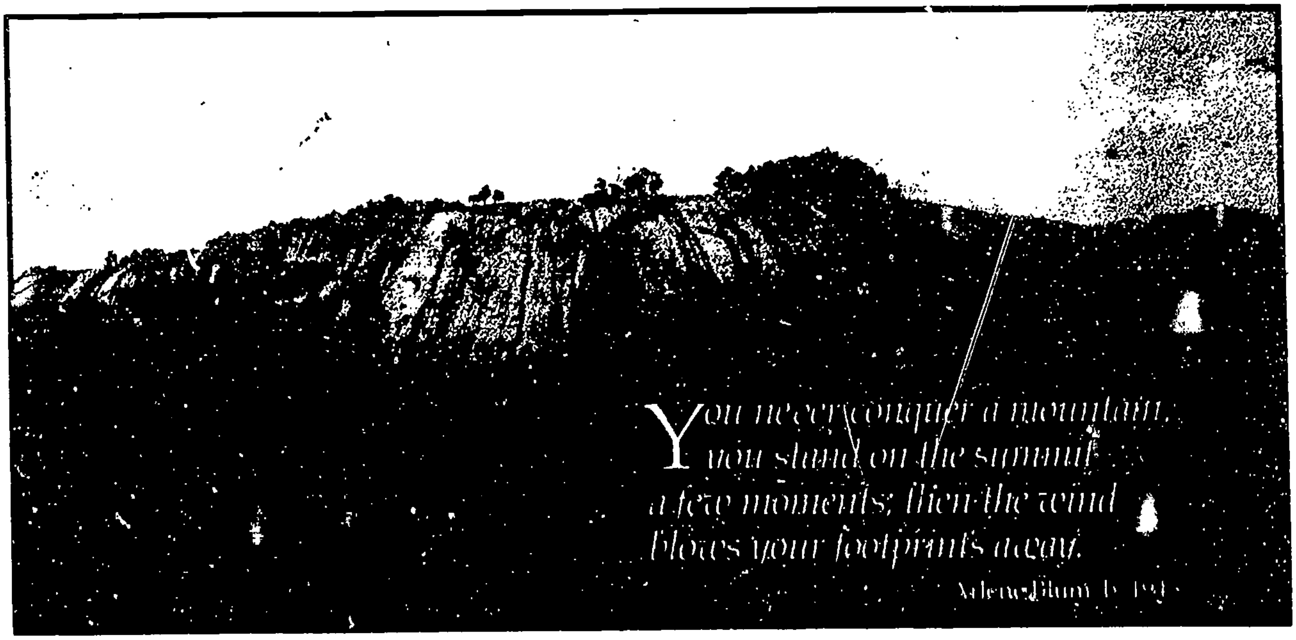
The most prominent feature of the park is Stone Mountain itself. This large, granite outcrop is a unique geological formation and is the largest granitic dome in North Carolina. Stone Mountain is approximately 390 million years old, and rises more than 2,200 feet above sea level. Its crest is almost 700 feet above the surrounding terrain of old fields, mixed forests, clear streams and waterfalls. Stone Mountain Falls, the largest waterfall in the park, is a cascade of over 200 feet. There are other granite outcrops and waterfalls that are accessible via the park's 15 miles of hiking trails. At Stone Mountain State Park, students can see and learn about some of the geologic processes that continue to shape our land.

The Park as an Outdoor Classroom:

State parks are not only wonderful places for scientific investigation, but also for environmental and cultural education. The major theme of Stone Mountain State Park is geology, but other themes can be studied here as well, such as plant communities, stream investigation, uses of plants and animals by Native Americans and early settlers, and the literature of nature writers such as Thoreau, Emerson and Muir.

Stone Mountain State Park abounds with natural history and is an excellent place to teach geology, ecology, environmental issues, biology, conservation, earth science, literature, math and recreation. In addition, the park is rich with cultural resources and provides a wonderful outdoor classroom for learning about the history of Stone Mountain, water quality, endangered species and a wide variety of other themes. Here is an opportunity for students to study and learn about these and many other subjects on a hands-on basis.

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, nature study and other activities. Leaders may



choose to design and conduct their own activities or make use of the park's environmental education activity packets. A park ranger would be happy to meet with your group to answer any questions the students may have, or welcome the group and present a short talk. Every effort will be made to accommodate persons with physical disabilities. Please contact the park office at least two weeks in advance to make arrangements for a group visit.

Recreation:

Another facet of state parks is outdoor recreation, such as rock climbing, hiking, camping, fishing, horseback riding and nature study. By preserving and protecting North Carolina's unique natural features, state parks provide high quality outdoor recreation in beautiful surroundings.

Park Facilities:

Restrooms: Restrooms are available at the park visitor center and at the parking area for Stone Mountain.

Picnic Area: Picnic tables and grills are available on a first-come basis. These are located at the gravel parking area at Stone Mountain and also across the creek, just after the paved main park road ends and the gravel road begins.

Family Camping: Family camping is available year-round on a first-come basis. Each of the 37 campsites has a grill, picnic table and gravel pad for tents or R.V's. A centrally located washhouse provides drinking water, hot showers and toilet facilities. This washhouse is closed during the winter. Electric and water hookups are not available, however a dump station is available for self-contained units. A modest fee is charged for family camping.

Group Camping: Six primitive campsites are available for organized groups. A small fee is charged for these sites which are available by reservation only. Each site has a grill, picnic table and trash receptacle. A pit toilet is also available. Drinking water must be carried to this area.

Back Country Camping: Six backpack campsites are located along Widow's Creek. The trail leading to the sites is one mile past the paved parking lot. Campers must walk 1.5 to 3 miles to the site depending on which one is available. All supplies must be packed to the camping area except water, which is available a short distance from each site. Backpack camping is on a first-come basis by permit only. Campers should register at the back country camping parking lot. A maximum of four people is permitted on each campsite. Please carry out your trash; there is no trash disposal at the campsite.

Scheduling a Trip:

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

2. Complete the scheduling worksheet, located on page 8.1, and return it to the park as soon as possible.

Before the Trip:

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

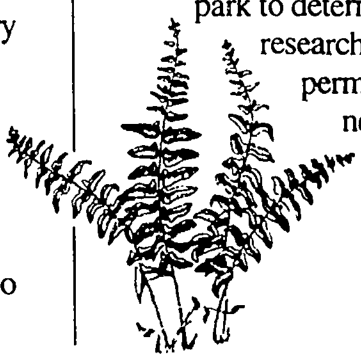
2. The group leader should visit the park without the participants prior to the group trip. This will enable you to become familiar with the facilities, park staff, identify themes and to work out any potential problems.

3. The group leader should discuss park rules and behavior expectations with adult leaders and participants. Safety should be stressed.

4. *The group leader is responsible for obtaining a parental consent form for each participant.* Be sure that health conditions and medical needs are noted. A sample consent form is located on page 8.2.

5. *If you will be late or need to cancel your trip, please notify the park immediately.*

6. Research Activity Permits may be required for activities in which samples will be taken from the park. Contact the park to determine if research activity permits are needed.



While At the Park:

Complete the on-site activity in the Environmental Education Learning Experience. As you enjoy the natural setting of the park, remember that the park is for your enjoyment, but please follow all safety concerns and obey all park rules and regulations.

1. Be as quiet as possible while in the park. This will help you get the most out of the experience, while increasing the chance of observing wildlife.

2. On hikes, walk behind the leader at all times. Running is not permitted. Please stay on the trails!

3. When hiking and studying at Stone Mountain State Park, please be safety conscious. Some sections of the park's trails are fairly strenuous. It is recommended that proper footwear be worn and that water be carried. Also, hazards such as bees, snakes, ticks, poison ivy and extreme weather conditions do exist. These hazards can cause problems if you are not prepared. Students with any medical conditions should be monitored closely by the adult leaders.

4. All plants and animals are protected within the park. Injuring or removing plants or animals is prohibited in all North Carolina State Parks. Removal of rocks is also prohibited. This allows others in the future the opportunity to enjoy our natural resources.

5. Picnic only in the designated picnic areas. Help keep the park clean and natural by not littering and by picking up any trash left behind by others.

6. *In case of accidents or emergencies, contact the park staff immediately.*

Following the Trip:

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

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

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

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

5. Please complete the program evaluation sheet, located on page 8.3, and send it to the park.

Park Information:

Address:

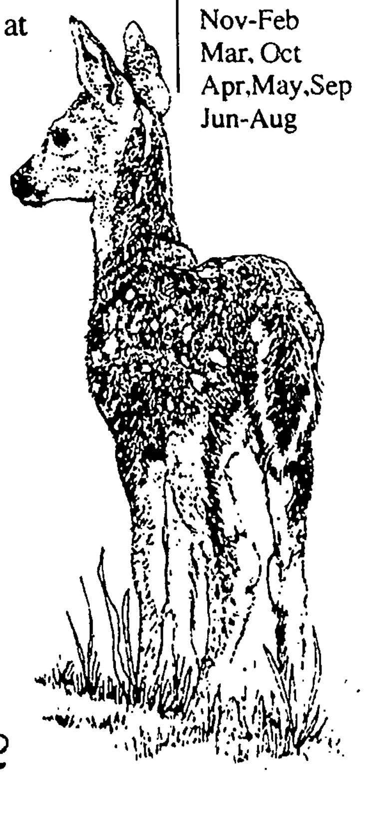
Stone Mountain State Park
Star Route 1, Box 17
Roaring Gap, NC 28668
Tel: (910) 957-8185
Fax: (910) 957-8185

Office Hours:

Year-round	
Mon. - Fri.	8:00 a.m. - 5:00 p.m.

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,Sep	8:00 a.m. - 8:00 p.m.
Jun-Aug	8:00 a.m. - 9:00 p.m.



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Introduction to the Activity Packet for Stone Mountain State Park

Stone Mountain State Park's Environmental Education Learning Experience (EELE), *Our Changing Land*, is designed to introduce the student to the geology of the Blue Ridge Mountains, with emphasis on Stone Mountain, through a series of hands-on activities. This EELE, which is designed for grades 4 - 6, meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. It will introduce students to concepts such as geologic time, weathering, erosion and rock building. There are three types of activities included in this Environmental Educational Learning Experience:

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 environment.

The pre-visit activity is designed to introduce students to the three different rock types, igneous, sedimentary and metamorphic. It should be done prior to the park visit in order to prepare students for the on-site activity, giving them the necessary introductory background and vocabulary.

The on-site activity, conducted at the park by a ranger or the class instructor, is designed to give students an understanding of the origin of Stone Mountain, weathering and erosion.

We encourage you to use the post-visit activity to reinforce concepts, skills and vocabulary learned during the pre-visit and on-site activities. These activities may be performed independently, however, we encourage you to do them in a series to build upon the students' newly gained knowledge and experience.

The Environmental Education Learning Experience, *Our Changing Land*, will acquaint students with the following major concepts:

- **Rock Cycle**
- **Weathering Factors**
- **Geological Time**
- **Sedimentary, Metamorphic and Igneous Rocks**
- **Stewardship of Natural Resources**

The first occurrence of a vocabulary word used in an activity is indicated in **bold type**. A list of definitions can be found in 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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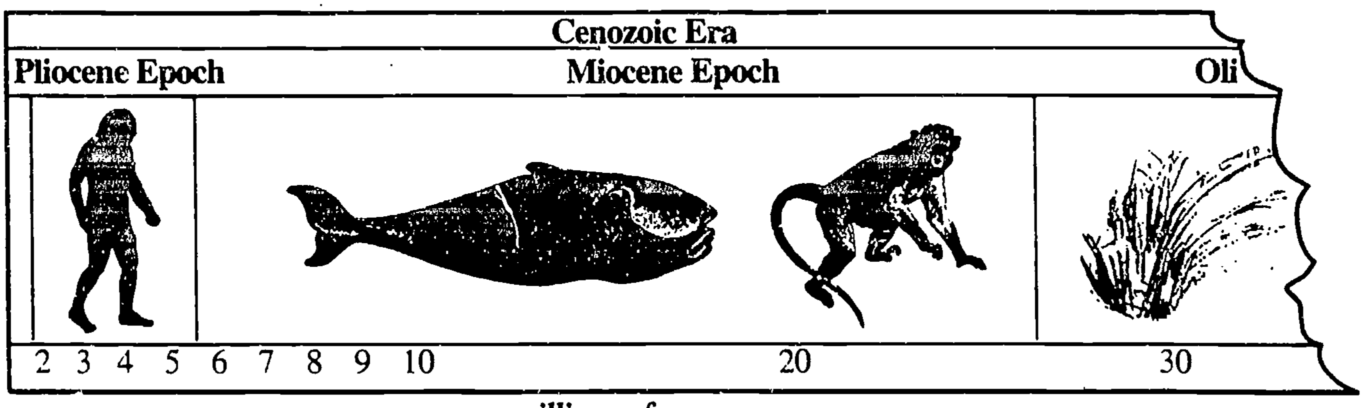
Graphic of timeline used in Post-Visit Activity #1



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.

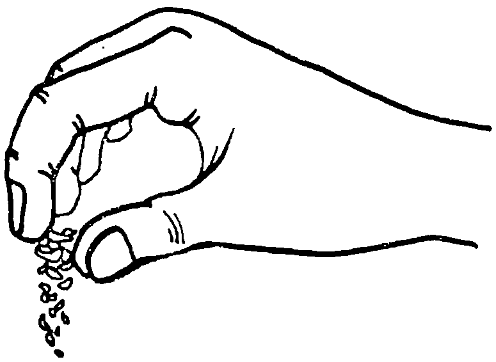
I. Pre-Visit Activity

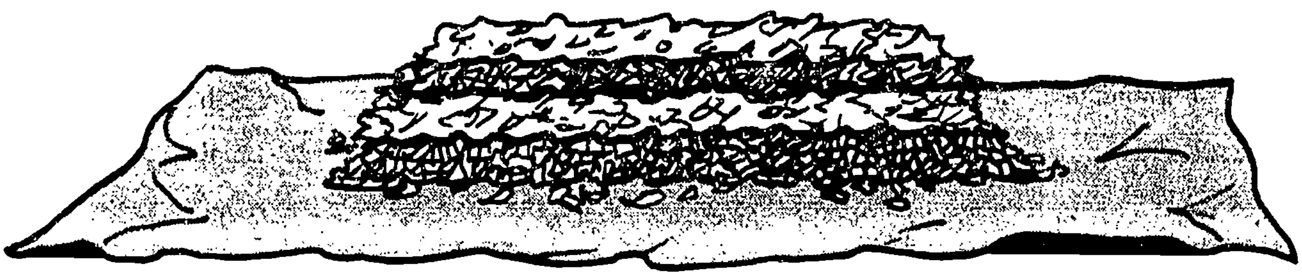
#1 The Pressure's On (page 3.1.1)

Through this activity, students will learn how sedimentary, metamorphic and igneous rocks are formed, and about the rock cycle.

Major concepts:
- Rock cycle
- Mechanical weathering
- Sedimentary rock formation
- Metamorphic rock formation
- Igneous rock formation

Objectives:
- List the three main rock classifications.
- Describe how the three rock classifications are formed.
- Explain the rock cycle.
- Identify four processes by which one rock classification changes into another.
- Name the predominant igneous rock, and its minerals, found at Stone Mountain State Park.





II. On-Site Activity

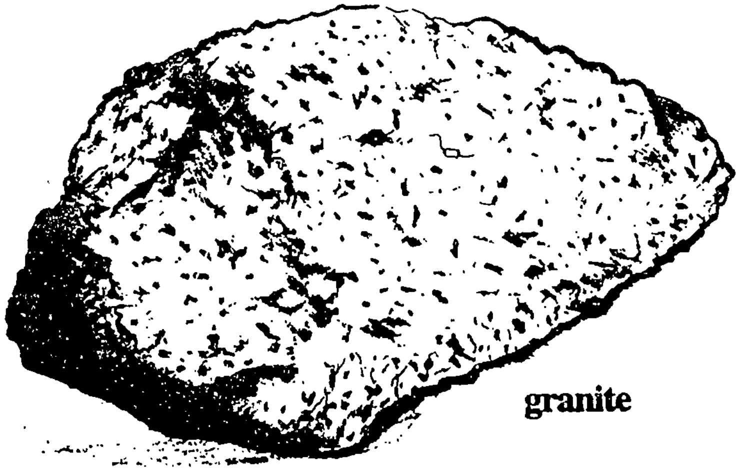
#1 Igneous Intruder (page 4.1.1)

In Part I, "Igneous Intruder," students will participate in an activity which represents the formation of Stone Mountain and how the mountain has been exposed by the forces of weathering and erosion. In Part II, "Rock Walk," the students will see first-hand examples of weathering, erosion, deposition and succession on the self-guided nature trail at the base of Stone Mountain.

Part I: Igneous Intruder

Major Concepts:
- Intrusive igneous rock
- Erosion

Objectives:
- Describe and illustrate how Stone Mountain was formed.
- List three minerals that make up the granite of Stone Mountain.



Part II: Rock Walk

Major Concepts:
- Weathering
- Erosion
- Land use
- Succession

Objectives:
- Describe five factors that cause rocks to weather and erode.
- List the stages in bare rock succession.
- List three ways early settlers used the rocks in this area and two ways we use them today.

III. Post-Visit Activity

#1 Let's Do A Time Warp (page 5.1.1)

The vast scale of geologic time is difficult to envision for most people. This activity presents geologic time in a pictorial representation which makes it easier to comprehend.

Major Concepts:
- Geologic time
- Geologic history

Objectives:
- Conceptualize geologic time using a mural model.
- Identify three different time periods from the beginning of the Earth until the present time.
- List one characteristic for each of the three time periods.
- Name the time period and era we live in now.

Pre-Visit Activity #1 The Pressure's On

Curriculum Objectives:
Grade 4
- Communication Skills: listening, writing
- Guidance: competency for interacting with others
- Healthful Living: school and recreational safety
- Social Studies: draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening, writing
- Guidance: competency for interacting with others
- Healthful Living: safe school environment
- Science: earth science
- Social Science: draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, writing
- Guidance: competency and skill for interacting with others
- Social Studies: draw conclusions

Location:
Classroom/Science lab

Group Size:
30 students or less, class size

Estimated Time: 2 to 4 hours

Appropriate Season: Any

Special Considerations:
Take proper safety precautions. Hot plate and hot crayon wax can cause burns. C-clamps can pinch/crush fingers.

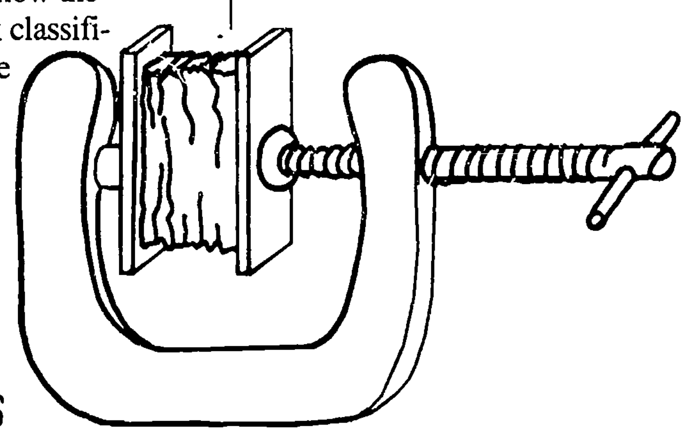
Materials:
Provided by the educator:
Per student: safety goggles, large pocket pencil sharpener, four wax crayons of the same color, (either red, green, blue, or yellow crayons), envelopes, wax paper
Per group: hot plate, two oven mittens, petri dish, aluminum foil, three disposable aluminum foil pie pans, trivet, newspaper (enough to cover lab surfaces–have lots of newspaper handy), one 8 inch C-clamp, two pieces of plywood, approximately 25 by 25 centimeters
Per class: samples of real sedimentary, metamorphic and volcanic rocks (contact the park if you need to borrow a rock set), crushed ice, water

Major Concepts:
- Rock cycle
- Mechanical weathering
- Sedimentary rock formation
- Metamorphic rock formation
- Igneous rock formation

Objectives:
- List the three main rock classifications.
- Describe how the three rock classifications are formed.
- Explain the rock cycle.
- Identify four processes by which one rock classification changes into another.
- Name the predominant igneous rock, and its minerals, found at Stone Mountain State Park.

Educator's Information:

Students often have a difficult time understanding the abstract concept of the **rock cycle**. 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 is extremely effective in giving students the opportunity to "see" the rock cycle through a series of simulation activities; **mechanical weathering** and erosional processes, 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.



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Rocks forming the **earth's crust** are classified according to their origin. There are three basic rock classifications. Of these three, two (**igneous** and **metamorphic**) are formed by **geologic processes** occurring deep within the earth. The other, **sedimentary**, is formed closer to the earth's surface. The relationship between these three rock classifications is what is generally considered the **rock cycle**. (The rock cycle is discussed below.)

1. **Sedimentary rock** - rock that is composed of tiny particles of sand, clay or other **sediments** that are deposited in layers on land or on the bottom of lakes, rivers and oceans. Over time, the extreme pressure from the weight of the layers above presses the **deposition** into rock, or the sedimentary particles are cemented together. Examples are **limestone**, **sandstone** and **shale**.

Sedimentary rocks are important when discussing the rock cycle and are also important in the understanding of how metamorphic rock is formed. The metamorphic rock of the Blue Ridge Mountains was formed when sedimentary rock layers were subjected to extremely high temperatures and tremendous pressure. The chemical action of solutions and gases during the last 540 million years of the earth's dynamic activity played a part as well.

2. **Metamorphic rock** - sedimentary or igneous rock that has been changed deep inside the earth by extreme heat and pressure over a long period of time into a harder rock, with different qualities. An example of sedimentary rock which was changed to a metamorphic rock is **mica schist**, which is made from mudstone. Mica **schist** is a major rock type found throughout the Blue Ridge Mountains.

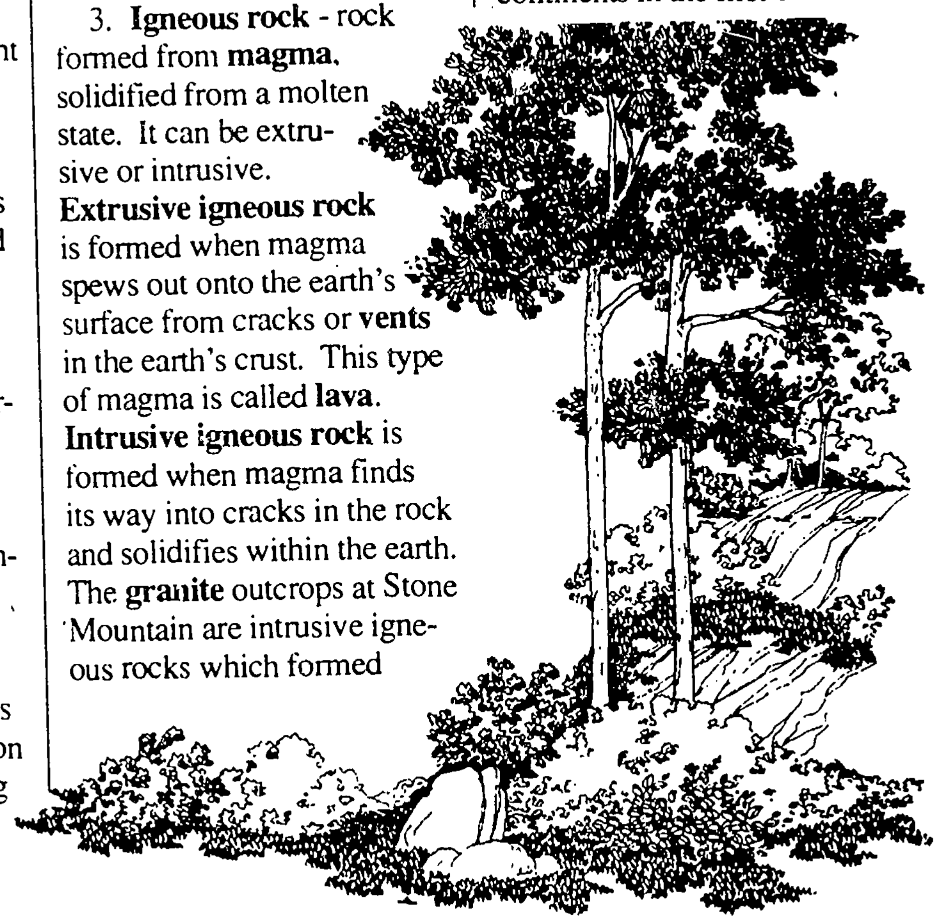
The word "**metamorphosis**" means a transformation, a marked change in appearance or condition. A familiar example would be a caterpillar changing, or metamorphosing, into a butterfly.

3. **Igneous rock** - rock formed from **magma**, solidified from a molten state. It can be extrusive or intrusive. **Extrusive igneous rock** is formed when magma spews out onto the earth's surface from cracks or **vents** in the earth's crust. This type of magma is called **lava**. **Intrusive igneous rock** is formed when magma finds its way into cracks in the rock and solidifies within the earth. The **granite** outcrops at Stone Mountain are intrusive igneous rocks which formed deep in the earth but are now exposed due to erosion.

The Rock Cycle

Geologists believe that at one time the earth was a ball of molten magma and gasses. As the earth cooled, the outermost layer of magma solidified into a crust of igneous rock. Today, the earth's crust is 30 miles thick in some places, yet in others it is so thin that lava can spew up through cracks.

Even as the first rocks cooled, **weathering** began breaking them down into sediments which were eroded away by wind and water. Those first sediments were deposited at the edges of the continents in the first oceans.

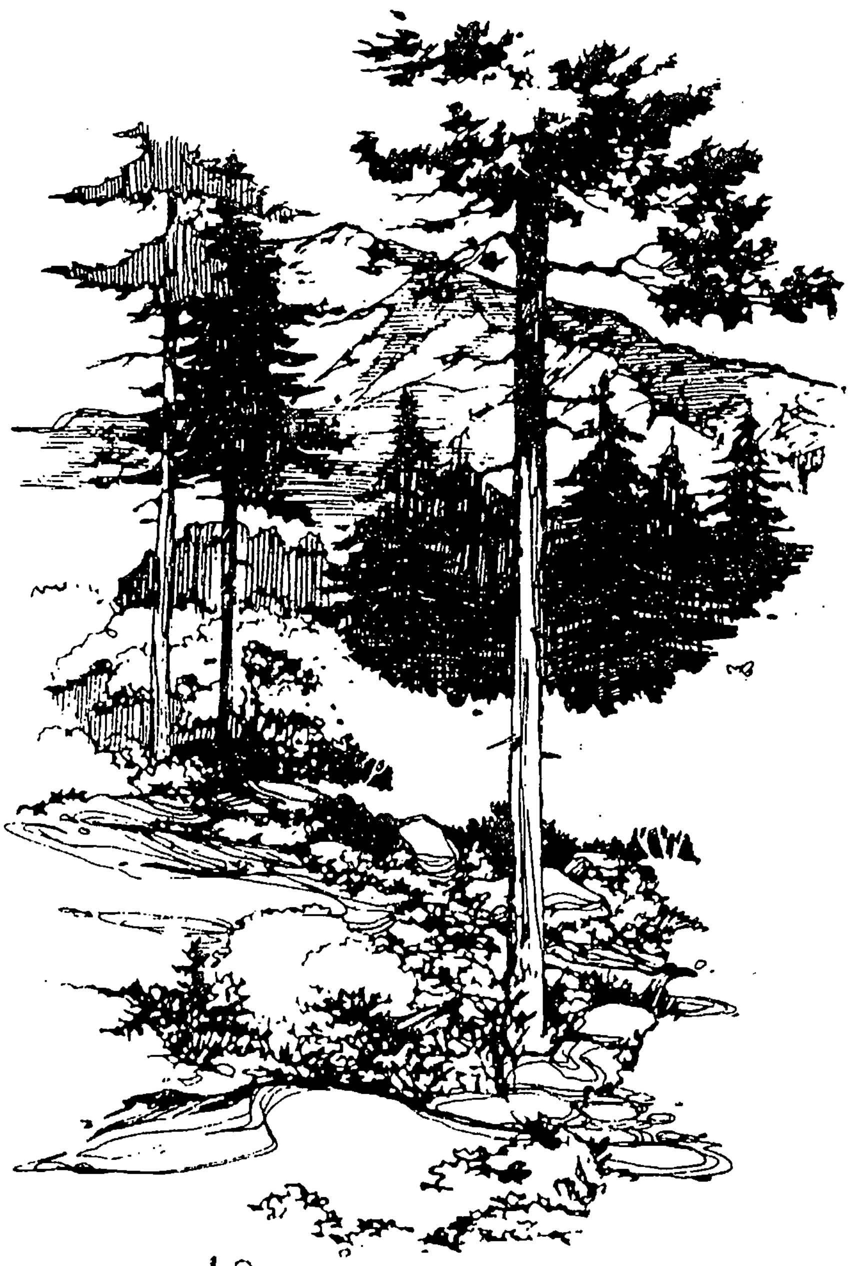


The eroded rock particles traveled more quickly then they do today, as there were no plants to stabilize these first soils. For over three billion years the continents were bare rock and sediments.

The sediments continued to build up as the continents wore down. The underlying sediments became rock again as the pressure and heat cemented the particles back together. Often, as the continents eroded they became lighter and rose up, exposing the sedimentary rocks to the air, where they started to erode away once again. Most of the earth's crust is made up of igneous rock, but the most common class of rock found on the earth's continental surface is sedimentary, which lies on top of the igneous crust.

The continents are not stationary, but slowly drift about on top of the molten **mantle** which is beneath the crust. The North American continent is slowly moving westward. This causes the crust at the leading edge to slide underneath the continental plate, pushing the crust down far enough that it melts, turning into magma. (This collision of crust and continent is what pushed up and continues to push up the Rocky Mountains.) This type of collision causes sedimentary and igneous rocks caught in it to be under tremendous heat and pressure, enough so that a third class of rock is formed: metamorphic. Eventually the metamorphic rock will reach the earth's surface where it to will be subjected to weathering.

The continuing cycle of rocks melting down and then cooling into rocks again, or breaking down and then being pressed into rocks again has happened many times. It is hard to imagine, but all the rocks you see around you were once sediments at the bottom of the sea, and one day the particles in these rocks will be washed there again. It is also difficult to imagine something as hard as a rock breaking down, or the time it takes for this to happen. For example, it has been estimated that the particles in the rocks that make up Mt. Everest, the highest mountain in the world, have eroded to the sea at least three times.



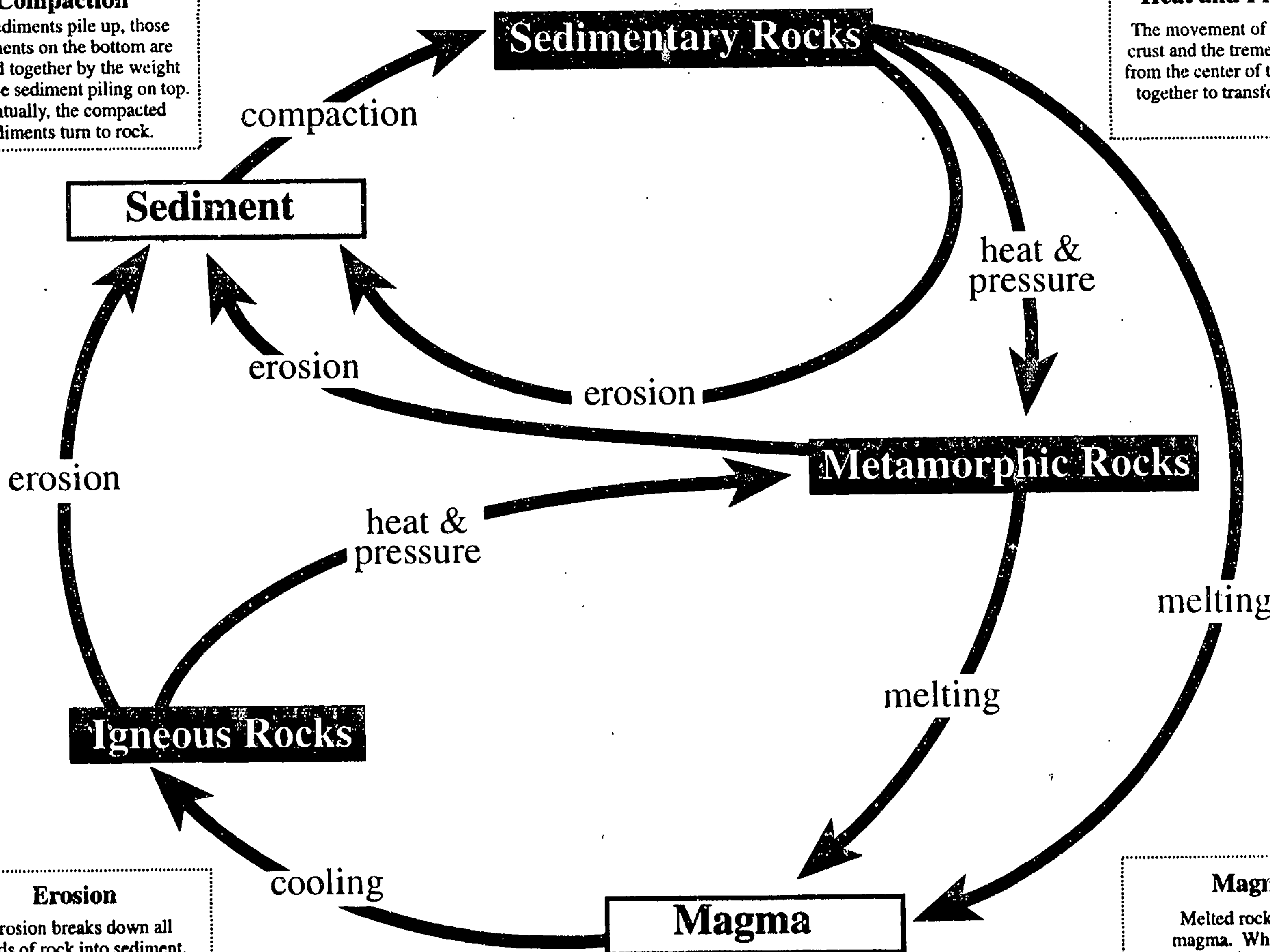
Rock Cycle Worksheet

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 movement of the earth's crust and the tremendous heat from the center of the earth act together to transform rocks.



Erosion

Erosion breaks down all kinds of rock into sediment. Wind, water, ice and snow all cause erosion.

Magma

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

Instructions:

Set the stage by asking students to describe local rocks and/or rock formations, or ones that 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. Be sure to have several rock samples distributed around the room.

Ask the students questions such as, "Have you ever wondered just how these rocks form?" and "Are new rocks forming at this moment?" You might ask each student to write down one rock-related question they would like to have answered in class. Discuss with the students the three classifications of rock: sedimentary, metamorphic and igneous.

Part A: Weathering

Each student should complete a "The Pressure's On" worksheet as they do the activity. Cover all desk tops with newspaper. Give each student a sheet of wax paper, a pocket pencil sharpener and four crayons of the same color. The crayons represent rock material, and the pencil sharpeners represent **weathering** agents. Students should remove and discard the paper from the outside of their crayons. Next, they should carefully shave the crayons with the pencil sharpener, keeping all of the fragments (which represent rock **sediments**) in a small pile. As the students are "weathering" their crayons on the wax paper, call their attention to the size and shape of the fragments. Discuss with them the following questions:

"Are the weathered fragments all the same?" (Answer: No.)

"Why or why not?" (Answer: The process of weathering can be either mechanical (breaking up a rock into smaller fragments), or chemical (rearranging the elements into new **minerals**). Many factors are involved within each of the two types. As a result, rock will show a characteristic size and/or shape, depending on which kind of weathering is taking place.)

"What are some of nature's weathering forces?" (Answer: Mechanical weathering forces can include water, ice, wind, growing roots, worms and burrowing animals, lightning, expansion and contraction caused by heating and cooling, human activity, and expansion of rock caused when **erosion** removes weight on top and produces cracks under the surface of the rock. **Chemical weathering** forces include oxygen, carbon dioxide, water, etc., reacting with a rock or mineral resulting in change.)

"Where do rock fragments tend to collect?" (Answer: On the downhill side of the rock.)

"Why?" (Answer: Gravity.)

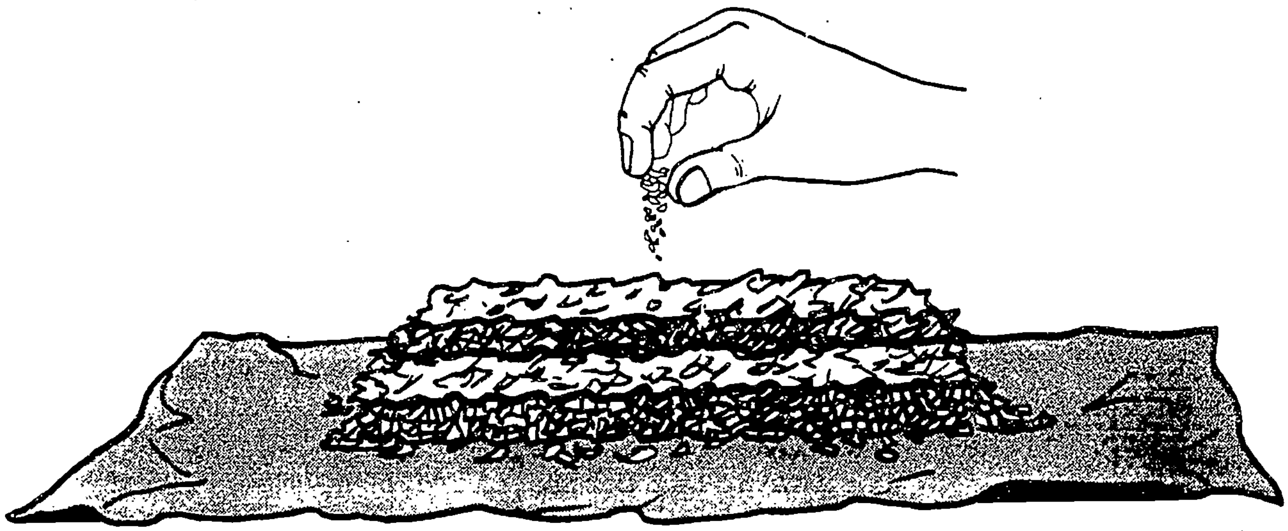
"Why do similarly sized fragments seem to be found together?" (Answer: Because similar weathering processes will usually take place in one particular area. Smaller, lighter rock fragments will be carried farther away, in a winnowing effect.)

When the "weathering" is complete, the students should wrap their fragments in their wax paper and place each wax paper packet in an envelope, unless you plan to do Part B immediately. Label each envelope as to its contents, "red," "yellow," etc., for proper distribution when the activity is resumed.

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 as they move the envelopes containing the fragments within the room. Ask the students what this force of movement is called, and to name some of its causes. (Answer: Erosion, caused by wind and water such as streams, rivers, and waves.)

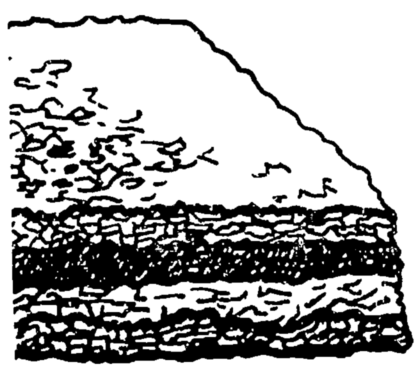
Place all the weathered "rock" fragments in four separate piles, one color to a pile. Divide the class into groups of four and give each group a sheet of aluminum foil (31 cm x 45 cm). A student from each group should carefully transfer some "weathered" fragments to the center of their aluminum foil. Spread the fragments into a 1 cm thick layer. Repeat with the remaining colors, layering the colors one on top of another (see illustration).



Students should record their observations of their "weathered" fragments on their "The Pressure's On" worksheet. Fold the foil over the fragment layers, allowing for a 1 cm space all around the fragments, and then carefully fold the edges to seal the packages. If you are breaking the activity into sections, stop here and label each package for proper distribution when the activity is resumed.

Part C: Sediments/ Sedimentary Rock Simulation

Instruct the groups to place their folded foil package between two pieces of plywood. Apply very light pressure with the C-clamp to compress the plywood pieces and the "rock"



fragments that are between them. Once the "rock sandwich" has been lightly compressed, remove it from the C-clamp. Students should then carefully open their packages and observe the new product. Call their attention to the central region which is more lightly compressed; they should lift this portion from the non-compressed fragments and carefully break it into two parts. Look at the broken edges and describe the layers. How do they compare with the original layers? What happened to the spaces between the fragments? (Answer: The layers are thinner and the spaces between the crayon fragments are now smaller.)

Each group should transfer a few of their loose fragments and the smaller piece of the "sedimentary rock" into one of their pie pans. Place the rest of the fragments in an envelope (for Part E). The pieces in the pie pan will be used for comparison with the other "rocks" the students will produce during this activity. Return the larger piece of "sedimentary rock" to the aluminum foil and wrap it up again.

Compare real sedimentary rock with the sedimentary "crayon rocks." Explain to the students that, in this area, sediments were laid down in a shallow basin or sea around 540 million years ago. These sediments were buried within the earth's crust, forming sedimentary rock. Then, when the North American and African **continental plates** collided, the buried sedimentary rock was changed into metamorphic rock. These rocks were the core, or basement, of the Appalachian Mountain Range that resulted from the collision. Later, as the rock above was eroded away, the landscape that we see around us today was exposed.

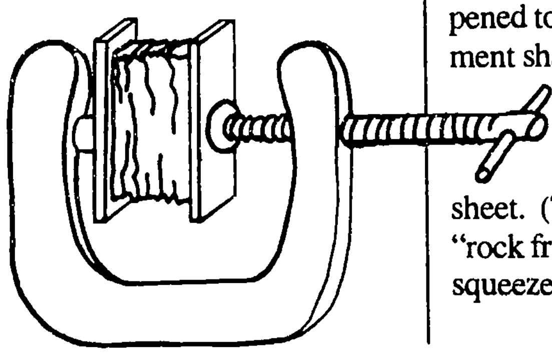
There is not much sedimentary rock left in its original layered form at Stone Mountain when compared to the amount of igneous rock. This is due to the age of the rocks and the changes the rocks underwent as the fragments were buried, heated, folded, and pressed together. As "The Pressure's On" demonstrates, the original fragments are hardly recognizable after the pressure and heat processes.

If available, have the class examine a sedimentary rock with **fossils** imbedded within it. Almost all fossils are found in sedimentary rock. Fossils are not found in igneous rock since the tremendous heat necessary to melt rock would obliterate any fossils. The same is true for metamorphic rock. Due to the heat, folding and pressure required to create metamorphic and igneous rock, any fossils that might have been present are usually destroyed. Since almost all the rocks at Stone Mountain State Park are igneous, no fossils have been found here.

If you are breaking the activity into sections, stop here and label each groups materials for proper distribution later.

Part D: Metamorphic Rock Simulation

Each group should place their foil package with the "sedimentary rock" between the two plywood boards and the C-clamp again. Tell the students to tighten the C-clamp as much as they can this time. This part of the activity demonstrates the need for greater pressure to cause a rock to metamorphose. In reality, as the pressure deep within the earth increases, the temperature increases as well. A temperature change is probably occurring in this activity, but we do not have the equipment to measure this change. The chemical activity associated with the formation of metamorphic rock is not a part of this activity. It is important for the students to understand that metamorphic rock may become contorted in appearance and actually flow like a plastic material in response to the pressure that is caused by the overriding rock load and continental plate movement.



Have the students release the compression on the C-clamp, 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, fragment shape and surface. The students should write down their observations on their work sheet. (The different colored "rock fragments" will be squeezed together.)

Examine a real metamorphic rock and compare it to the metamorphic "crayon rock." Also compare the real metamorphic rock to the real sedimentary rock. Have the students examine the texture, the edges and overall appearance of these rocks. As the basin or sea opened and closed due to two continents colliding about 250 million years ago, the sedimentary rock was turned into metamorphic rock by heat and pressure.

Place the smaller piece of "metamorphic rock" into the pie pan with the fragments and the first sedimentary "rock" sample the students made. The larger piece of "metamorphic rock" will go in an envelope labeled "metamorphic." (You can reuse an envelopes used earlier to hold the crayon fragments.) If you are breaking the activity into sections, stop here and label each group's materials for proper distribution later.

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 remaining two pie pans with aluminum foil and do the following:

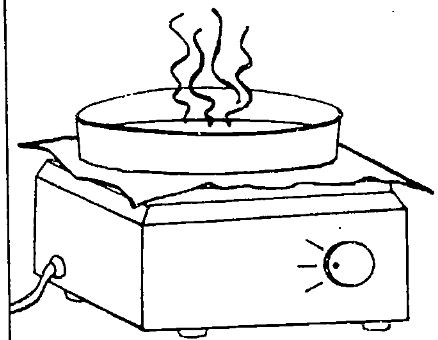
Groups 1 and 2 should each fill one of their pie pans with crushed ice.

Group 3 should fill one of their pie pans halfway with warm water.

Group 4 should place the "weathered fragments" and the smaller pieces of "sedimentary" and "metamorphic" rocks they saved earlier into one of their foil-lined pie pans. (Groups 1, 2, and 3 will save their fragments and "rock" pieces for comparison with "igneous rocks" they will make during this part of the activity.)

For the igneous rock simulation, all groups should place the "weathered sediments" they set aside in envelopes, plus the larger piece of "metamorphic rock," into one of their foil-lined pie pans.

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 pie pan 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 "weathered sediments" are in the molten state, turn the hot plate off and carefully remove the pie pan, 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, representing magma, a student from each group, or the teacher, should CAREFULLY do the following:

Group 1 - Form a trench in the ice, and using the oven mittens, pour the melted wax into the ice trench. Then cover the "**magma**" with more crushed ice. This simulates **intrusive igneous rock**, which is formed by magma flowing into rock cracks deep inside the earth.

Group 2 - Using the oven mittens, pour the melted wax (lava) directly over the surface of the crushed ice. This simulates the formation of **extrusive igneous rock**.

Group 3 - Using the oven mittens, pour the melted wax into the warm water. This simulates the formation of extrusive igneous rock in a warm water region, i.e. a **volcano** that forms under the ocean.

Group 4 - Using the oven mittens, pour the melted wax over the "weathered sediments" and the small pieces of "sedimentary" and "metamorphic" rock from Parts B and C. This simulates **lava** flowing over sediments and sedimentary and/or metamorphic rock, as would happen in a **volcanic eruption**. Some of the fragments will melt quickly, while the sedimentary and the metamorphic "rocks" will at least partially maintain their integrity. During a volcanic eruption, lava will flow over and around rocks in its path, causing some to melt, while others remain as they were originally. These rocks that are surrounded by lava are called **xenoliths**.

Allow the pie pans and wax to cool thoroughly (about 5 to 10 minutes). After the "lava" wax has cooled, the students should carefully remove their "igneous rock" from the pie pans. Students should make comparisons between the igneous rock in each groups' pie pans, then draw and write their observations on their work sheet. For instance, comparisons should be made

between the **crystal** sizes and shapes formed by each of the group's cooled magma. Comparisons should also be made between these "igneous rocks" and the "sediments" and the "sedimentary and metamorphic rocks" students created in the previous sections of this activity.

As a class be sure to discuss the following:

Using Group 1's pie pan, discuss the effect of the "magma" on the sedimentary or metamorphic "rock" which the ice represents.

Using Group 2's pie pan, discuss the effect of "lava" on the surface "sediments" and "rocks" which the ice represents.

Using Group 3's pie pan, discuss the effect of the warm water on the "lava."

Using Group 4's pie pan, discuss the effect of the "lava" flowing directly onto the sedimentary and metamorphic "rock" and "sediments."

If possible, show the students various examples of real volcanic rocks and compare the real rocks with their "igneous crayon rocks." Remind the students that most of the rock visible at Stone Mountain State Park is igneous in origin. These rocks formed deep within the earth. Most of the rock is still buried, however, the process of weathering and erosion has exposed a few scattered **outcrops** such as Stone Mountain.

While the students are looking at the three types of rocks, lead a discussion on the rock cycle, focusing on the processes they observed to transform one rock into the next.

Have the students discuss the differences and similarities between their "crayon rocks" and the real rock samples. Talk about the questions your students had when the activity first started.

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

It is important for everyone to understand that not all conditions for rock formations can 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.

"The Pressure's On" Worksheet

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

2. Do 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. Do 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?

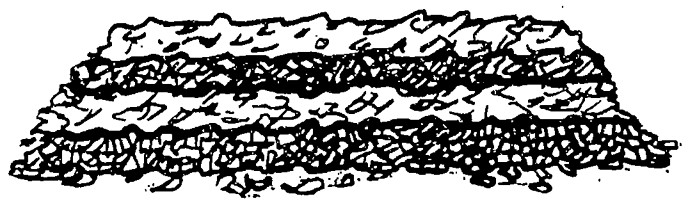
4. Do a colored drawing of each of the four "igneous rocks" created. Compare and contrast the formation of the extrusive with the intrusive "igneous rocks."

Group One's "Igneous Rock"	**Group Two's "Igneous Rock"**
Group Three's "Igneous Rock"	**Group Four's "Igneous Rock"**

5. Write a comparison between the "weathered rock fragments," "sedimentary rocks," metamorphic rocks," and "igneous rocks" formed in this activity. Describe their similarities and differences as to color, texture, etc.

"The Pressure's On" Answer Sheet

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



2. Do 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. Do 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. Do a colored drawing of each of the four "igneous rocks" created. Compare and contrast the formation of the extrusive with the intrusive "igneous rocks."	
Group One's "Igneous Rock"	**Group Two's "Igneous Rock"**
Group Three's "Igneous Rock"	**Group Four's "Igneous Rock"**

5. Write a comparison between the "weathered rock fragments," "sedimentary rocks," metamorphic rocks," and "igneous rocks" formed in this activity. Describe their similarities and differences as to color, texture, etc.

The "weathered rock fragments" will vary in size and shape, depending on the implement used and how it is used. The "rock fragments" can be oriented (up/down or right/left) in any direction. In the "metamorphic rocks" the space between the 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 due to the melting and mixing of different "rock fragments" and has a variety of forms, depending on how the separate groups' rocks were cooled.

Note: 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 Igneous Intruder

Curriculum Objectives:

Grade 4
- Communication Skills: listening, writing
- Guidance: competency for interacting with others
- Healthful Living: recreational safety
- Science: weather and climate, living things - animals, adaptation to environment
- Social Studies: draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening, vocabulary and viewing comprehension
- Guidance: competency for interacting with others
- Healthful Living: recreational safety
- Science: earth science, living things - plants, environment
- Social Science: analyze information, draw conclusions

Grade 6
- Communication Skills: listening, vocabulary and viewing comprehension, writing
- Guidance: competency for interacting with others
- Healthful Living: recreational safety
- Science: earth science, ecology, environment
- Social Studies: evaluate, organize and analyze information, draw conclusions

Location:
Stone Mountain State Park

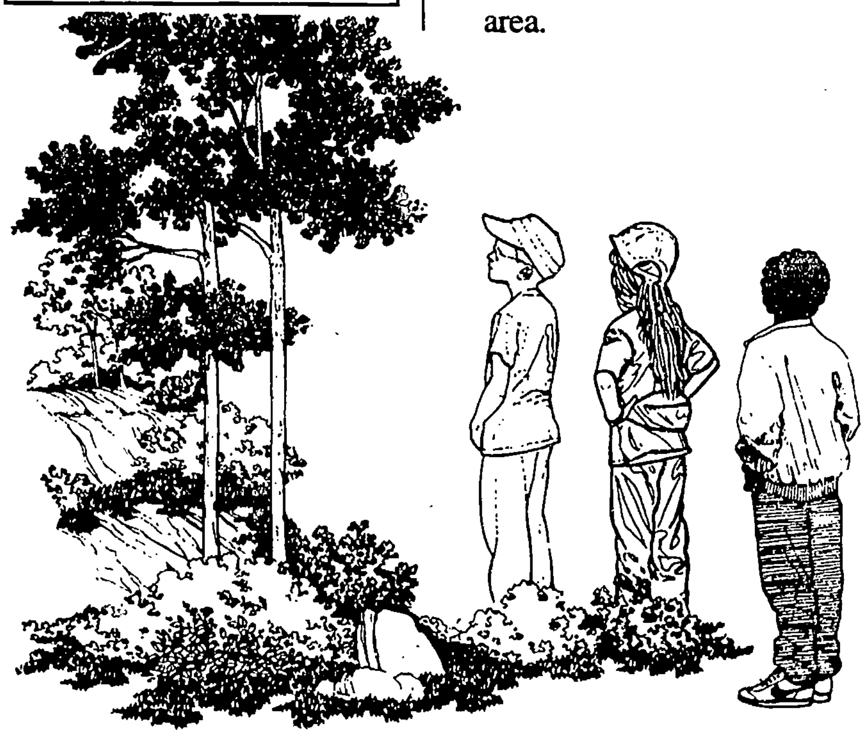
Group Size: 30 or less

Estimated Time:
Part I: 1 hour
Part II: 1 and 1/2 hours

Appropriate Season: Any

Materials:
Part I:
Provided by the educator:
Per student: pencils, paper, crayons, drawing markers, clipboard, "Igneous Intruder" worksheet
Provided by the park: plywood box, air hose, inflatable rubber ball, inflation needle, bicycle pump, buckets of soil and small rocks, watering can, water, samples of granite, hand lenses
Part II:
Provided by the park: 15 hand lenses

Special Considerations:
Part II of this on-site activity will require hiking, which could expose the students to hot, humid conditions as well as ticks, bees and snakes. Accessibility to some of these areas may be difficult for persons with special needs. Leaders should make students aware that they are in a natural area with hazards associated with rocks, high places and water.



Major Concepts:
Part I:
- Intrusive igneous rock
- Erosion

Part II:
- Weathering
- Erosion
- Land use
- Succession

Objectives:
Part I:
- Describe and illustrate how Stone Mountain was formed.
- List three minerals that make up the granite of Stone Mountain.

Part II:
- Describe five factors that cause rocks to weather and erode.
- List the stages in bare rock succession.
- List three ways early settlers used the rocks in this area.

Part I: Igneous Intruder

Educator's Information:

During this activity the class will see a demonstration of how Stone Mountain was formed.

Instructions:

1. Discuss the Student's Information. Pass around samples of **granite** and have the students identify the **minerals** with the hand lenses. Remember that the feldspar will appear white or gray, the **quartz** will appear clear or glassy, and the biotite **mica** will appear as black or dark specks.

2. Explain that this activity simulates how Stone Mountain was formed.

3. Have a few students pour the buckets of soil and **rocks** into the plywood box. The students will "build a mountain" about one foot high from these materials. (A deflated ball, covered with soil materials. will already be in the box so the students can't see it. An air hose will be connected to the ball and run to a bicycle pump outside of the box.) Have the students draw a picture of this "mountain" on the "Igneous Intruder Worksheet" in box #1.

4. After completing the "mountain building," have a student use the watering can to pour a couple of gallons of water on to the top of the "mountain." Notice what happens here. Soil and smaller rocks are moved from one place to another. Have the students draw a picture of how the mountain now looks in box #2 on their worksheet.

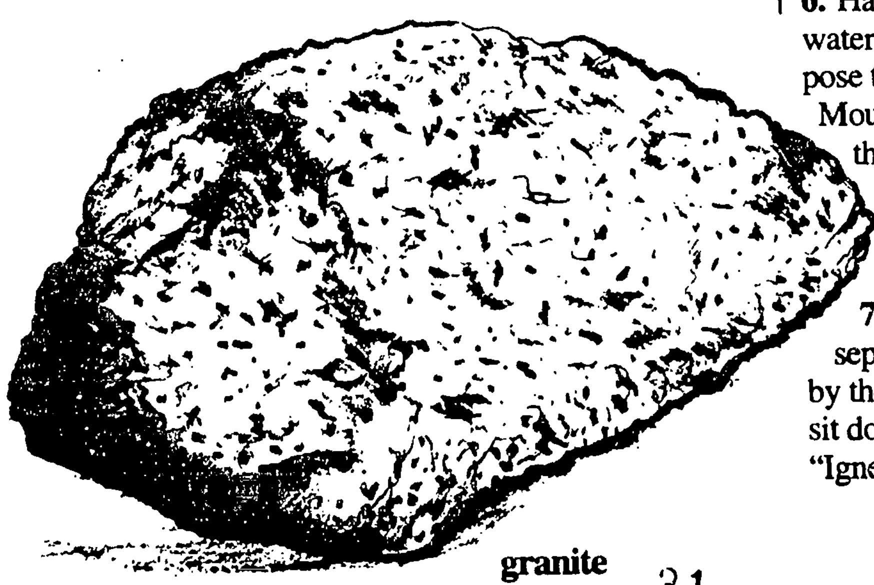
Talk about what forces of nature help break up and move materials. Emphasize that millions of years ago the Appalachian Mountains were much taller than they are today, but **weathering** and **erosion** have removed miles of material from them.

5. Discuss what an **intrusive igneous rock** is, then have a student pump the bicycle pump. The rubber ball buried beneath the "mountain" will start rising. Pumping air into the ball represents **magma** intruding into the overlying bedrock. As the "magma" continues to intrude, the "mountain" will start to move. The soil on the "mountain" will crack and materials will be carried down the "mountain." Have the students draw a picture of how the "mountain" now appears in box #3 of their worksheets.

When resistance is felt against the bicycle pump, have the student stop pumping. At this point the hidden ball should be mostly inflated.

6. Have a student pour enough water on the "mountain" to expose the "granite face of Stone Mountain" (the ball). Have the students draw the final appearance of "Stone Mountain" in box #4 of their worksheets.

7. Have the students separate and find a place by themselves where they can sit down and complete the "Igneous Intruder Worksheet."



granite

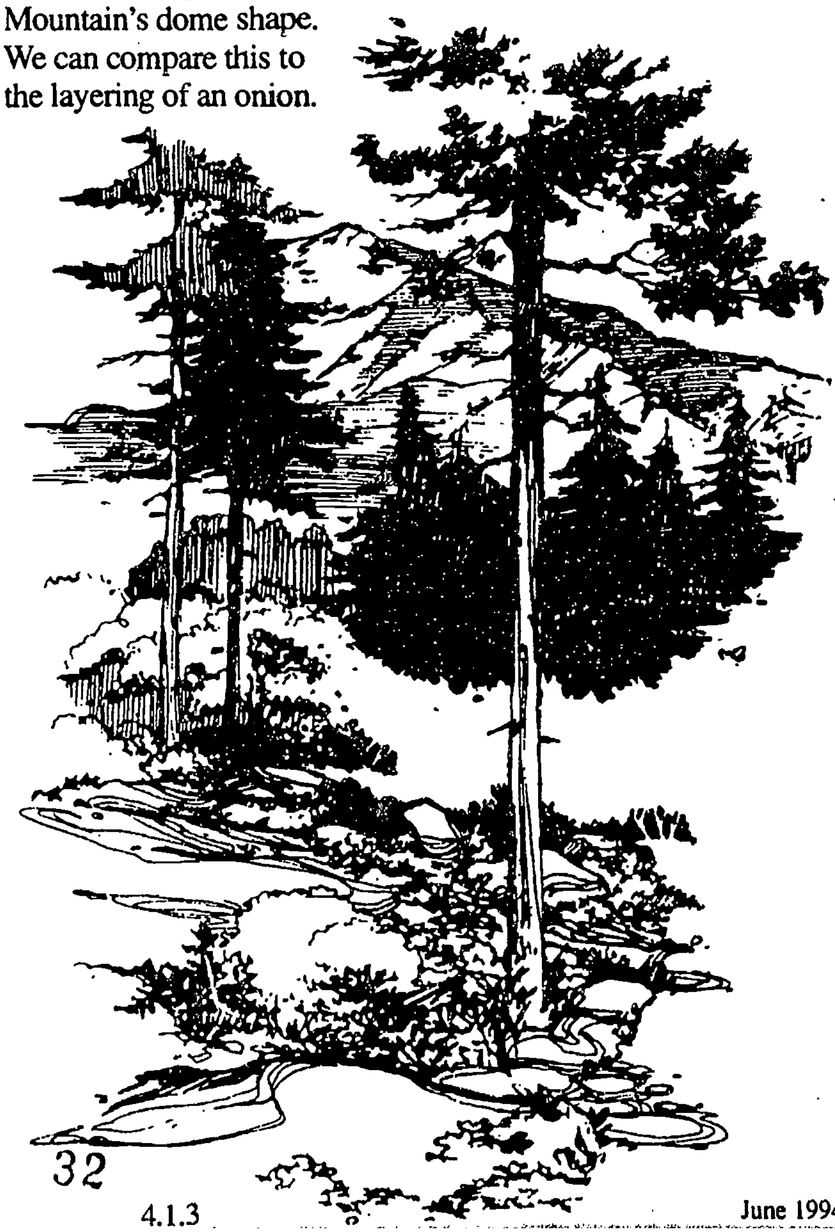
Student's Information - Part I

It's hard to imagine, as you stand in front of Stone Mountain, that the Appalachian Mountains may have once stood as tall as the modern Alps or Andes Mountains, approximately six miles higher than the mountains we see today. Stone Mountain was buried beneath much of this mountain material but became exposed over the millions of years by **weathering** and **erosion.**

The Appalachian Mountains, the oldest mountain range in North America, took millions of years to form. The series of complex activities that built this mountain range started during the Ordovician period, 520 million years ago. Several hundred million years later, during the Permian period (255 million years ago), this mountain building process reached a climax. About 390 million years ago, during the Devonian period, a mass of **magma** formed several miles deep in the Earth, below the area of what is now Wilkes and Alleghany counties. This magma cooled slowly beneath the Earth's surface, creating a **plutonic batholith**, a gigantic, dome-shaped rock. Magma solidifying beneath the earth's surface in this way is called **intrusive igneous rock.**

About 255 million years ago, the weathering and erosion forces started stripping away some of the overlying rocks. As the miles of earth and rock overlying the newly formed **granite** plutonic batholith were removed by erosion, the release in surface pressure caused the rock mass to move upward. As it expanded upward, it also expanded outward, causing the rock to fracture into large slabs, or **exfoliation** sheets. Therefore, Stone Mountain is commonly referred to as an exfoliation dome. These curved exfoliation sheets help define Stone Mountain's dome shape. We can compare this to the layering of an onion.

The granite that makes up Stone Mountain is a very hard, light colored, coarse-grained rock. It is composed of three **minerals**: feldspar, **quartz** and biotite **mica**, with feldspar and quartz being predominant. Feldspar represents about 60% of the rock, quartz represents about 30%, while biotite mica represents about 10%. The dull white or gray areas are feldspar, the clear, glassy mineral is quartz, and the black or dark specks are biotite mica.



Igneous Intruder Worksheet

Draw a series of pictures illustrating how Stone Mountain formed.

Box #1	Box #2
Box #3	Box #4

Describe how granite plutonic batholiths (or exfoliation domes), like Stone Mountain, are formed. Be sure to list the three most common minerals found in the granite at Stone Mountain. ______________________________

Explain the importance of state parks and other protected lands in preserving areas of significant natural beauty. ______________________________

Igneous Intruder Answer Sheet

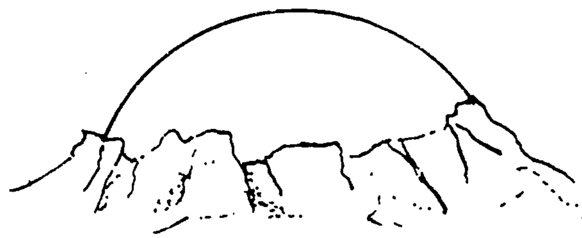
Draw a series of pictures illustrating how Stone Mountain formed.

Box #1

Box #2

Box #3

Box #4



Describe how granite plutonic batholiths (or exfoliation domes), like Stone Mountain, are formed. Be sure to list the three most common minerals found in the granite at Stone Mountain. *A mass of magma forms several miles deep in the Earth. This magma cools slowly beneath the Earth's surface, creating a plutonic batholith, a gigantic, dome-shaped rock. Weathering and erosion forces start stripping away some of the overlying rocks. As the miles of earth and rock overlying the granite plutonic batholith are removed by erosion, the release in surface pressure causes the rock mass to move upward. As it expands upward, it also expands outward, causing the rock to fracture into large slabs, or exfoliation sheets. These curved exfoliation sheets help define the mountain's dome shape.*

Stone Mountain is composed of three minerals: feldspar, quartz and biotite mica, with feldspar and quartz being predominant.

Explain the importance of state parks and other protected lands in preserving areas of significant natural beauty. *With an ever growing human population, protected lands are vital in preserving the state's natural heritage. While there seem to be vast areas of wild country, mountains and forests in this state, where one person sees scenic rock outcrops and trees, others see minerals for mining and timber for cutting. It is only through setting land aside, that many of these outcrops and trees will not be developed. State Parks are set up to preserve and protect these scenic wild lands. Through state parks, people of future generations will have many of the same opportunities to enjoy nature as we have.*

Part II: Rock Walk

Educator's Information:

The class will take a short hike on the self-guided nature trail at the base of Stone Mountain to see evidence of **weathering, erosion, deposition** and succession. The group will walk a trail over **rocks**, roots and water, so caution is needed to prevent injury.

Instructions:

1. Discuss basic trail safety information with the students (see Special Considerations). Remind the students that the purpose of the state parks system is to preserve and protect our natural resources. Explain to them that they should not pick, injure or destroy any plants or animals, and rocks should not be removed from the park.

2. Discuss the Student's Information with the class before arriving at the park. For each stop, have one of the students read aloud that stop's information as the rest of the class looks for and identifies the objects and processes described.

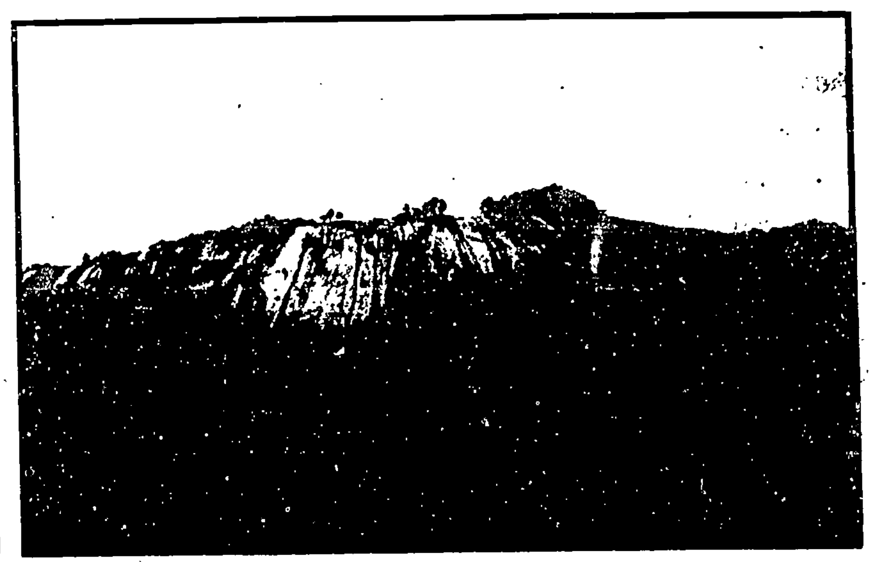
Stop 1: Field at base of Stone Mountain
(read aloud)

This field is a pasture created by early settlers. It is maintained by the park to help preserve the cultural past and provide a vista of the mountain for visitors. Look at the surface of the field. Notice the mounds and shallow ditches that were used to control the direction and force of running water to help prevent **erosion**. Deer and rabbits use the field as a food source and can often be seen grazing here.

As you look at the south-facing slope of Stone Mountain, notice the shape of the rock and the trees growing on it. Also, notice the Great Arch, which was formed when part of the mountain's rock **exfoliated**.

The trees you see growing on the mountain are part of a never ending cycle called bare rock succession. First, a shallow depression forms, due to **weathering** and erosion. Next, sand and soil are washed or blown into the weathered pit. Mosses and grasses start growing in the collected soil, helping to hold moisture and adding **organic** material which enriches the soil. Over time, more soil accumulates and eventually, if the soil is rich and deep enough, trees and shrubs are able to survive. As the trees get taller and more top heavy, winds will sometimes blow them over, for they are not deeply rooted. The soil mat is lifted out by the tree's roots and then is often washed away. The whole process of building up the soil in the weathered pit then starts over again.

The plants that live in these weathered depressions have to contend with desert-like conditions. The soil is often sandy and poor in nutrients, just like desert soils. Most of the time the soil is very dry because of



rapid evaporation of the moisture by wind and sun. The plants also have to adapt to high light intensity caused by the reflection of sunlight off the rock. The rock surface temperature in summer often exceeds 100 degrees F. These desert-like conditions place the plants under a lot of stress, causing them to grow more slowly than identical species growing in a better habitat. The trees growing on the rock are often stunted and gnarled from the harsh environment. This gives them a "bonsai" character which is both intriguing and beautiful.

Stop 2: Climbing Display Exhibit
(read aloud)

Granite boulders of various shapes and sizes are scattered everywhere. All these rocks broke off Stone Mountain and tumbled down. This mature forest growing among the boulders is very diverse, containing many different species of trees.

The dominant oak here is the chestnut oak. It commonly grows on rocky slopes, where precipitation drains away quickly, leaving the soil very dry most of the time. Almost all the larger chestnut oaks are hollow, providing homes for many animals, including woodpeckers, nuthatches, owls, squirrels, raccoons, opossums, insects, mice and snakes.

While the students are looking at the Climbing Display, go over the information given here. Explain the park's rules and regulations regarding rock climbing.

Stop 3: Practice Rocks
(read aloud)

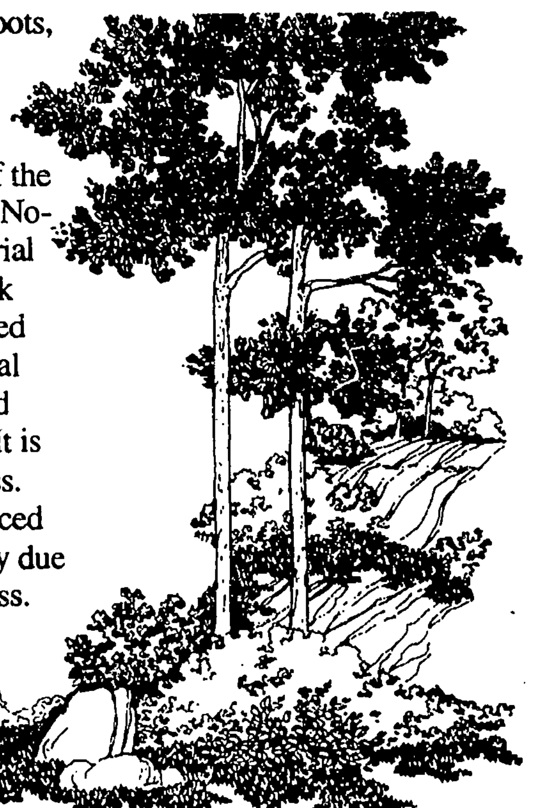
The first rock has a slanted surface where we can practice friction climbing. Stone Mountain is famous among climbers as one of the best friction climbing mountains in the southeast. The second practice rock has shallow indentations in the rock, called lentils, that can be used for handholds and footholds.

Next is the balanced rock. The top surface of the bottom rock has black moss growing on it. The firmly anchored moss obviously needs no soil, just the rough rock surface. It is slowly breaking down this rock with its small roots, the acid produced by its decaying leaves, and its ability to hold moisture longer after a rain than if the rock surface were bare. Notice the small rock material on top of the bottom rock at the base of the balanced rock. This sandy material comes from the balanced rock as it erodes away. It is a slow but steady process. The surface of the balanced rock is rough and bumpy due to this weathering process.

Have the students practice climbing these two boulders to let them experience how difficult rock climbing can be and what granite rock feels like. Have several students push up on the balanced rock. They will get an appreciation of just how heavy granite is, as they will not be able to move the rock at all. As the students hike to Stop 4, just off the nature trail at the base of the mountain, call their attention to the number of trees growing on top of the rocks.

Stop 4: Base of Stone Mountain
(read aloud)

Over time, many of the rocks at the base of the mountain have become rounded by the rain water pouring off of Stone Mountain. The rounding of the stone is caused primarily by the sandy particles



carried by the rainwater flowing off Stone Mountain. The particles act like sand blasters on the rocks at the mountain's base.

Off to the right, there is a crack going straight up the rock which has grass, called broomsedge, growing out of it. Notice the birch tree with most of its roots exposed on top of the rock. This shows how adaptable some plants can be.

Have the students lean forward and touch the rock. How does it feel? Cold or hot? Rough or smooth?

Return to the Nature Trail by the same route.

Stop 5: Threshing Rock

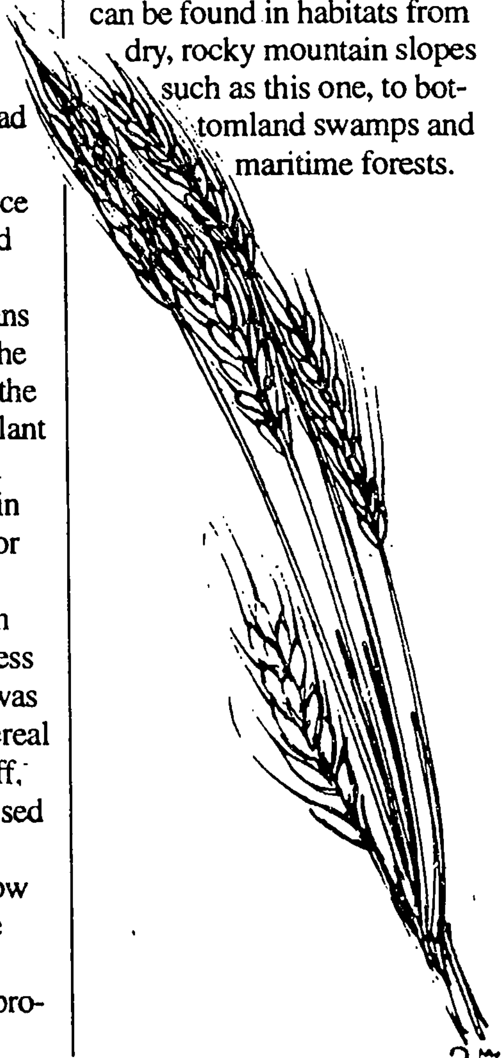
(Have the students sit on the "threshing" rock and read aloud.)

Years ago, this was a place where local famers threshed the wheat, rye, oats, buckwheat, barley, peas and beans they harvested. To thresh the grain, they would separate the seeds from the rest of the plant by using a **flail**, made from a hickory sapling. The grain was then stored and used for food. The straw was used for livestock feed, placed in stables or used to fill mattress ticks. The threshing rock was also used to separate the cereal grains from the lighter chaff, or husk. The grain was tossed up into the air using a bed sheet. The wind would blow away the chaff, leaving the heavier seed kernels to fall back onto the sheet. This process is called winnowing.

Farmers also used rocks in the area for building fences, chimneys and support pillars to keep wooden structures away from termites and the rotting effect of moist soil. Many of these structures can still be seen at old home sites scattered throughout the park.

Stop 6: Rock Exfoliating
(read aloud)

Notice the red maple that has produced a burl in response to being blown back and forth against the rock boulder. Red maples are the most widely distributed deciduous trees in the forests of eastern North America. They can be found in habitats from dry, rocky mountain slopes such as this one, to bottomland swamps and maritime forests.



The red maple gets its name from the many parts of the tree that are red, including its flowers, winter twigs, buds and fall leaf color.

Just beyond this tree is a boulder with an exfoliated slab of rock. This chunk of rock has been broken loose by ice wedging. Water that freezes each winter behind this rock is pushing the slab away from the boulder. Gravity is also helping pull this rock slab slowly down the boulder.

Stop 7: Rock Weathering
(read aloud)

The odd pockets in these boulders show the strange shape that weathering can produce. Why the pockets are shaped this way is unknown. Perhaps the rocks' matrix of minerals is not as strongly held together as that of other boulders. For example, if the rocks had a higher concentration of potassium and magnesium, they would be more susceptible than other rocks to **chemical weathering** by carbonic acid, which is always present in rainwater. Note that the **sediments** which have sloughed off can be seen on the ground at the base of the rock.

Stop 8: Rock Moss and Root Wedging
(read aloud)

The flat rock in front of you is covered with moss. Similar to Stop 3, this moss is helping to slowly weather this rock.

The boulder behind this flat rock shows that tree roots also play a role in breaking rocks apart. Walk up to the rock and you will see two large cracks filled with two types of tree roots. The roots of the large, old, dead tree that grew on top of the rock can be seen in the cracks, along with the roots of the young red maple that is still alive and growing on top of this boulder. The older roots are dead and fill the bottom of the crack completely, whereas the live roots of the maple can be seen on top of the dead roots. The older tree's roots widened the cracks so that now the maple's roots will have more room to grow. The live tree also benefits from the nutrients released from the **decaying** dead tree. Perhaps this maple will grow into a large tree as well, with its roots further widening the cracks. When it dies perhaps another tree seed will land on top of this rock, grow into a large tree and its roots will continue the process of breaking this rock apart.

Stop 9: Spring (read aloud)

Water falling from the sky in its many forms either evaporates, runs off the land into bodies of water, or is absorbed into the ground. Once in the ground, the water seeps into cracks in rocks, creating a water table. People who live in the country often get water from wells which are drilled into these rocks.

Springs are also a source of water. A spring occurs when the water table reaches the land's surface. The water in a water table generally contains **minerals**, such as iron or copper, that have **leached** from the rocks.

The average temperature of water coming from a spring in this area is 55 degrees F. Before electrical refrigeration, mountain families often built a stone structure around a spring, called a "spring house," where they would store food to keep it cool.

Stop 10: Delta Valley
(read aloud)

This small, relatively flat delta has been made from soil that washed here from the steep hollow above. All the water that flows through this hollow is an example of a watershed. A watershed is an area between two ridges where all the precipitation that falls there flows to one place, like a stream, river, lake or ocean. Look for any areas where **deposition** is occurring. Are all the deposited materials the same size and shape? What are be the primary erosional forces causing the deposition? (Running water and gravity.)

quartz

Stop 11: Ridge Top
(read aloud)

The soil on this ridge is richer and deeper than the soil found in the boulder area. The white oaks growing here are evidence of this, for they require better soil than chestnut oaks do, which dominate the boulder area. This ridge also divides two small watersheds.

Stop 12: Creek Convergence
(read aloud)

Several small creeks or streams come together in this area, forming a small marsh. The ground is squishy under foot. Ferns and sphagnum moss grow very well here. Sphagnum moss can hold ten times its weight in water. This characteristic, and the fact that it is naturally sterile, is why the moss was once used to dress wounds on battlefields.

Look at the rocks in the water. Are they all the same? How do the rocks in the stream differ from the boulders just seen? Along the stream, notice all the **quartz** sand that has weathered and eroded from Stone Mountain. The dull, whitish gravel is the mineral feldspar. Using a hand lens, see if you can find small, glassy pieces of sand (quartz), black flakes (bioite **mica**), and whitish flakes (biotite mica that has absorbed water). The quartz sand is the most **resistant** mineral here, and is the only one durable enough to be carried by streams and rivers all the way to the ocean.

Stop 13: Gravel Trail
(read aloud)

As we start back along the trail through the field, look for signs of erosion. What has caused the trail to erode? Could it be something as simple as people hiking the trail? Thousands of hikers use this trail every year, creating an impact on the trail's surface which speeds up erosion by compressing the soil. This results in rainwater not being absorbed, but running off quickly, creating gullies. To slow down the erosion, the park staff has put in water bars, which are shallow ditches crossing the trail at an angle. These bars divert water from the trail before it can build up enough speed and force to gouge out gullies. The park staff has also put down gravel to increase traction so people don't slip, and to lessen the **compaction** on the soil.

Even though this trail shows erosion and compaction problems, it is still very important to stay on the trail. The erosion damage would be far greater if all the hikers were to scatter across this area. By keeping on the trail, the impact can at least be localized and monitored.

Stop 14: Stone Mountain Vista

Oncé you reach the open field, review what you've learned about:

- bare rock succession processes;
- uses of rocks by early European settlers to the region, compared to how we use the rocks today; and
- weathering and erosion forces, using at least five examples from the hike.

Suggested Extensions:

1. Hike the other trails in the park, especially the one going across the top of Stone Mountain and the trail across Wolf Rock.
2. Once the group has returned to school, take a short walk around the school grounds looking for signs of weathering and erosion. Discuss what forces cause the erosion they see. Also discuss ways people can help slow down the erosion. The class may even find an erosion problem they can correct as a class project.

Student's Information - Part II

We have briefly discussed **weathering** and **erosion,** but we will now take a much closer look at these forces. Stone Mountain and other rock **outcrops** in this area are part of a large **granite pluton** formed deep within the **earth's crust** millions of years ago. The exposed outcrops came about due to geologic disturbances and general erosion or "wear and tear agents."

When we think of **rock**, we think of a material that is very hard, almost indestructible. When we think of mountains, we think of massive features that are unchanging. This isn't at all the case. All landforms on Earth, from mountains to river valleys to the coastline, are constantly changing. As some landforms are slowly worn away, new ones are building up.

Two forces, weathering and erosion, constantly wear away at the rocks that make up the Earth's crust. Weathering causes rocks to crack, fragment, crumble or break down by physical and/or chemical means. Erosion loosens and carries away the rock pieces produced by weathering. Over millions of years these two forces, working together, have changed our land and will continue to do so millions of years into the future.

Weathering:

All rocks weather, but not at the same rate. Some rocks will weather much faster than others. The rock's **minerals** determine the rate at which it weathers. Climatic factors, such as rainfall, also play a role.

There are four weathering factors that we will focus on:

1. The Freeze and Crack Cycle: When water runs into cracks in rocks and freezes, the ice expands. When the ice expands, it needs more room so it pushes against the rock, exerting great amounts of force and pressure. This eventually causes the rock to break apart.

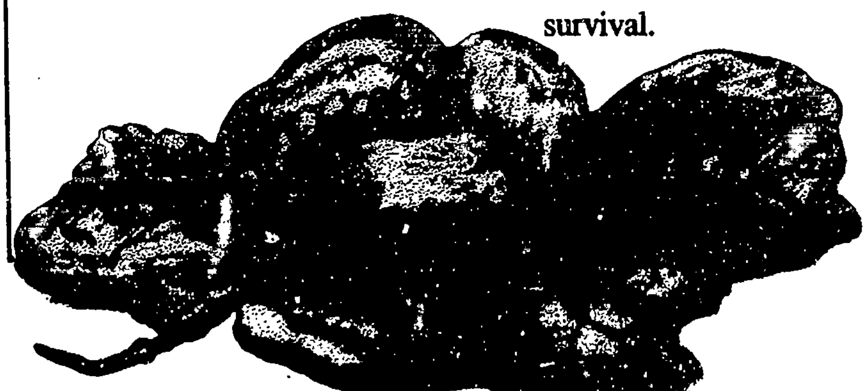
2. The Hot-Cold Cycle: The daily change in temperature from cool nights to warm days also causes expansion and contraction which will cause rocks to crack and break apart.

3. The Roots of Destruction: Plants play a role in breaking rocks apart. As small amounts of soil gather in rock cracks, seeds, deposited there by winds, birds and other animals, start to grow. As a plant's roots expand into the cracks, they put pressure against the rock. This forces the cracks to widen, eventually splitting the rock apart.

4. Chemical Breakdown: Some minerals change as they react with the chemicals in air and water. Dead and decaying matter such as leaf litter forms humic acid. Even rain water is acidic. These acids help weather rock.

Not all minerals react to chemicals in the same way. Irregularly rounded depressions, called weathering pits, pockmark the surface of Stone Mountain. These weathering pits form when some minerals weather more rapidly than others. Water, with its carbonic acid, collects in these pits, causing additional **chemical weathering.**

Without weathering, we couldn't survive. As rocks are continually broken down into smaller parts, they eventually become fine enough to be called silt or sand, two very important ingredients of soil. This soil is essential to our survival.



Erosion:

Erosion involves forces that continue the work started by weathering. Erosion helps to loosen particles and move weathered rock material. There are five erosion forces we will focus on:

1. Moving water: Water does more to wear away our land than all other geologic forces combined. A fast flowing stream will carry a lot more than just water. Soil, sand, silt and rocks can all be carried by fast flowing water. Notice a stream after a hard rain and you will see erosion in action.

2. Wind: Wind erodes by lifting and removing dry, fine particles which are sand-sized or smaller.

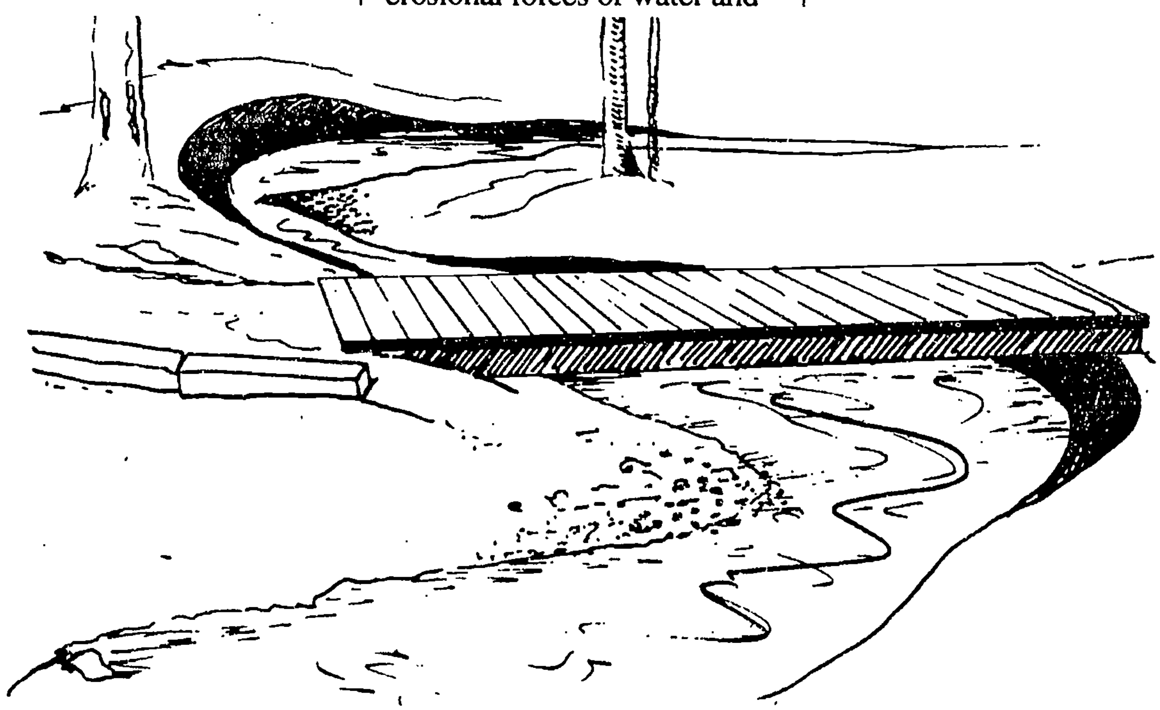
3. Ice: Ice is the one force of erosion that we don't see much of in our area of the world. In the colder regions, snow may pile up hundreds of feet thick, forming a great sheet of ice called a glacier. Glaciers from past ice ages have shaped much of the world's landscapes. There is evidence that in the last ice age, glaciers may have been present in some of the northern-facing North Carolina mountain valleys.

4. Gravity: Gravity moves weathered rocks, especially on steep slopes. The boulders at the base of Stone Mountain tumbled here after being exfoliated from the rock above. An analogy to **exfoliation** is peeling the layers of an onion.

5. People: People constantly modify the landscape. We cut the forests and scrape off the soil, drain swamps, fill in wetlands and strip mine for minerals; we build houses, shopping centers, landfills, farms and whatever else we feel we need. We often do this without thinking of the irreparable damage we have caused. The land, once cleared, is open to the erosional forces of water and wind. All the changes people make to the Earth's surface affect the natural patterns of weathering, erosion and **deposition.**

As weathering and erosion constantly wear away our Earth's crust, other forces are at work building it up. Mountains, **volcanoes** and **faults** are formed as rocks are pushed up, warped, folded or fractured due to great force and pressure deep within the Earth. Water, wind and ice can also build up areas by carrying **sediments**, which are produced by weathering and erosion, and dumping them in another area. This buildup, or deposition, creates new landforms.

Mountains are created and leveled, valleys dug out and filled in, seas born and dried to dust. The Earth is constantly changing--nothing remains unchanged but the agents of change themselves.



Post-Visit Activity #1 Let's Do the Time Warp

Curriculum Objectives:

Grade 4

- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: competency for interacting with others
- Mathematics: solve problems in time and measurement
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 5

- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: competency and skill for interacting with others
- Science: earth science
- Mathematics: whole numbers, measurement
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6

- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: competency for interacting with others, variety and complexity of occupations
- Mathematics: whole numbers, measurement
- Science: earth science
- Social Studies: evaluate, organize and analyze information, draw conclusions

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
2 - 3 class periods

Appropriate Season: Any

Materials:
Provided by the educator:
A 65' long continuous strip of 24" wide paper, yard stick or tape measure, magic markers or crayons, tape, scissors, reference books on fossils and life during the various geologic time periods
Per student: "Events in Geologic History" fact sheet, "Geologic Time" fact sheet

Major Concepts:

- Geologic time
- Geologic history

Objectives:

- Conceptualize geologic time using a mural model.
- Identify three different time periods from the beginning of the Earth until the present time.
- List one characteristic for each of the three time periods.
- Name the time period and era we live in now.

Educator's Information:

Geology is the science of the Earth and its history. When we study geologic history, we find that water invaded the land, layers of **sediment** were deposited, the land was pushed up into mountains, and eventually wind, rain and ice leveled the land again. This sequence has been repeated many times throughout the Earth's history.

It is difficult for most of us to understand the concept of geologic time. Because we tend to regard events using a time scale of hours, days, months and years, it is easy to underestimate the vast amount of time covered during eras such as the Precambrian.

By creating a visual model, the students should begin to more clearly understand the broad scope of geologic time.

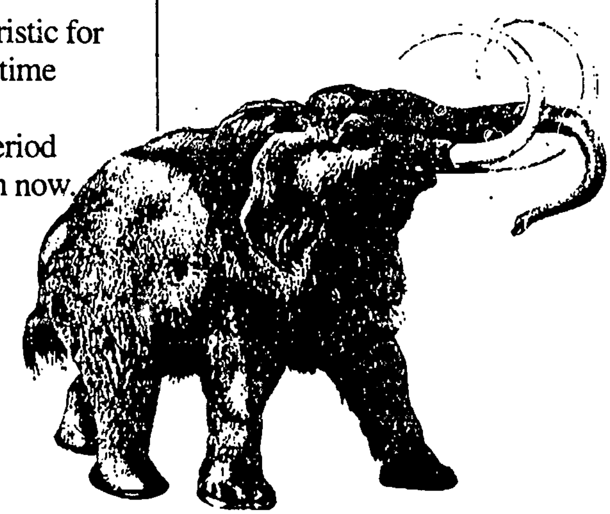
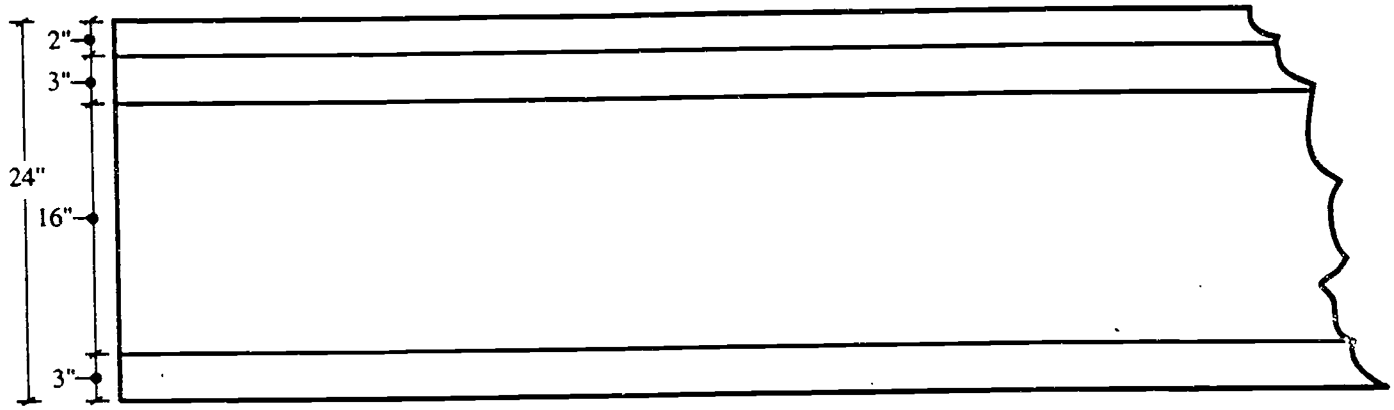


Figure A



Instructions:

1. Starting near the classroom door, run a continuous strip of paper along the wall around the room. (Note: If the circumference of the classroom is less than 65 feet, spiral the paper around the room.)

2. Using a yardstick and a black marker or crayon, have the students draw a continuous line, three inches up from the bottom of the paper, along the entire length of the paper.

3. Have the students draw a second continuous line, with the marker or crayon and yardstick, 16 inches above the first line.

4. Three inches above the line drawn in step 3, have the students make another continuous line. After steps 1 through 4, the paper should look similar to Figure A.

5. Using the magic marker or crayon, have the students place 390 marks, two inches apart, on the paper below the bottom line. Have them label the marks by 10 mya (million years ago) intervals, giving a total representation of 3,900 million years. This works out well as the oldest rock on earth is 3,800 million years old; 3,900 million = 3.9 billion.

Marks for one-half million years ago (0.5 mya) and then 1 mya through 9 mya should also be written in between 0 and 10 mya. After step 5, the paper should look like Figure B.

6. This geologic time activity provides information on 16 periods and epochs. Divide the class into 15 teams. (This may mean that some "teams" consist of just one student.) The whole class will be responsible for depicting the Precambrian period after the other periods and epochs have been portrayed.

Each team should be assigned an epoch or period from the "Geologic Time" fact sheet. The team is responsible for finding their period or epoch on the time scale mural and marking it off with vertical lines, being sure to label the time periods (Figure C). They will illustrate what animals and plants lived during their period or epoch.

Figure B

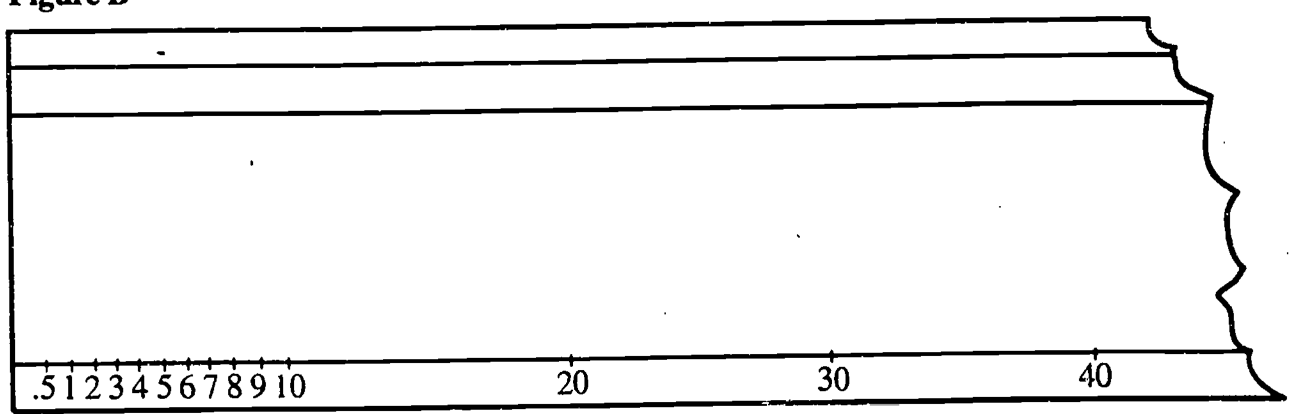
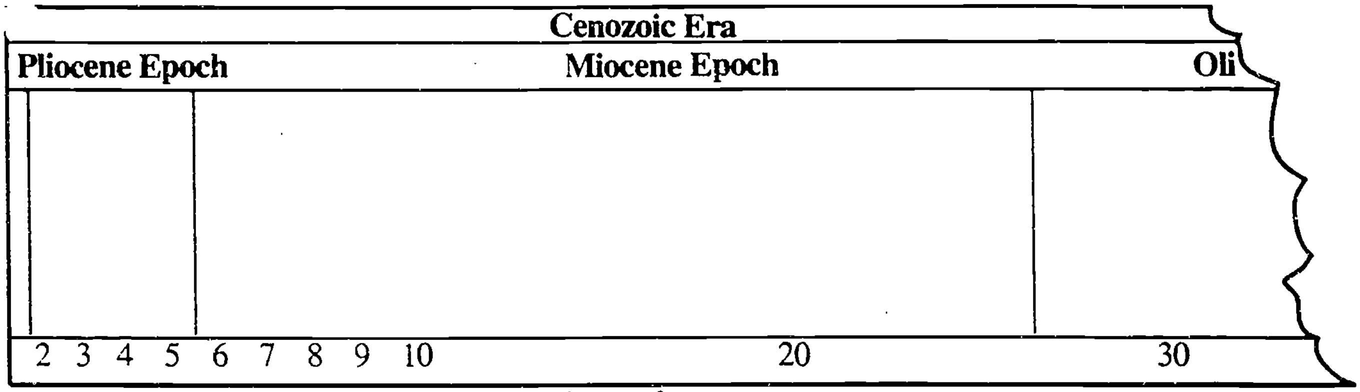


Figure C



millions of years ago

Those students working within the 0 to 10 mya scale (the most recent epochs) will not have room within their two inches to place all the illustrations. They should connect their illustrations to the time-line with arrows to indicate where their illustrations fit into the main scale on the paper.

The students may have to do some independent research if they are not familiar with the animals and plants found in their time period or epoch. After step 6 the mural should resemble Figure D.

7. In the space remaining on the mural, fill in various events in time over the appropriate years. Depict on the mural events such as when the **rocks** and geologic formations of their area formed. Draw pictures with markers and/or crayons to illustrate the events. Use the "Events in Geologic History" fact sheet and library references as a guide.

8. After completing the time line mural, stress that when studying **geology**, it is often difficult to determine absolute ages. Therefore, geologists use geologic eras and periods when discussing the Earth's history rather than calendar dates. This mural illustrates the vast number of years our earth's history covers.

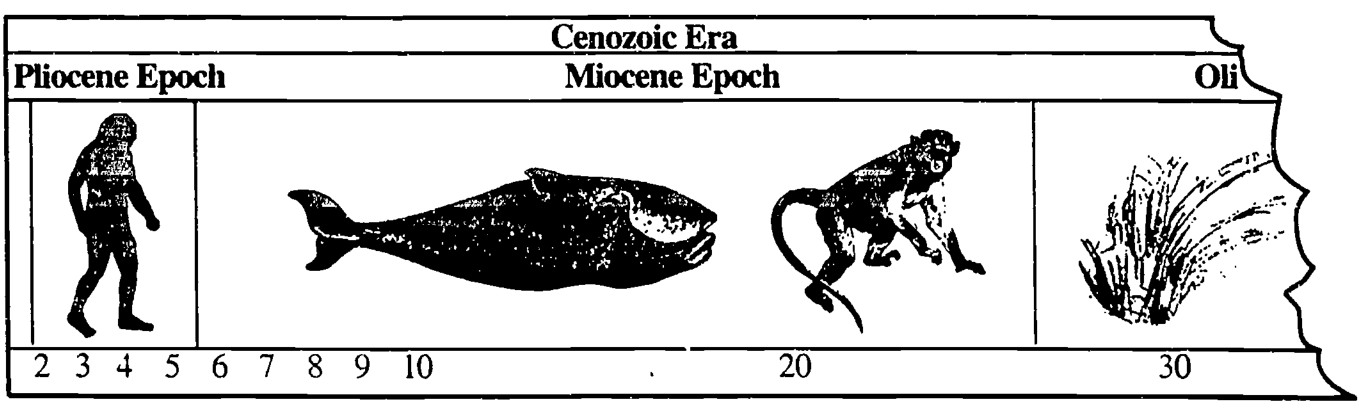
9. Compare the students' life historys (years of age) with the history and age of the Earth, and with the age of the rocks and geologic formations of their area. Be sure to note what era and time period we live in.

Extensions:

1. Using reference books, encyclopedias, field guides, etc., search for other earth history events not listed in the "Events In Geologic History" fact sheet and include them in the mural. Events such as the Ice Ages, formation of mountain ranges like the Appalachians, the coming of humans to the Americas, etc., might be used.

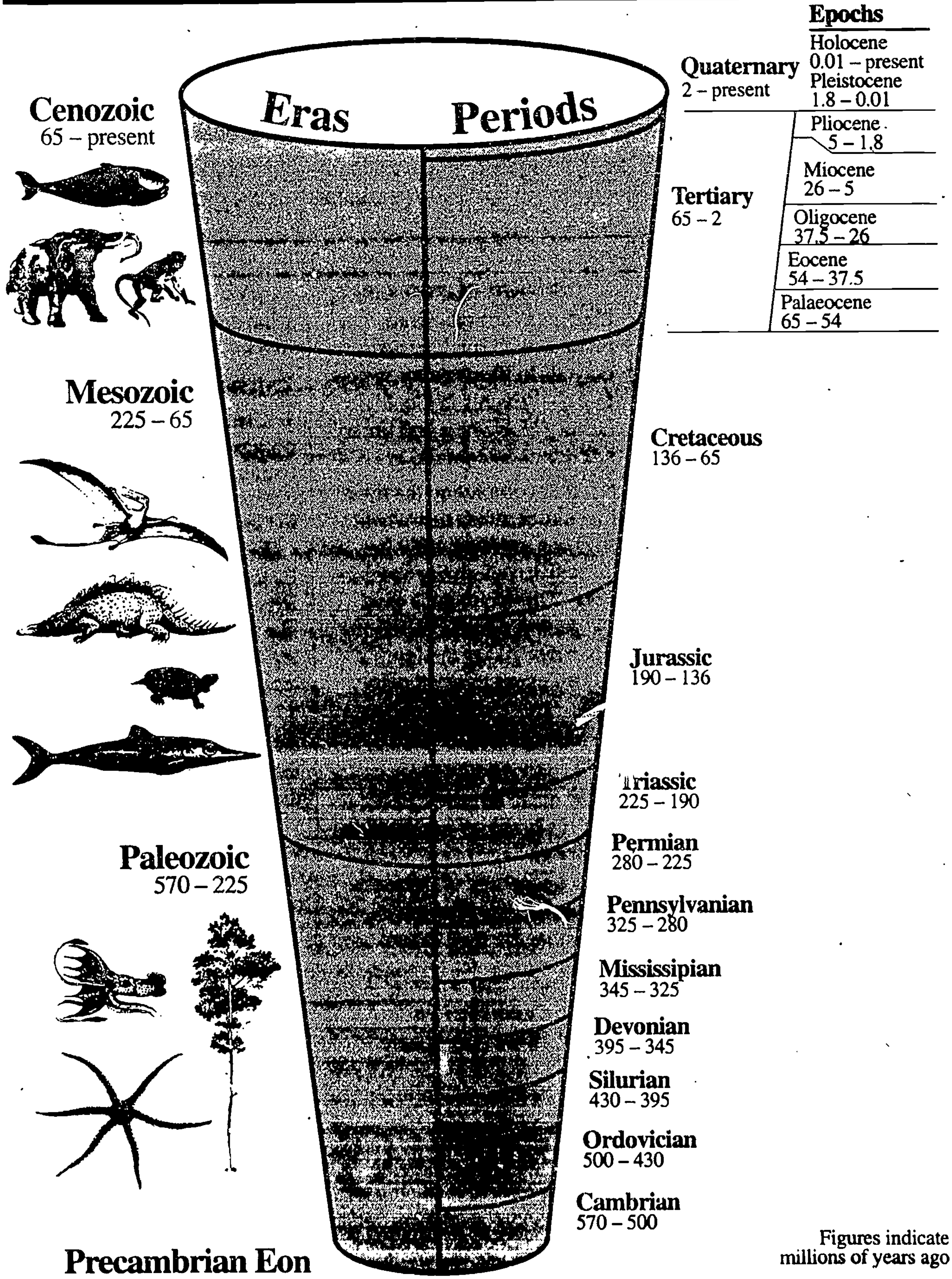
2. Each team could give an oral report to the class about their period or epoch, using their portion of the mural as a visual prop. (Just to give you some ideas, past teams have written poems, performed plays and rap songs on their period or epoch.)

Figure D



millions of years ago

Geologic Time Fact Sheet



Geologic Time Fact Sheet

Time is an extremely important concept in geology. Geologic time includes all the time that has occurred since the formation of the earth – an estimated 4.6 billion years ago. These 4.6 billion years have been broken down into different eons, eras, periods and epochs based on the life forms that were inhabiting the Earth at the time. All of time is divided into two eons: Precambrian and Phanerozoic. The Precambrian Eon lasted from the formation of the earth until the time when fossils became abundant in the rocks. The Phanerozoic Eon has been divided into three eras. Each of the eras is further subdivided into periods. Each of the periods is further subdivided into epochs. Each of the units of geologic time is characterized by different environmental conditions and specific kinds of life that flourished. Often, the boundaries between the geologic time periods was marked by mass extinctions. Scientists are using records that are preserved in rocks to put together a history of our planet.

Precambrian Eon

4.6 billion years ago to 570 million years ago

This is the longest division of Earth's history, representing about 87% of the 4.6 billion years that the Earth has existed. The rocks laid down during the Precambrian Eon form the cores of today's continents. The very first, extremely simple forms of life started to evolve about 3.4 billion years ago. Life on Earth began as simple, one-celled organisms, like blue-green algae. This algae used carbon dioxide and sunlight as energy sources. However, its waste product, oxygen, enabled the evolution of more complex life. Sponges, soft corals, jellyfish and annelid worms also evolved during the Precambrian Eon.

Phanerozoic Eon

570 million years ago to the present

Paleozoic Era

"Age of Ancient Life"

570 million to 225 million years ago

Cambrian Period

570 to 500 million years ago

This period marks the first appearance of fossil shells. The most common shelled animal of this time was the trilobite. Trilobites were probably scavengers on the floor of the ocean. All life lived in the ocean during this period, because the Earth's atmosphere had not yet developed to protect the land from the ultraviolet radiation of the sun. Along with the trilobites, there were sponges, brachiopods and gastropods (one-shelled mollusks like whelks). At the end of the Cambrian Period, there was a mass extinction of 75% of all the trilobite families, 50% of the sponge families and many of the brachiopods and gastropods. No one knows what caused this extinction.

Ordovician Period

500 to 430 million years ago

A few very primitive plants evolved to live on land during this period. However, most life forms were still evolving in the oceans. Bivalves, like clams and oysters, developed during the Ordovician Period, along with most of the other invertebrate (without a backbone) animals. Starfish, brittle stars, hard corals and crinoids were some of these invertebrates. Very primitive, jawless fishes also developed during this period. Fish are one kind of vertebrate, or animal with a backbone. There was a mass extinction at the end of this period. Many of the remaining trilobites and some of the sponges and early fish went extinct.

Silurian Period

430 to 395 million years ago

This period is marked by the development of extensive coral reefs. No new major forms of life developed during this period. All of the life that had already evolved continued to flourish with the exception of the trilobite which continued to become rarer. There may have been millipedes and scorpions beginning to live on the land.

Devonian Period

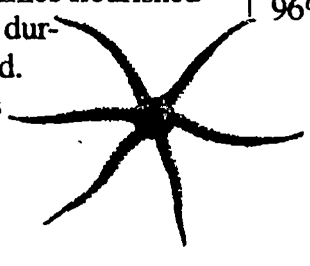
395 to 345 million years ago

This period is called the Age of Fishes because the early, primitive forms of fish really multiplied and diversified. Sharks, rays and bony fishes developed during this period. One was the giant, 30 foot long fish called the Dunkleosteus. It did not have any teeth, but the bones in its jaw were as sharp as knives. Other invertebrates began to live in fresh water during this period. The first amphibians, animals that live part of their life in water and part on land, evolved. The first forests, with giant horsetails and tree ferns, were formed during the Devonian Period. The first seed-bearing plants also evolved then. Mass extinction marked the end of this period. About 25% of all species went extinct.

Mississippian Period:

345 to 325 million years ago

During this period almost all of North America was covered by oceans. Crinoids, feather stars and sea lilies flourished in the oceans during this period. The trilobites continued to decline.



Pennsylvanian Period:

325 to 280 million years ago

The 45 million years of the Pennsylvanian period were a time of mountain building and the loss of many of the shallow seas. As a result, many of the marine species declined. However, the first insects and reptiles evolved. In fact, the largest insect that ever lived, a dragonfly with a wingspan of 29," lived during this time. Most of the land was covered with swampy forests. Conifers first developed during the Pennsylvanian Period.

Permian Period:

280 to 225 million years ago

During the 55 million years of the Permian Period, the marine invertebrates specialized into many different forms. The ginko tree first appeared. Reptiles and amphibians continued to develop. One of the most important groups of reptiles from this period was the pelycosaurs. They had tall, sail-like projections from their backs that were supported by spines out of their backbone. The pelycosaur probably used its sail to help heat and cool its body. The pelycosaurs were the ancient forerunners of mammals. The Permian Period ended with the most severe of all mass extinctions– 96% of all species were lost.

Mesozoic Era:

"Time of Middle Life"

225 to 65 million years ago

Triassic Period:

225 to 193 million years ago

At the beginning of the Triassic Period, there was very little marine life left after the mass extinction that ended the Permian Period. The first modern corals developed. The entire Mesozoic Era is known as the Age of Reptiles because the reptiles developed to dominate the air, land and sea. The first dinosaurs appeared near the end of the Triassic. These dinosaurs were the saurichians which walked on two feet and had stabbing teeth. Crocodiles also appeared in the end of the Triassic Period. Lizards, turtles and marine reptiles, like the plesiosaurs, also evolved in the Triassic. Finally, the first mammal, a small mouse-like animal that ate insects, evolved. The Triassic ended with a mass extinction in which 25% of all species went extinct.

Jurassic Period:

190 to 136 million years ago

Oysters, crabs, lobsters, sea urchins and shrimps developed in the oceans. The stegosaurus and the pterosaurs, flying reptiles, appeared during this time. The mammals were still quite small, but more diverse. The Jurassic Period marks the evolution of the first bird. Insects continued to become more diverse.

Cretaceous Period:

136 to 65 million years ago

The Cretaceous Period was one of the longest periods, lasting 70 million years. Much of the land was covered by shallow seas. Pterosaurs, the flying reptiles, became more specialized. Some of the Cretaceous Period dinosaurs include tyrannosaurs, ankylosaurs and the duck-billed dinosaurs. Flowering plants, bees and butterflies also evolved during this time. The end of the Cretaceous Period was also the end of the Mesozoic Era and was marked by a mass extinction, second only to the extinction that marked the end of the Permian Period. All of the dinosaurs went extinct, along with marine reptiles, pterosaurs, many corals, sponges and other marine invertebrates.

Cenozoic Era:

"Time of Recent Life"

65 million years to present

Tertiary Period:

65 to 2 million years ago

Paleocene Epoch:

65 to 54 million years ago

Much more dry land was exposed as the seas dried up during the Paleocene or "old recent life" epoch. The entire Tertiary Period is known as the Age of Mammals because of the development of many different kinds of mammals during the 63 million years of the period. Along with the development of hoofed mammals, rodents and squirrel-like primates on land, sharks were very abundant in the oceans.

Eocene Epoch:

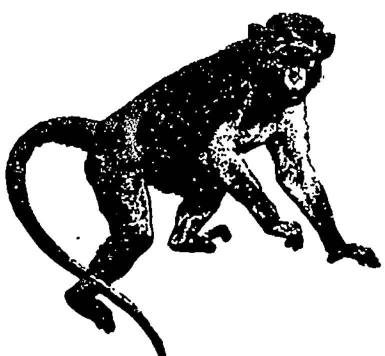
54 to 38 million years ago

Eocene means the dawn of recent life. Mammals continued to diversify giving rise to whales, sea cows, bats, early horses, tapirs and rhinoceroses.

Oligocene Epoch:

38 to 26 million years ago

Oligocene means "few recent (kinds of life)." Dogs, rats, camels, cats and pigs all multiplied during this time. Sloths, armadillos and guinea pigs also evolved.



Miocene Epoch:

26 to 5 million years ago

The "less recent" epoch lasted for 19 million years. Saber-toothed cats, elephants, apes, monkeys, giraffes and cattle are some of the mammals that evolved and multiplied during this epoch.

Pliocene Epoch:

5 to 2 million years ago

The vegetation of the Pliocene was much like today's. Australopithecines, the ancestors of humans, evolved during the Pliocene. The mammals that had evolved during the other epochs continued to multiply and spread throughout the earth.

Quaternary Period:

2 million years ago to the present

Pleistocene Epoch:

2 million to 10,000 years ago

There were at least four glacial advances during the Pleistocene Epoch, or Ice Ages. Most notably during this epoch, Homo sapiens, or humans, evolved–probably in Africa. During the Ice Ages, wooly mammoths, mastodons and wooly rhinoceroses were common. During the warmer periods, giant ground sloths, saber-toothed cats, lions, wolves, bison, camels, cattle and horses were common. Many of the large mammals went extinct at the end of this epoch. Some scientists think that it may have been due to hunting by the early humans, but no one knows for sure.

Holocene Epoch:

10,000 years ago to the present

The climate of the present epoch is much warmer than the climate of the Ice Ages. Humans are playing a greater role in causing extinctions, particularly in the rain forest regions of the world. Many scientists feel that another ice age will likely start within a few thousand years.

Events In Geologic History

Millions of Years Ago

4000 +++ .... Planet formed.
4000 .... By now, the earth has relatively stable crust with oceans and primitive atmosphere.
3800 .... Age of some of the oldest rocks on the earth's surface today.
3400 .... Primitive single cell life appears.
1700 .... Sediment is deposited in area that becomes North Carolina.
850 .... Iapetus Sea develops in area that becomes North Carolina.
570 .... First animals with shells appear in oceans; Cambrian Period begins.
500 .... Ordovician Period begins.
460 .... Layers of rock under Iapetus Sea are folded and bent.
440 .... Land begins to rise above sea. Immediately erosion begins and still continues today.
430 .... Silurian Period begins.
408 .... Due to movement of the earth's crust, Iapetus Sea is destroyed.
400 .... Plants are thriving on land above the sea; first land animals appear.
395 .... Devonian Period begins; granite batholite forms what later will be Stone Mountain.
380 .... Insects are common.
345 .... Mississippian Period begins.
325 .... Pennsylvanian Period begins.
300 .... Reptiles appear.
280 .... True dragonflies are present; Permian Period begins.
230 .... Final building of Appalachian Mountains.
225 .... Early dinosaurs; Triassic Period begins.
208 .... Age of Dinosaurs.
200 .... First mammals.
190 .... Jurassic Period begins.
136 .... Cretaceous Period begins.
78 .... Modern fish appear.
70 .... Dinosaurs become extinct; Rocky Mountains pushed up.
65 .... Paleocene Epoch begins.
60 .... Age of Mammals begins; first hoofed mammals and primates appear.
54 .... Eocene Epoch begins.
37.5 .... Oligocene Epoch begins.
26. .... Miocene Epoch begins.

5.	Pliocene Epoch begins.
1.8	Pleistocene Epoch begins.
1	Time of Ice Ages.
100,000 yrs ago	Neanderthal people walk the Earth.
40,000 yrs ago	Homo Sapiens (modern people) appear.
30,000 yrs ago	People first cross over to North America.
20,000 yrs ago	Physical evolution of humans as we know them today is complete.
15,000 yrs ago	Ice sheets still cover most of North America.
11,000 yrs ago	The last glacial advance retreats; recent epoch begins.
10,000 yrs ago	Groups of people in North America begin to settle down in villages.
0	Present time.

VOCABULARY

Batholith - A large plutonic mass, at least partially igneous, that has more than 40 square miles (100 square kilometers) of surface exposure and no known floor.

Chemical weathering - The erosion or wearing down of a rock and its minerals by chemical reactions which change the identities of the minerals.

Compaction - The process or state of being pressed together; compacted.

Continental plates - Granitic (granite) plates on which the continents ride. When these plates collide, they push up mountains and create metamorphic rock because of the pressure of the collision.

Crystal - A solid mass of mineral, having a crystalline structure: a regular geometric shape bounded by smooth, flat surface (crystal faces).

Decay - To decompose; rot.

Deposition - Process by which materials, carried by the agents of erosion, are dropped elsewhere.

Earth's crust - A rigid shell only about 30 miles thick, less than one hundredth of the distance to the Earth's center. Eight elements account for almost 99% of the Earth's crust: oxygen (46.7%), silicone (27.7%), aluminum (8.1%), iron (5.1%), calcium (3.7%), sodium (2.8%), potassium (2.6%) and magnesium (2.1%).

Erosion - The group of natural processes including weathering, dissolution, abrasion, corrosion and transportation, by which soil or rock material is removed from any part of the Earth's surface to another.

Exfoliation - An erosional process in rocks where parts of the rock flake or come off in layers.

Extrusive igneous rocks - Rocks formed on the Earth's surface by the cooling of molten magma material originating within the Earth's crust. Once magma reaches the surface it is called lava.

Fault - A fracture in the Earth's crust along which rocks on one side have been displaced relative to rocks on the other side.

Flail - A manual threshing device consisting of a long, wooden handle or staff and a shorter, free-swinging stick attached to one end. It was used to strike or beat grain to separate the grain from the rest of the plant.

Folding - To bend over or double up so that one part lies on another part.

Fossils - The remains or indications of an organism that lived in the geologic past.

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

Geologic process - The breaking down and building up of rocks, such as weathering, erosion, sedimentation and volcanic action; the phenomena of how the earth is shaped.

Granite - An intrusive igneous rock with very course grains composed of quartz, feldspar and dark minerals such as mica.

Igneous rocks - Rocks formed by the cooling of molten magma.

Intrusive igneous rocks - Molten igneous rocks that force their way into the surrounding rock and solidify below the Earth's surface.

Lava - Molten rock (magma) that is forced out of a volcano or out of cracks in the Earth's crust and onto its surface.

Leaching - Process by which water dissolves and carries away minerals.

Limestone - A sedimentary rock that consists mainly of calcium carbonate.

Magma - Molten rock deep within the Earth from which igneous rock is formed.

Mantle - In geology, the layer of the Earth between the crust and the core.

Mechanical weathering - The erosion or breakdown of rock into particles without changing the identities of the minerals in the rocks; ice is the most important agent.

Metamorphic rocks - Rocks that have changed both physically and chemically due to increases in pressure and temperature, and chemically active solutions.

Metamorphosis - A transformation, a marked change in appearance or condition.

Mica - A mineral family easily recognized by its dark colors and its capacity to be split easily into characteristic thin, pearly sheets.

Mica schist - A layered metamorphic rock generally containing noticeable mica minerals. It appears shiny.

Mineral - A solid, naturally occurring blend of elements having a fairly uniform chemical composition and a constant set of physical properties, including a crystalline shape.

Organic - Of, pertaining to, or derived from living organisms.

Outcrop - An area of exposed rock. Examples are road cuts, stream beds, quarries and naturally occurring rocky areas.

Plutonic rock - Coarse-textured rocks formed deep within the earth with igneous or metamorphic origins.

Quartz - A hard crystalline mineral made of silicon dioxide, SiO_2.

Resistant - Rocks or minerals that weather and erode more slowly than other rocks or minerals in the same area.

Rock - A naturally occurring consistent mass of one or more minerals; the three rock types are named according to their formation processes: sedimentary, metamorphic and igneous.

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

Sandstone - A sedimentary rock consisting of quartz and sand cemented together.

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

Sediment - Material that settles to the bottom of a liquid, such as soil being washed into a lake and settling to the bottom.

Sedimentary rock - Bits and pieces of other kinds of rock that have been cemented together under pressure and deposited in layers near the earth's surface; sometimes containing the remains of once-living things (fossils).

Shale - A fine-grained sedimentary rock composed largely of clay, mud or silt and characterized by its tendency to split easily along parallel planes.

Vent - An exit hole for hot gases and lava to flow from a volcano.

Volcanic eruption - A generally violent bursting forth of lava, volcanic ash and gases from a volcano's vent.

Volcano - A cone-shaped hill or mountain consisting chiefly of volcanic materials built up around a vent or hole in the earth's crust from which eruptions occur.

Weathering - The chemical alteration and mechanical breakdown of rock materials during exposure to air, moisture, and organic matter.

Xenolith - Literally, a "stranger" rock, which was surrounded during the movement of magma to form an unrelated inclusion within the surrounding igneous rock.

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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: Stone Mountain State Park   Fax: (910) 957-8185
Star Route 1, Box 17
Roaring Gap, NC 28668

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PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at **Stone Mountain State Park**. 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.

Stone Mountain State Park
Star Route 1, Box 17
Roaring Gap, NC 28668