This activity guide, developed to provide hands-on environmental education activities geared to South Mountains State Park in North Carolina, is targeted for grades 4 and 5 and meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included: pre-visit, on-site, and post-visit. The on-site activity is conducted at the park, while pre- and post-visit activities are designed for the classroom. Major concepts included are: water quality; biotic index; indicator species; metamorphosis; native aquatic species; stewardship of natural resources; watersheds; and natural resource management. Includes a vocabulary list, scheduling worksheet, parental permission form, North Carolina Parks and Recreation program evaluation, and information about South Mountains State Park. (MKR)
An Environmental Education Learning Experience
Designed for Grades 4-5
W I L D

WONDERFUL

W A T E R

South Mountains State Park
An Environmental Education Learning Experience
Designed for Grades 4-5
"The greatest miracle on this planet is water."

- Loren Eiseley
Funding for this publication was generously provided by

CP&L
This Environmental Education Learning Experience
was developed by

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Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen’s axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park. That was in 1915. The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.

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

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

For more information contact:

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

March 1994
Introduction to South Mountains State Park

South Mountains State Park, located in southern Burke County, is nestled in the beautiful 100,000 acre South Mountains range. Isolated from the more prominent Blue Ridge range to the northwest, the South Mountains range rises from the piedmont plateau to an altitude of 2,980 feet at Buzzard’s Roost, the tallest peak in the range. The park itself is characterized by relatively steep terrain with narrow ridge tops and valleys. Slopes frequently exceed 60° with very little flat ground. Elevations in the park range from 2,894 feet on Benn’s Knob to less than 1,250 feet along the Jacob’s Fork River. In terrain and biology, the park serves as a perfect example of the piedmont-mountain transition. As such, the park contains plant and animal species of both the piedmont and mountain regions, making it a real natural history treasure.

The South Mountains are located in the Catawha River watershed. The Catawha River Valley and the gaps across the mountain range to the west were major avenues of travel for Native Americans and early European settlers. The South Mountains served as a buffer zone between the Cherokee and the Catawba Indians. The first permanent settlements in the area were along the fertile river bottomlands. In 1828, gold was discovered at Brindle Creek in the South Mountains. According to legend, gold grains and flakes were first discovered in the mud used to seal a log cabin. The ensuing gold rush attracted immigrants, mining companies and slave owners to the area. Gold was mined into the twentieth century when the productivity of the mines declined.

Development of land, in what is now the park, began in the 1930’s, when Camp Dryer, a Civilian Conservation Corps (CCC) camp, was established at Enola. The youths employed at the camp constructed forest service roads, cleaned stream beds and built a forest observation tower on Horse Ridge. Although the tower no longer exists, the Lower CCC Road and Upper CCC Road are still in use at the park today.

South Mountains State Park was established in December of 1974, as a result of recommendations made by a National Park Service study conducted in coordination with the state.
The Park as an Outdoor Classroom

South Mountains State Park abounds with natural history and is an excellent place to teach ecology, environmental issues, biology, geology, conservation, earth science, literature, math, geology and recreation. The park is rich with cultural resources as well, and provides a wonderful outdoor classroom for learning about the history of Native Americans, European migrants, and many other historical themes. The park's major theme is water quality, which is one of the concepts of this Environmental Education Learning Experience (EELIE). This activity packet is hands-on and curriculum-based, and offers an opportunity for students to study and learn about this and many other subjects.

The park has numerous facilities available for visitors. Restrooms: Restrooms with running water and acess for persons with physical disabilities are available at the Jacob's Fork Picnic Area.

Picnic Areas: The Jacob's Fork Picnic Area is located adjacent to the main parking area. This area contains twelve tables and nine grills and is accessible to persons with disabilities. The Shinny Creek Picnic area is located 0.4 mile from the main parking area. Four tables, three grills and a pit toilet are provided here.

Backpack Camping: Camping is available to the backpaker in any of four areas: above the High Shoals Falls (sites 1 - 4), near the third bridge crossing on Shinny Creek (sites 5 - 8), on Fox Trail (sites 9 - 11), and on Sawtooth Trail (sites 12 - 14).

Family Camping: A primitive campground with 11 sites lies adjacent to the horse trailer parking area 0.5 mile east of the park office. Each site offers a picnic table and rock fire circle, with two pit toilets available for the entire campground.

Scheduling a Trip

1. Please contact the park one month in advance to schedule an Environmental Education Learning Experience. For other types of programs, including special requests, please contact the park at least two weeks in advance.

2. Complete the scheduling worksheet, located at the back of this activity packet on page 8.1, and return it to the park as soon as possible.

Before the Trip

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

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

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

4. Inform the group about poison ivy, ticks and snakes. You may want to bring insect repellent in the spring and summer.

5. Make sure the students and adult leaders dress appropriately for the season. Comfortable walking shoes and clothes that can get dirty are recommended.

6. The group leader is responsible for parental permission forms, located at the back of this packet on page 8.2, and the group's medical and health needs.

7. If you will be late or need to cancel your trip, notify the park immediately.
8. Research activity permits may be required for activities in which samples are to be taken from the park. Contact the park if research activity permits are needed.

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

While at the Park

Please obey the following rules:

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. Exercise special care in areas with loose gravel, water bars, exposed roots or steps. Running or jumping is not permitted. Please stay on the trails!

3. All plants and animals are protected within the park. Injuring or removing plants or animals is prohibited in all state parks. Removal of rocks is also prohibited. This allows others in the future to be able to enjoy our natural resources.

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

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

Following the Trip

1. We encourage you to 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 in the back of the packet, on page 8, and send it to the park.

Park Information

South Mountains State Park
Route 1, Box 206-C
Connelly Springs, NC 28612
Tel: (704) 433-4772

Hours of Operation

Nov - Feb
Mar, Oct
Apr, May, Sep
Jun - Aug

8:00 a.m. - 6:00 p.m.
8:00 a.m. - 7:00 p.m.
8:00 a.m. - 8:00 p.m.
8:00 a.m. - 9:00 p.m.
The Environmental Education Learning Experience “Wild, Wonderful Water” was developed to provide environmental education through a series of hands-on activities geared to South Mountains State Park. This activity packet, designed to be implemented in the 4th and 5th grades, meets established curriculum objectives of the North Carolina Department of Public Instruction. It includes three types of activities:

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. The Environmental Education Learning Experience, “Wild, Wonderful Water,” will acquaint students with the following major concepts:

- Water quality
- Biotic index
- Indicator species
- Metamorphosis
- Native aquatic species
- Stewardship of natural resources
- Watersheds
- Natural resource management

The first occurrence of a vocabulary word used in each of these activities is indicated in bold type. Definitions are listed 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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NOTE: On-site activities, weather and river conditions permitting, will be held on the banks of the river and in the river. Students will wade in shallow rocky areas. They should dress appropriately (long pants and tennis shoes) and bring a change of clothing. The students may encounter ticks, poison ivy and snakes, though this is not likely as long as students stay in appropriate areas. Chemical reagents are used in water quality testing. Because misuse of these chemicals can be hazardous, standard chemical protection procedures will be required. Goggles and rubber gloves will be provided for all students handling testing kits. These must be worn at all times during test procedures.

The educator will assist in seeing that all safety precautions are followed. It is also the responsibility of the educator to be aware of special considerations, medical needs, etc. of participants and be prepared to take appropriate precautionary measures. Park staff should be informed of any special considerations prior to the group’s arrival at the park.
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 Keys to Knowing (page 3.1.1)

Introduce your students to the use of dichotomous identification keys through a series of fun activities. In Part 1, students will use a simple key to identify unknown tree leaves. In Part 2, the students will use a more complex key to identify macroinvertebrates found in the Jacob’s Fork River.

Major Concepts:
Part I
- Dichotomous key
- How to use a key
- Importance of keys for identification
Part II
- Basic taxonomy

Objectives:
Part I
- Define dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.
Part II
- Define taxonomy.
- List the five kingdoms.
- Key out at least one macroinvertebrate using a simple key.
II. On-Site Activity

#1 What's in the Water? (page 4.1.1)
Get wet, have fun, and learn while doing it. Students will use different methods to collect and identify aquatic organisms.

Major Concepts:
- Aquatic habitats
- Aquatic sampling
- Diversity of stream life
- Human influence on water quality
- Indicator species
- Water quality

Objectives:
- Key out and identify three macroinvertebrates.
- Describe three characteristics of an aquatic macroinvertebrate.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Calculate the biotic index.
- Determine the water quality of the Jacob’s Fork River.
- List three or more ways humans affect aquatic life.

III. Post-Visit Activity

#1 Caddisfly Creek (page 5.1.1)
Using a map of the Caddisfly Creek and land use cutouts, students will make decisions about the development of a portion of the river area and the resulting effects of this development on water quality and aquatic life.

Major Concepts:
- Human impact on watersheds
- Water quality
- Land use planning and its effect on a river
- Preservation of natural areas
- Resource management

Objectives:
- Evaluate the effects of different imaginary land uses on Caddisfly Creek.
- Discuss and evaluate the effects of three different land use methods on the river.
- List three ways people can change their lifestyles to decrease damaging effects on water quality and on the river.
- List three ways local businesses, industries and communities could change the way they “do business” to decrease damaging effects on water quality and on the river.
- Assess the importance of state parks in protecting the quality of our waters.
Pre-Visit Activity #1 The Keys to Knowing

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency for interacting with others
- Science: living things—animals, adaptation to environment, interdependence of animals
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension, study skills
- Science: earth science, environment
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Location: Classroom

Group Size: 30 students, class size

Estimated Time:
Part A: 20 - 30 minutes
Part B: 30 - 50 minutes

Appropriate Season: Any

Materials:
Provided by the educator:
Per student: "Key it Out" worksheet, "Key to 10 Common Leaves," pencil
Per group: "Key to Aquatic Macroinvertebrates of the Jacob's Fork River," "Aquatic Life Illustrations," ruler

Educator's Information:
The purpose of this two-part activity is to introduce the use of a simple dichotomous identification key. Students will learn what a dichotomous key is, why keys are useful and how to use an identification key.

Part I will give students an introduction to the use of a simple leaf identification key. In Part 2, the students will key out several macroinvertebrates using the same key they will use in the on-site activity entitled "What's in the Water?"

Major Concepts:
Part I
- Dichotomous key
- How to use a key
- Importance of keys for identification

Part II
- Basic taxonomy

Objectives:
Part I
- Define dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.

Part II
- Define taxonomy.
- List the five kingdoms.
- Key out at least one macroinvertebrate using a simple key.

March 1994
Instructions for Part I:

Have the students read the Student's Information. Discuss taxonomy and how organisms are divided into naturally related groups. Define a key and explain how keys work. Discuss why keys are useful. Hand out copies of the "Key to 10 Common Leaves" to each student. Have students work independently through this tree key to identify each of the 10 leaves. As a class, go over the answers and discuss any difficulties encountered.

Instructions for Part II:

Divide the class into groups of four or five. Give each group a copy of "Aquatic Life Illustrations" and a copy of "Key To Common Macroinvertebrates of the Jacob's Fork River." As a class, work through the key to identify animal #1, then have the students work within their groups to identify the rest of the macroinvertebrates. When the groups are finished, have each group share how they identified one of the macroinvertebrates. Discuss the difficulties encountered and reinforce the importance of keys.

Suggested Extensions:

1. Divide the class into six groups and give each group a picture of a macroinvertebrate. Instruct each group to identify their organism. Have each group share with the class how they identified it. Rotate pictures until each group has identified all six organisms.
2. Have the students create macroinvertebrate "flash cards" to learn identification.
Taxonomy is the branch of biology that deals with the classification of organisms into established categories. The word, taxonomy, comes from the Greek words meaning arrangement and law. Through taxonomy, organisms are arranged into related groups based on similarities in morphology, anatomy, physiology, genetics, ecology and distribution.

All organisms are divided into large groups known as kingdoms. There are five major kingdoms: 1) Animalia (mammals, insects, birds, reptiles, etc.); 2) Plantae (plants); 3) Fungi (mushrooms, molds, yeasts, etc.); 4) Protista (some algae and protozoans); and 5) Monera (bacteria and blue-green algae).

These kingdoms are further divided several times into more closely related groups down to a specific organism. For example, let's trace the taxonomic classifications of a dragonfly. Dragonflies belong to the kingdom Animalia. From here they are divided into the phylum Arthropoda which contains all insects and their relatives. Next, they are placed in the class entitled Insecta. In North America alone there are 88,600 species of insects. The class Insecta is further divided into groups called orders. In North America there are 27 orders, each order containing closely related insects. Dragonflies are in the order Odonata. They are further divided up into families, then genus and finally species. Worldwide, there are about 4,500 species of dragonflies, while in North Carolina there are only 186 species. To know what species we have in North Carolina, we would use an identification key.

Keys:

A key is an essential tool used by people studying the science of taxonomy. It is defined as "an ordered list of significant characteristics of a group of organisms used to identify unknown organisms." Simply put, a key is a list of characteristics that describe an organism. Keys are used by scientists and students to identify unknown organisms. Keys often use a combination of pictures and written descriptions to aid in identification. Once you know the name of an organism, then you can look up information about it.

Dichotomous Keys:

Most keys are dichotomous, which means dividing or branching into two parts. A dichotomous key, therefore, is a key that divides the characteristics describing an organism into two choices. At each level of the key, you pick the choice that best describes the organism you are trying to identify.

How a Key Works:

Here's how a dichotomous key works. A list of characteristics arranged as a series of either/or statements is used for identifying plants and animals. For each pair of statements, choose the one that best describes the item you're identifying. For example, if you were handed a leaf (from a pine tree) to identify, you would start at the top of the tree identification key with these two choices:

1. Leaves not long or needle-like
2. Leaves long and needle-like

Of course, a pine leaf (or needle) is long and needle-like so you would choose option #2 and continue to the next choice under that side of the dichotomous key.
10 Common Leaves

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 

South Mountains State Park, NC

March 1994
Key To Aquatic Macroinvertebrates of the Jacob's Fork River

**Macroinvertebrates**

With shells

- Double shell
  - Shell nearly uniform in shape (rounded)
  - Freshwater clam (M)
- Single shell
  - Shell longer than wide
  - Freshwater mussel (I)
  - Spiral shell
  - Pouch snail (I)
  - Coiled shell
  - Ramshorn snail (I)

Without shells

- Obvious legs
  - Three pairs of legs
    - Two pairs of wings extending over abdomen
      - Beetle-like appearance
        - Hind legs short
          - Whirligig beetle adult (M)
        - Hind legs long
          - Swims on back two long oar-like legs
            - Backswimmer adult (M)
          - Crawls on rocks, black body
            - Rifflle beetle adult (M)
  - No wings
    - Two pairs of wings extending over abdomen
      - Thin body with wide spread legs
        - Active on water surface
        - Water strider adult (M)
        - Water scorpion adult (M)
      - Body with hardened exoskeleton, flattened
        - Active under water surface
        - Water penny
        - Riffle beetle larva (I)
        - Stonefly nymph (I)
      - Entire body soft/cylindrical
        - Body white to greenish with or without a portable case
          - Caddisfly larva (I)
          - Mayfly nymph (I)
      - Body dark, head with prominent pinchers
        - No tail-like appendages small round
          - Tail-like appendages
            - Dobsonfly larva (I)
            - Fish fly (I)
        - Long conspicuous tail appendages
          - Tail appendages bristle-like
            - Stonyfly nymph (I)
          - Tail appendages broad & oar-like
            - Dragonfly nymph (M)
          - Short inconspicuous tail appendages
            - Tail appendages
  - More than three pairs of legs
    - More than three pairs of legs
      - Distinct head, enlarged abdomen
        - Black fly larva (T)
        - Leech (T)
      - No distinct head, body tapered at both ends
        - Crane fly larva (M)
      - Body with suction disks at both ends
        - Water scorpion adult (M)
      - Body without suction disks
        - Water penny
        - Riffle beetle larva (I)
        - Stonefly nymph (I)
  - No obvious legs

**Legend**

Pollution Tolerance

- (I) - Intolerant
- (M) - Moderate
- (T) - Tolerant

Index Value

- Group I
- Group II
- Group III
1. Willow oak
2. Sassafras
3. Sweet gum
4. Shortleaf pine
5. Tulip poplar
6. River birch
7. American holly
8. White oak
9. Red maple
10. Loblolly pine
1. Crayfish
2. Water strider
3. Crane fly larva
4. Water penny
5. Caddisfly larva
6. Mayfly nymph
On-Site Activity #1

What's in the Water?

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources, writing
- Guidance: group interaction
- Healthful Living: recreational safety
- Science: living things—animals, adaptation to environment, interdependence of animals
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension
- Guidance: group interaction
- Healthful Living: recreational safety
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Location:
Jacob's Fork River. Hemlock Nature Trail Access

Group Size:
30 or fewer, in groups of 5 or less

Estimated Time:
1-1 1/2 hours

Appropriate Season:
April to October

Credits:
Adapted from "A Field Manual for Water Quality Monitoring, an Environmental Education Program for Schools" by Mark K. Mitchell and William B. Stapp, and Aquatic Project WILD activity, "Water Canaries."

Materials:
Provided by park:
Per student: life jacket, pencil
Per group: kick net, wide mouth plastic jars, aquariums, plastic tubes, dissecting scope, magnifying glass, tweezers, clipboards, field guides to aquatic life, laminated fish keys, laminated invertebrate key, aquarium nets, plastic spoons, examples of adult macroinvertebrates, rubber gloves
Per class: remarkable board, tables, extra activity sheets
Provided by the educator:
Per student: "Key to Common Macroinvertebrates of Jacob's Fork River," "Aquatic Sampling" worksheet, "Pollution Tolerance of Macroinvertebrates" key
Provided by each student:
complete change of clothes (wear clothes and shoes that can get wet and/or dirty)

Note: A restroom is located near the activity site where the students can change clothes.

Major Concepts:
- Aquatic habitats
- Aquatic sampling
- Diversity of stream life
- Human influence on water quality
- Indicator species
- Water quality

Objectives:
- Key out and identify three macroinvertebrates.
- Describe three characteristics of an aquatic macroinvertebrate.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Calculate the biotic index.
- Determine the water quality of Jacob's Fork River.
- List three or more ways humans affect aquatic life.

Special Considerations:
Carry a rescue throw rope. Students should wear gloves when sorting samples. Handle organisms carefully so that they can be returned without injury to the water after the activity. Before activity, advise the students of appropriate dress (i.e. old shoes without holes, old jeans, etc.).
Educator's Information:

To prepare your students for their visit, we recommend they read the Student's Information and complete the Pre-Visit Activity, “The Keys to Knowing.” Discuss these topics as a class prior to your visit.

In the early days of coal mining, canaries were taken into mines. Canaries are more sensitive than humans to the presence of dangerous gases in the air, therefore their discomfort or death indicated the air was unsafe for the miners to breathe. Although this practice no longer exists, it stands as an example of how animals have differing sensitivities to environmental factors than humans.

In aquatic and terrestrial environments, certain organisms, called indicator species, reveal much about the quality of the environment. These creatures comprise a biotic index. Their absence or presence tells us something about the environment’s quality.

Water habitats with a rich and varied range of aquatic creatures are usually “healthy” environments, whereas water with just a few species usually indicates conditions that are less “healthy.” Healthy is a term used here to indicate an environment that supports a wide variety of living things. Pollution reduces the quality of the environment and, in turn, the diversity of life forms. In some cases the actual biomass, or amount of living material, will increase due to pollution, but the diversity inevitably goes down.

The major purpose of this activity is to introduce students to macroinvertebrates and aquatic organisms and how these can be used as indicator species to determine the health of a river. We expect the students will find the biotic index for the Jacob’s Fork River is very high, due to the quality of the water.

The students will be involved in collecting macroinvertebrates from the river and must be dressed appropriately. Life jackets must be worn at all times. A first aid kit will be available. The park staff will rope off an area where the sampling will occur. They will discuss safety considerations and the group leader will assist in seeing that all safety precautions are followed. The students will work in groups of four or five, with one person in each group recording the data.

Have the students start by observing the water. Look for organisms on the surface and underwater. Using the sampling equipment (nets, trays, assorted containers, etc.), students should collect as many different forms of animal life as possible. Ask them to be alert to differing micro habitats located near rocks, in riffles and in eddies. Place the collected animals in the white trays, plastic jars or aquariums for viewing and keying out. The whiteness of the trays allows greater detail to be seen on the animals collected. Keep an adequate amount of water in the trays and place them in a cool, shady spot. Change the water as often as necessary to keep the animals cool and alive.

Have the students use their aquatic macroinvertebrate identification key to identify the animals. Have them fill out their worksheets indicating the number of each species found and describing the actual locations where that animal was found, i.e. in pool areas, under rocks, the water’s surface, etc. Once these observations and the worksheets are completed, carefully return the animals to their natural habitat.

Note: These animals are protected by park rules and regulations. By exercising care, all the animals can be returned to their home without being harmed.

Encourage the students to discuss their observations. How many different aquatic animals were found? Introduce the concept of diversity of life, and particularly emphasize that a variety of different kinds of plants and animals is usually an indication of a healthy ecosystem.
“Water. Water everywhere
nor any drop to drink.” So
says the sailor in Samuel
Taylor Coleridge’s Rime of the
Ancient Mariner as his ship is
becalmed at sea. Fortunately,
in our area water is every-
where and there seems to be
plenty to drink. But that could
change as this area becomes
more developed and the water
is used by more people. Let’s
take a closer look at water and
discover what a fragile and
sensitive resource it is.

What is water?
The dictionary defines
water as a colorless, odorless
transparent liquid essential
for plant and animal life. It is
found on earth in rivers, lakes
and oceans, and falls from the
clouds as rain, snow and ice.
Water occupies more than 70
percent of the earth’s surface,
and it makes up approximately
60 percent of the human body.

You may have heard the say-
ing “Water is life.” Think
about that for a minute. Can
you think of any living organ-
ism that does not depend on
water?

David Quammen, in his
book, Natural Acts: A Sidelong
View of Science and Nature

says, “Without life, there
would still be water. Without
water no life.”

Recipe for a River:
Water comes in many
forms. To really appreciate it
you need to pick out one of its
many forms and get to know
it personally. For your visit to
South Mountains State Park,
you need to know more about
water in the form of a river.

What is a river?
A river is defined as a large,
natural stream of water empty-
ing into an ocean, lake or other
body of water and usually fed
along its course by converging
tributaries. The Jacob’s
Fork River is the largest river
in South Mountains State
Park. The river is the result
of springs, streams and creeks
joining together to produce a
larger volume of flow. These
smaller bodies of water are
called tributaries. The land
that a river and its tributaries
flow through is called a water-
shed. A healthy river must
have a well protected water-
shed because any kind of dis-
turbance to the watershed has
an effect on the river.

Life in a River:
The various forms of life
found in a river can be com-
pared to a fine stew or soup.
A fine stew or soup needs lots of
different ingredients. Usually
the more you add, the bet-
ter the stew. A stew also needs
small amounts of spices to
make it taste just right. If you
try to make a stew with just
one ingredient, or if you leave
out an important spice, your
stew is not going to be good.

Here then is a recipe for a
fine, healthy river.

Some sunlight - just
enough for algae, moss, di-
atoms and aquatic plants to
photosynthesize. (Too much
sun heats up the water and
robs it of dissolved oxygen.)

Dissolved oxygen and
carbon dioxide - all the
animals in the river need
dissolved oxygen to breathe.
These same animals breathe
out carbon dioxide which is
essential for algae and other
aquatic plants. These plants in
turn take in the carbon dioxide
and give off oxygen.

Fallen leaves - they provide
the main source of food energy
in a river system. In the fall,
leaves drift down from the
trees into the water where they
soon sink to the bottom or get
captured in logjams or wedged
between rocks. At this point,
bacteria and fungi climb
aboard the leaves and begin to
munch out, causing the leaves
to decompose and break down
into smaller pieces. The half-
eaten leaves, along with the
decomposers, are eventually
swept downstream. They
provide food for munchers,
grazers and filter feeders – the
wonderfully adapted macroin-
vertebrates (macros), such
as stonefly nymphs, mayfly

South Mountains State Park, NC
March 1994
nymphs, and caddisfly larvae. These organisms further break down the leaves into a very fine mulch called detritus.

In addition to the munchers, grazers and filter feeders, there are macros that prey on other macros. Lots of different kinds of macros are a sign of a healthy river.

**Various minerals** - the fine spices of a river include calcium bicarbonate, potassium, nitrates and phosphates. These ingredients help balance a river's pH, provide building material for the shells of snails, mussels, clams and crayfish, help fish breathe more efficiently and act as natural fertilizers essential for aquatic plants.

Aquatic plants and animals - aquatic plants provide cover for macros and small minnows. The aquatic plants and animals in the river, and those living along the river, provide food for each other in a complex food web. When all these various plants and animals die or excrete waste, they return essential nutrients that were borrowed so they could live back to the food web.

These are just the minimum ingredients needed for a healthy river. Now mind you, a river needs only natural ingredients, unnatural ingredients can have a bad effect on a river. David Quammen sums up what makes a healthy river when he talks about a trout stream. "A good trout stream must first be an excellent insect stream, a superior haven for algae and fungi and bacteria."

If there are large numbers of many different species of plants and animals in the water, then we have a healthy river. Taking samples of these aquatic plants and animals is a means to monitor the quality of a river's waters.

mention the occasional bear. And who knows but that, sometime, a human might want to drink."

**South Mountains State Park, NC**

**March 1994**
Instructions:

1. Park staff will lead a brief discussion focusing on: macroinvertebrates (macros), what they are and why they are important; **metamorphosis**, what it is and how it is accomplished; and **indicator species**, what they are and how they are used to determine the health of a river. Park staff will also demonstrate how to use sampling equipment, and safety precautions that must be followed when using the equipment.

2. Have the students predict the **biotic index** for the Jacob's Fork River on their worksheet.

3. Briefly review the macroinvertebrate key. Be sure to point out that the key is not complete and the students should therefore key organisms as close as possible. For example, there are 186 dragonfly species in North Carolina, and the key only shows one dragonfly larva species, but the illustration should be close enough for the students to identify any dragonfly larva they find.

4. a. Divide the class into groups of five or less and distribute their equipment.
   b. Instruct them on how to collect samples using kick nets.
   c. Fill the white trays, aquariums and plastic jars half way with water.
   d. Have the groups net their samples in the roped off area.
   e. As soon as the samples are collected, have the groups move to the shore.
   f. Drain the excess water from the nets.
   g. Have the students put on rubber gloves and search for organisms. (They may want to use a magnifying glass.)
   h. Using tweezers or hands, carefully remove any organisms found and place them in the white tray, aquarium or plastic jar for observation and identification.

5. After collecting samples, each group should identify the aquatic macroinvertebrates they found using the “**Key to Common Macroinvertebrates**” field guides and dissecting scopes. Have them record their answers on the “**Aquatic Sampling Data Sheet**” and use their results to determine the Biotic Index Value (relative health) of the river.

The Biotic Index Value groups macros based upon how tolerant or sensitive they are to changes in water quality.

Group I macros are very intolerant of water pollution. The dominant presence of Group I species is an indication of good water quality. Group I is given an index value of 3. Group II macros are moderately tolerant to a reduction in water quality. They are given an index value of 2. Group III macros are tolerant to pollution. Their dominance indicates poor water quality. They are given an index value of 1.
The students can calculate the Biotic Index Value by using a simple formula:

\[
(3 \times \text{no. of Group I}) + (2 \times \text{no. of Group II}) + (1 \times \text{no. of Group III}) = \text{Biotic Index Value}
\]

6. Return all organisms to the water after the research is done.

7. After the students have identified their specimens and determined the Biotic Index Value, park staff will lead a group discussion summarizing what they’ve learned, what they’ve identified from the river and the importance of indicator species and the Biotic Index Value.

8. Instruct the groups to gather and clean their equipment and return it where they found it.

9. Assemble the class and have each group present their findings. According to their study, what is the rating of the Jacob’s Fork water quality? How does it compare to the students' initial prediction? If different, encourage students to explore reasons. Do different groups have different results? If so, explore reasons why. (Answers: improper collection/identification techniques, luck of the hunt, weather, water level, season, etc.)

Suggested Extensions:
1. Have the class compare their findings with other classes that have done this activity in the past by comparing worksheets. The worksheets can be different due to collection/identification techniques, luck of the hunt, weather, water level, season, etc.

2. Sample other streams and rivers in the area and compare the biotic index value with that of the Jacob's Fork River.

3. Take a hike to observe and experience High Shoals Falls.

South Mountains State Park, NC

March 1994
Aquatic Sampling Worksheet

Name: ___________________________ Date: ___________________
Location: ________________________
Methods used to sample: _______________ Biotic Index Value: _______________

A. Prediction of the river's Biotic Index: Excellent Good Fair Poor
Circle your choice. Why do you think the Jacob's Fork River will have this Biotic Index?

B. Instructions:

1. Use the "Key to Common Macroinvertebrates" or "Pollution Tolerance of Macroinvertebrates" key to identify organisms.

2. Record the species of organisms found in the space below, using the key to classify them by their tolerance levels. (See example below.)

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
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<td>4.</td>
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<tr>
<td>5.</td>
<td>5.</td>
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</tr>
<tr>
<td>6.</td>
<td>6.</td>
<td>6.</td>
</tr>
<tr>
<td>7.</td>
<td>7.</td>
<td>7.</td>
</tr>
</tbody>
</table>

Total = ______  Total = ______  Total = ______

3. Calculate the Biotic Index Value by multiplying the number of species of organisms in each group by the index value for that group. Then, add the resulting three numbers to obtain the Biotic Index Value (see example below).

\[
\text{Cumulative Biotic Index Values} = (3 \times \text{no. of species - Group I}) + (2 \times \text{no. of species - Group II}) + (1 \times \text{no. of species - Group III})
\]

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. hellgrammite</td>
<td>1. dragonfly</td>
<td>1. blackfly larva</td>
</tr>
<tr>
<td>2. mayfly</td>
<td>2. crayfish</td>
<td>2. freshwater worm</td>
</tr>
<tr>
<td>3. snail</td>
<td>3.</td>
<td>3.</td>
</tr>
</tbody>
</table>

\[
\text{Biotic Index Value} = (3 \times 4) + (2 \times 2) + (1 \times 2) = 18
\]

[18 is the biotic index value, which is a good rating according to the chart above.]


South Mountains State Park, NC 4.1.33 March 1994
4. How would you describe the river’s water quality based on its Biotic Index?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. What do you think has caused or contributed to the water quality?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Key To Aquatic Macroinvertebrates of the Jacob's Fork River

Macroinvertebrates

With shells

Double shell
- Shell nearly uniform in shape (rounded)
  - Freshwater clam (M)

Single shell
- Shell longer than wide
  - Freshwater mussel (I)
- Spiral shell
  - Pouch snail (I)
- Coiled shell
  - Ramshorn snail (I)

Without shells

Obvious legs
- Three pairs of legs
  - Two pairs of wings extending over abdomen
    - Beetle-like appearance
      - Hind legs short
        - Whirligig beetle adult (M)
      - Water strider adult (M)
    - Thin body with wide spread legs
      - Active on water surface
        - Backswimmer adult (M)
    - Body with hardened exoskeleton, flattened
      - Active under water surface
        - Riffle beetle larva (I)

More than three pairs of legs

Caterpillar-like
- Distinct head, enlarged abdomen
  - Body with suction disks between appendages
    - Black fly larva (T)
  - No distinct head, body tapered at both ends
    - Body with suction disks at both ends
    - Dragonfly nymph (M)

Worm-like
- Body dark, head with prominent pinchers
  - Body without suction disks
    - Water penny adult (M)
    - Stonefly nymph (I)
    - Mayfly nymph (I)
    - Damsel fly nymph (M)

Legend

Pollution Tolerance
(I) - Intolerant  Group I
(M) - Moderate  Group II
(T) - Tolerant  Group III

Index Value
Group I
Group II
Group III

March 1984
Pollution Tolerance of Macroinvertebrates key

Group I - Index Value = 3
These macroinvertebrates can not tolerate pollution or changes in water quality. Their presence or dominance generally indicates good water quality.

- Mayfly nymph
- Stonefly nymph
- Water penny (riffle beetle larva)
- Hellgrammite (dobsonfly larva)
- Riffle beetle adult
- Caddisfly larva
- Freshwater mussel
- Right-handed pouch snail

Group II - Index Value = 2
These macroinvertebrates can exist in a wide variety of water quality conditions.

- Dragonfly nymph
- Freshwater clam
- Whirligig beetle
- Damselfly nymph
- Scud
- Water strider
- Crayfish

Group III - Index Value = 1
These macroinvertebrates can exist in polluted water. Their dominance indicates poor water quality.

- Black fly larva
- Leech
- Freshwater worm
Post-Visit Activity #1

Caddisfly Creek

Curriculum Objectives:

Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: evaluate the importance of familiar jobs, competency for interacting with others
- Science: living things—animals, interdependence of animals
- Social Studies: gather, organize and analyze information, draw conclusions, use maps, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension, study skills
- Guidance: competency and skill for interacting with others
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions; use maps, participate effectively in groups

Location: Classroom

Group Size: One class

Estimated Time:
One to three 45 minute periods

Appropriate Season: Any

Credits:
This activity was adapted from the Aquatic Project WILD activity, "Dragonfly Pond."

Materials:
Provided by educator:
Per student: one copy of Student's Information, and "Special Species" fact sheet
Per group: scissors, masking tape, paste or glue, paper, one copy each of "Land Use" cutouts, "Caddisfly Creek" maps

Major Concepts:
- Human impact on watersheds
- Water quality
- Land use planning and its effect on a river
- Preservation of natural areas
- Resource management

Objectives:
- Evaluate the effects of different imaginary land uses on “Caddisfly Creek.”
- Discuss and evaluate the effects of three different land use methods on the river.
- List three ways people can change their lifestyles to decrease damaging effects on water quality and on the Jacob's Fork River.
- List three ways local businesses, industries and communities could change the way they “do business” to decrease damaging effects on water quality and on the river.
- Assess the importance of state parks in protecting the quality of our water.

Educator's Information:
The major purpose of this activity is to encourage the students to wrestle with potentially conflicting land use concerns in an effort to preserve a creek and its watershed. After the students reach an agreement about local land uses, they will consider how their decisions affect the aquatic resources downstream. End the activity with a discussion of the idea that the earth's aquatic resources are all interconnected, and all land use activities impact other things.
Every human use of land in the Jacob’s Fork River watershed has a positive or negative effect, not only on the Jacob’s Fork River, but also on the water, wildlife and people downstream to the Atlantic Ocean. What we do with land is a reflection of our priorities, lifestyles and conservation ethic. The search for a modern day “good life” and all of its efficiencies produces mixed results for plants, animals, water quality and people in the Jacob’s Fork River watershed. Some people see our natural resources as little more than raw material for human use. Others believe a natural environment should always be preserved without being damaged by humans and their lifestyles. Still others believe there should be a balance between development and protection of our resources. Very real differences of opinion on these issues exist between well meaning people.

Given the extensive impact humans have on the earth, a major challenge we now face is how to act more responsibly. We must develop the awareness, knowledge, skills and commitment necessary to encourage others to act more responsibly when it comes to stewardship of watersheds and the remaining natural areas. We must work to restore areas where human disturbance has existed for centuries. At the core of land use issues is the concept of growth. Growth in natural systems has inherent limitations, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space and continued survival. This means that the vitality of natural systems is expressed by their ability to be self-regulating. This capacity for self-regulation makes it possible for all natural members of an ecosystem to live in harmony. All life forms of any ecosystem must be considered. The macroinvertebrates in the water are just as necessary to a habitat as the plants and fish. It is this natural, dynamic balance, with all its inherent and essential parts, that much of human land use has tended to disturb. Human activities often go beyond the natural limits of an ecosystem.

The South Mountains area is growing rapidly. Homeowners and industry are spreading out from our cities, seeking undeveloped land to use. They help our local economy by creating new jobs. This development is good, but it sometimes conflicts with protecting the river’s water quality and the plants and animals that live in and around the river. This is where different people have different ideas about how to best use the land and water from Jacob’s Fork River and still ensure the river is clean.

Think back to your visit to South Mountains State Park. We know that Jacob’s Fork River provides water which is used in a variety of ways, including water for drinking, for industry and for sewage treatment for many towns and cities. Many different forms of recreation are enjoyed on and around the Jacob’s Fork River. The river is also home to a wide variety of plants and animals.

Humans have the ability to import energy sources that allow a system to exceed its natural limits - or to remove energy sources that are necessary for a system to stay in balance. For example, people can dam rivers to make lakes to provide power and irrigation. Water from Jacob’s Fork River can be used in factories, mills and other industries that need large amounts of water to produce certain products. All of these activities could affect life in the river.

So how do we make land use decisions that will benefit the local economy and still protect our natural resources? The following activity is designed to give you a taste for how difficult the decision making process can be.
Instructions:

1. Prepare copies of the “Special Species” Fact Sheet, the “Caddisfly Creek” map, the “Land Use” cutouts and the Student’s Information ahead of time. Explain the activity. Tell the students they will be responsible for arranging the pattern of land use along Caddisfly Creek in such a way as to minimize the impact on the river and protect this resource. Remind them that some of these land uses might be conflicting and therefore they will have to make some very tough management decisions. Pass out the Student’s Information and have the students read it.

2. Divide the class into groups of three to five, with each group representing one of the interest groups. Students will stay in these groups until the end of the activity. Interest groups are:
   A. Farmers want to clear and use land to produce food, livestock and lumber for profit.
   B. Highway department wants to build highways to provide access to the area for fire, police and emergency medical services.
   C. Permanent residents want development, but not so much that their homes are affected by noise, traffic, pollution, etc.
   D. Business interests want to use the land for commerce and development for profit (home builders, small business, etc.)
   E. Public services - want to build and operate a waste water treatment plant in the area.
   F. Division of State Parks wants to preserve and protect the watershed for plants and wildlife, recreation, drinking water, historical sites and as an “outdoor classroom” to teach visitors about nature and its importance.
   G. Adopt-a-State Park group wants to help preserve additional land for the area park

3. Pass out the “Special Species”, “Caddisfly Creek” and “Land Use” sheets. Have the students cut out the land use pieces and place them along the river’s watershed. Tell them all of the land use pieces must be used, and none may be placed within the state park. The pieces may be cut smaller, but must not overlap. The students may also create land uses of their own.

   Point out to the students that there are two species of plants and three species of animals on the map where they might naturally occur. Most of these species are either state protected or have special habitat requirements. The purpose of placing these on the map is to make the decisions more realistic. Information on these species is on the “Special Species” Fact Sheet.

4. Once the students have cut out the necessary materials and are ready to begin the process of making land use decisions, have them create a list of pros and cons for each land use. Guide the class discussion so that they consider the consequences of each land use. Record these on the chalkboard.

   The following are a few examples:

   **Natural Areas**
   **PRO**
   - Provide outdoor recreation opportunities such as hiking and nature study.
   - Provide protection of natural communities and habitats, the watershed and native species.
   - Bring tourist dollars into local economy as park visitors spend money at local businesses.
   **CON**
   - Remove land for possible development (i.e. agriculture, forestry, industry, etc.).
   - Remove land from the tax base.

   **Farms**
   **PRO**
   - Produce food.
   - Provide jobs.
   - Produce lumber and other wood products.
CON
- Increase soil erosion.
- Use chemicals (pesticides, herbicides, etc.) that may harm people and the environment.
- Use fertilizers and produce animal wastes which increase the nutrient load in the aquatic systems upsetting the balance of the ecosystem.
- Sometimes destroy stream buffers, wetlands or other natural areas for fields or to harvest lumber.

Homes
PRO
- Provide human shelter.
- Provide jobs in construction and maintenance.
CON
- Generate waste, sewage and other pollution (i.e. used oil, lawn chemicals, etc.).
- Contribute to loss of natural areas (i.e. development and energy needs).

Waste Water Treatment Plant
PRO
- Provides for more development.
- Provides treatment for waste water.
- Provides jobs in construction, maintenance and operation of the plant.
CON
- Discharges effluent containing chlorine and nutrients into the watershed.
- Contributes to loss of natural areas (i.e. construction, maintenance, and energy needs).
- Increases runoff from impervious surfaces (parking lots, roofs, etc.) resulting from increased development.

Restaurant
PRO
- Provides jobs.
CON
- Contributes to loss of natural areas (i.e. energy needs).

Highways
PRO
- Provide access to areas for emergency medical services.
- Provide jobs in construction and maintenance of roads.
CON
- Contribute to loss of natural areas (i.e. construction, maintenance and energy needs).
- Increase runoff due to impervious surfaces.
- During construction, increase soil erosion.

- Disrupt natural water flow and animal migration patterns.
- During maintenance of roadsides, contribute to the use of herbicides that may harm people and the environment.
- Can be hazardous for people and other animals (wildlife is attracted to the garbage thrown along the roadside).

Laundromat
PRO
- Provides jobs in construction and operation.
CON
- Contributes to loss of natural areas (i.e. energy needs).
- May introduce significant amounts of polluted water into watershed.
- Increases runoff due to impervious surfaces (parking lots, roofs, etc.).

Gas Station
PRO
- Provides jobs in construction, maintenance and operation.
CON
- Contributes to loss of natural areas (i.e. energy needs).
- Runoff may contain pollutants such as gas and oil.
- Increases runoff due to impervious surfaces (parking lots, roofs, etc.).
- Can contaminate groundwater if underground storage tanks are leaking.
5. Have the students work in their teams long enough to begin serious debate over the land use decisions before them. Remind them that no land use can be excluded, the river corridor must be preserved, and the special species must be protected. Everyone in the group must reach consensus for each land use. Offer an opposing viewpoint should they need it. Have them lightly fasten the cut-outs to the map by placing small loops of tape on the back of each cut-out. This will allow the students to change their minds before the cut-outs are permanently placed on the map.

6. Give the students time to come up with what they believe to be the best possible land use plan under the circumstances. (Be sensitive to their frustrations.) Display all the final land use plans in the classroom and analyze and discuss the merits of each of the approaches. Point out that although their solutions may not be perfect, each one, in some way, minimizes damage to the Caddisfly Creek's watershed. Be sure to remind the students that all of the pollutants dumped into the river's watershed eventually flow downstream.

7. Ask the students to brainstorm possible problems that could be faced within each of the aquatic systems of the Jacob's Fork River, Henry Fork River and Catawba River as a result of the human activities around the Jacob's Fork River. Make inferences and predictions about the potential consequences of these activities. For instance, you could emphasize the wastewater from a Laundromat. How will it be treated? Where? By whom? Where will it go? With what effects?

8. Ask the students to look again at all of the land uses in this activity. If they had been considering any of them as inherently bad, have them consider a different question. What could the people who are in charge of these various businesses do to minimize the damage to Caddisfly Creek? Have the activity end with a positive emphasis on solutions rather than problems and write these solutions on the board.

9. Have the students create a list of things that they personally can do to reduce the potentially damaging effects of their lifestyles on the "downstream" areas. If possible, invite them to report on their progress throughout the school year in carrying out these new practices. Consider with them the idea that all of the waters of the earth are interconnected and are in fact part of a single "Caddisfly Creek" watershed.

Suggested Extensions:

1. Organize a "Stream Watch" group in your community. Stream Watch groups "adopt" a waterway, or portion of one, and act on its behalf. They take care of the waterway by monitoring water quality, providing educational programs, removing litter, etc. For more information on Stream Watch, contact:

   Stream Watch Coordinator
   Division of Water Resources
   NC Department of Environment, Health and Natural Resources
   P.O. Box 27687
   Raleigh, NC 27611
   (919) 733-4064

2. Collect newspaper articles for local water related and land use issues as a current events activity.

3. Learn more about environmental impact statements. Try to obtain actual statements about natural areas in your region from local and state government offices. See what concerns are addressed in these documents.


4. Learn more about private organizations that work to protect natural resources. Examples include:
   - The North Carolina Environmental Defense Fund
     128 E. Hargett St., Suite #202
     Raleigh, NC 27601
   - The North Carolina Nature Conservancy
     Carr Mill Mall, Suite 223
     Carrboro, NC 27510
   - The Catawba Lands Conservancy
     1614 Fountain View
     Charlotte, NC 28203

5. Find out about zoning laws and land use regulations in your area by contacting the following:
   - City/County:
     Director of City/County Planning/Zoning
   - State:
     Division of Environmental Management
     PO Box 27687
     Raleigh, NC 27611
   - Would the plan your group proposed for the park river watershed be allowed in your community?

6. Send a representative sample of the students’ land use plans to the park. (We would appreciate the feedback.)

7. Write to the Burke County Planning and Zoning Board about any concerns you have with the water quality of the Jacob’s Fork, Henry and Catawba rivers’ watersheds.
   Planning and Zoning Board
   P.O. Box 219
   Morganton, NC 28655
   (704) 433-4035
Land use around the Jacob's Fork River is very important because it affects the kinds of plants and animals you see at South Mountains State Park. Listed below are some special species at the park which need certain conditions to thrive.

**Caddisfly**

These insects need a healthy aquatic environment to live in and are quite common in the park's pristine streams. They provide food for the trout and other aquatic macroinvertebrates that live there. The caddisfly larvae construct cases of twigs, leaves, sand, pebbles and other debris. The individual species are identified by the materials they use in their larval cases.

**Ginseng**

A medicinal plant that has been over-collected to sell in this country and overseas. Ginseng is now uncommon in the mountains where it was once plentiful. This plant has been used for centuries for its reputed medicinal powers.

**Copperhead**

One of only two poisonous snake species found in the park. Copperheads are nocturnal during the hot summer months. They crawl down from the woods to the grassy fields near creeks to hunt for small rodents in late summer. Copperheads are considered non-aggressive and only bite if provoked.

**Yellow Lady's Slipper Orchid**

An uncommon wildflower, requiring soils that are close to a neutral pH (most soils in our region are acidic) and a mature tree canopy to give it partial shade. It takes a minimum of 15 years for this orchid to grow from a seed to a flowering plant.

**Common Raven**

A rare native bird found in Western North Carolina. Nesting sites are uncommon due to a lack of remoteness and privacy which the ravens seem to require. For several consecutive years, they have successfully raised young on a cliff near High Shoals Falls, located in the park. Their call is a hoarse, croaking sound.
**Acid** - Having a pH less than 7; the chemical state of water or other substance in which the hydrogen (H+) ions exceed the hydroxyl (OH-) ions. For example, a car’s battery acid has a pH of 1. See pH.

**Adaptation** - A change in the structure or activity of an organism that produces a better adjustment to its environment, thus enhancing its ability to survive and reproduce. For example, the flattened, oval shape of the larva of the riffle beetle (called a water penny) is an adaptation that helps it cling to the surface of rocks in swift waters.

**Algae** - Simple, one-celled or many-celled plants, capable of photosynthesis. They are usually aquatic and have no true root, stem or leaf.

**Anatomy** - The branch of biology that deals with the structure of plants and animals.

**Aquatic** - Living or growing in water.

**Base** - Having a pH greater than 7; the chemical state of water or other substance in which the hydroxyl (OH-) ions exceed the hydrogen (H+) ions. For example, soap has a pH of 10. See pH.

**Biology** - The science that deals with the origin, history, physical characteristics, life processes and habits of plants and animals.

**Biotic index** - An indicator of the health of a habitat. It is based on the tolerance or sensitivity of plants and animals to changes in environmental quality and is calculated using a simple formula. The health of a stream is determined by the number of individual organisms plus the diversity of species found there.

**Classification** - The grouping of organisms into categories based on shared characteristics or traits. For example, any animal that has feathers is considered a bird and is placed in the Class Aves. Furthermore, if the bird had its eyes in front rather than on the side of its head, it is a member of the Order Strigiformes (the owls).

**Detritus** - Dead organic matter, such as fallen leaves, twigs, and other plant and animal material, which exists in any ecosystem.

**Dichotomous** - Divided into two parts, groups or classes, such as a dichotomous key. Using a dichotomous key, one can identify an unknown organism by following the one branch of each pair that best describes the organism.

**Distribution** - The act of scattering or spreading out; the geographic range of an organism.

**Dissolved oxygen** (DO) - The amount of oxygen gas molecules dissolved in water. Fish and other aquatic animals depend on DO for respiration.

**Diversity** - In the context of these activities, it refers to a variety of species of plants and animals.

**Ecology** - The science of the relationships between organisms and their environments.

**Ecosystem** - Plants, animals and their physical surroundings which interact with environmental conditions, such as temperature and rainfall, forming an interdependent system.

**Effluent** - A liquid flowing out. The outflow of a sewer, septic tank, etc.
**Erosion** - The process of soil and rock particles being moved from one location to another by natural processes such as water, wind, gravity, or other forces or processes.

**Food Chain** - The transfer of energy and material through a series of organisms as each one is fed upon by the next. For example: Detritus > caddisfly larvae > sunfish > otter.

**Food Web** - The interlocking pattern of food chains which exist in an ecosystem.

**Genus** - In biology, a taxonomic category ranking below a family and above a species, used in grouping similar living things, either alone or followed by a Latin adjective or epithet, to form the name of an organism. It is the main subdivision of a family.

**Groundwater** - Water that fills the spaces between rocks and soil particles underground. Groundwater is replenished when rainwater trickles through the soil. Surface water, such as lakes and rivers, is often replenished by groundwater.

**Habitat** - The environmental conditions of an area where a plant or animal naturally grows or lives; its environment.

**Healthy** - In the context of these activities, it refers to the cleanliness or purity of the stream water.

**Impervious surface** - A surface that doesn’t absorb water such as a paved parking lot.

**Indicator species** - An organism whose presence or absence in a particular environment can be used to determine the health of that particular environment.

**Insect** - Any animal in the Class Insecta. It has a head, thorax, abdomen, and three pairs of legs on the thorax. An adult usually has one or two pairs of wings attached to the thorax as well.

**Irrigation** - The pumping of water from ponds, lakes, or rivers through pipes or canals to supply crops or livestock with water during dry periods of weather.

**Key** - In the context of these activities, it is an ordered list of significant characteristics of a group of organisms used to identify unknown species.

**Larva** - (larvae, plural) The immature form of an animal that changes structurally when it becomes an adult, usually by complex metamorphosis.

**Lifestyle** - A way of life, including attitudes, values and priorities.

**Macroinvertebrate** - Macro means “large,” invertebrate means “without a backbone.” An invertebrate usually large enough to be seen without the aid of magnification.

**Metamorphosis** - Meta means “change,” morphe means “form.” A change in form, structure or function as a result of development. A physical transformation undergone by various animals during development from the larval stage to the adult form. For example, through metamorphosis, a hellgrammite (larval form) becomes a Dobsonfly (adult form). The change from a tadpole (larval form) to a frog (adult form) is another example of metamorphosis.

**Mussel** - Any of the various freshwater or saltwater bivalves (meaning the two shells), held together by a strong muscle.

**Native** - Refers to a plant or animal originally found in a certain area; not foreign.

**Nymph** - The young of an insect that undergoes incomplete metamorphosis, differing from the adult primarily in size and structural proportions (i.e. wings).
**Organism** - A living thing. Examples include plants and animals.

**Outstanding Resource Water** - A legal designation given to very pure, unpolluted stream water. Examples are Jacob's Fork River and Shinny Creek, located within South Mountains State Park.

**pH** - potential of hydrogen. A measure that indicates the relative acidity or alkalinity of a substance. The pH scale is a logarithmic scale ranging from 0 (most acidic) to 14 (most basic), with a pH of 7 being neutral.

**Photosynthesis** - The chemical process carried on by green plants in which the cells that contain chlorophyll use light energy to produce glucose (a plant food) from carbon dioxide and water; oxygen is released as a by-product. See Respiration.

**Pollution** - A human-caused change in the physical, chemical, or biological conditions of the environment that creates an undesirable effect on living things.

**Quality** - A degree of excellence which a thing possesses.

**Runoff** - Rain, melted snow and other materials that drain or flow off surfaces such as city streets, roofs, suburban lawns and agricultural land.

**Sediment** - Deposits of soil or organic matter which were suspended in water and then settled to the bottom. It is often deposited in the water by runoff.

**Silt** - A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

**Soil** - A collection of organic and inorganic particles, mainly composed of clay, silt, sand and gravel.

- **clay** - less than 1/256 of a millimeter (mm) in diameter
- **silt** - between 1/256 and 1/16 of a mm in diameter
- **sand** - between 1/16 and 2 mm in diameter
- **gravel** - over 2 mm in diameter

**Species** - The taxonomic category located after genus which consists of organisms that have a high degree of similarity and can mate and produce fertile offspring.

**Stewardship** - The act of people taking responsibility for the protection and preservation of a clean and healthy environment.

**Taxonomy** - A branch of biology dealing with arranging and classifying organisms into natural, related groups based on some factor common to each, such as structure, embryology, biochemistry, etc.

**Tributary** - A stream or river flowing into a larger stream, river or lake. The Jacob's Fork River is a tributary of the Catawba River.

**Waste Water Treatment Plant** - Facility where water from households, businesses and industrial are treated with chemicals, processed to remove harmful bacteria and chemicals.

**Water** - A transparent, odorless, tasteless liquid compound of hydrogen and oxygen (H₂O) which occurs on the earth's surface as oceans, lakes, rivers, etc.

**Water Quality** - A way of determining or measuring certain characteristics of water.

**Watershed** - All of the land area that drains directly or indirectly into a creek, river, lake or other body of water.


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Montgomery County Public Schools. 1972. “Activities for Studying Ponds,” Environmental Education Series, Bulletin No. 247 D. For more information, contact the Montgomery County Public Schools, 850 Hungerford Drive, Rockville, MD 28050.

National Aquarium in Baltimore. 1987. Living in Water, Aquatic Science Curriculum for Grades 4-6. For more information, contact the National Aquarium in Baltimore, MD.


Park files. 1983. South Mountains Nature Trail Guide. (non-published manuscript). For more information, contact South Mountains State Park, Rt 1, Box 206, Connelly Springs, NC 28612.


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SCHEDULING WORKSHEET

<table>
<thead>
<tr>
<th>For office use only:</th>
<th>Request received by</th>
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</thead>
<tbody>
<tr>
<td>Date request received</td>
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</table>

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 9.2.

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

Return to: South Mountains State Park
           Route 1, Box 206-C
           Connell Springs, NC 28612

South Mountains State Park, NC 8.1
March 1994
PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at South Mountains 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 __________________

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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.

South Mountains State Park
Route 1, Box 206-C
Connelly Springs, NC 28612

March 1994