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ABSTRACT

This curriculum packet was developed to provide environmental education through a series of hands-on activities for the classroom and the outdoor setting of South Mountains State Park, North Carolina. Targeted for grades 4 through 7, this packet meets the established curriculum objectives of the North Carolina Department of Public Instruction. Students are exposed to major concepts such as water quality, indicator species, stewardship of natural resources, watersheds, natural resource management, the Jacob's Fork River, river basins, riparian areas, and water pollution (point and nonpoint sources). The packet is divided into eight sections: (1) introduction to the North Carolina State Parks system, South Mountains State Park, and the activity packet; (2) activity summary and correlation chart showing how each activity correlates with Department of Public Instruction objectives; (3) pre-visit activities; (4) on-site activities; (5) post-visit activities; (6) vocabulary; (7) references; and (8) a scheduling worksheet, permission form, and program evaluation form. Each set of activities is comprised of three activities. The first activity includes curriculum objectives for grade levels 4-5. The second and third activities list learning skills and subject areas covered. All activities contain descriptions of location, group size, estimated time needed, appropriate season, materials needed, major concepts covered, and activity objectives, as well as background information for the educator, instructions, and worksheets. Most activities also include extensions, assessment tools, and student information sheets. (PVD)

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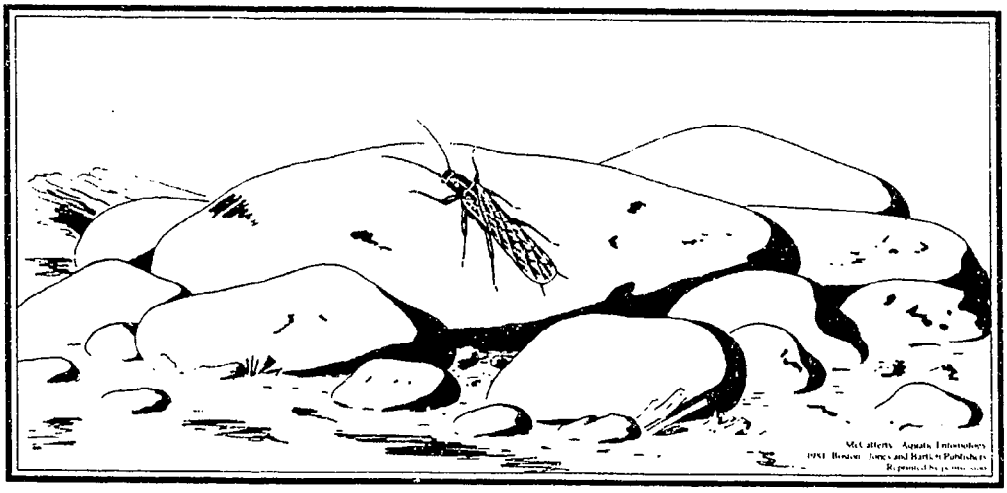

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South Mountains State Park

An Environmental Education Learning Experience

Designed for Grades 4-5

SE001914

"The greatest miracle on this planet is water."

- Loren Eiseley

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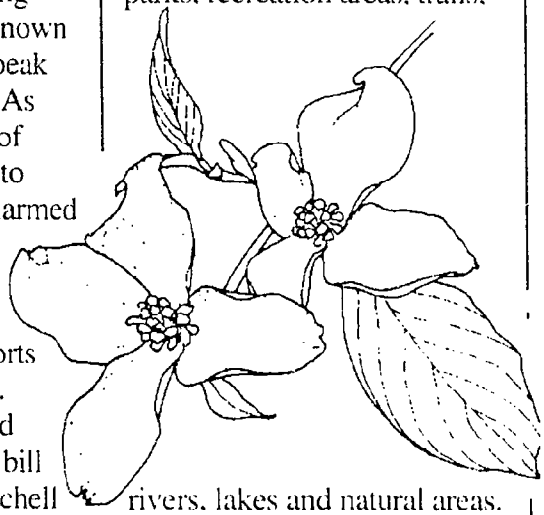
Introduction to the North Carolina State Parks System

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

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



As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 144,000 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
WEB: http://ils.unc.edu / parkproject/ncparks.html

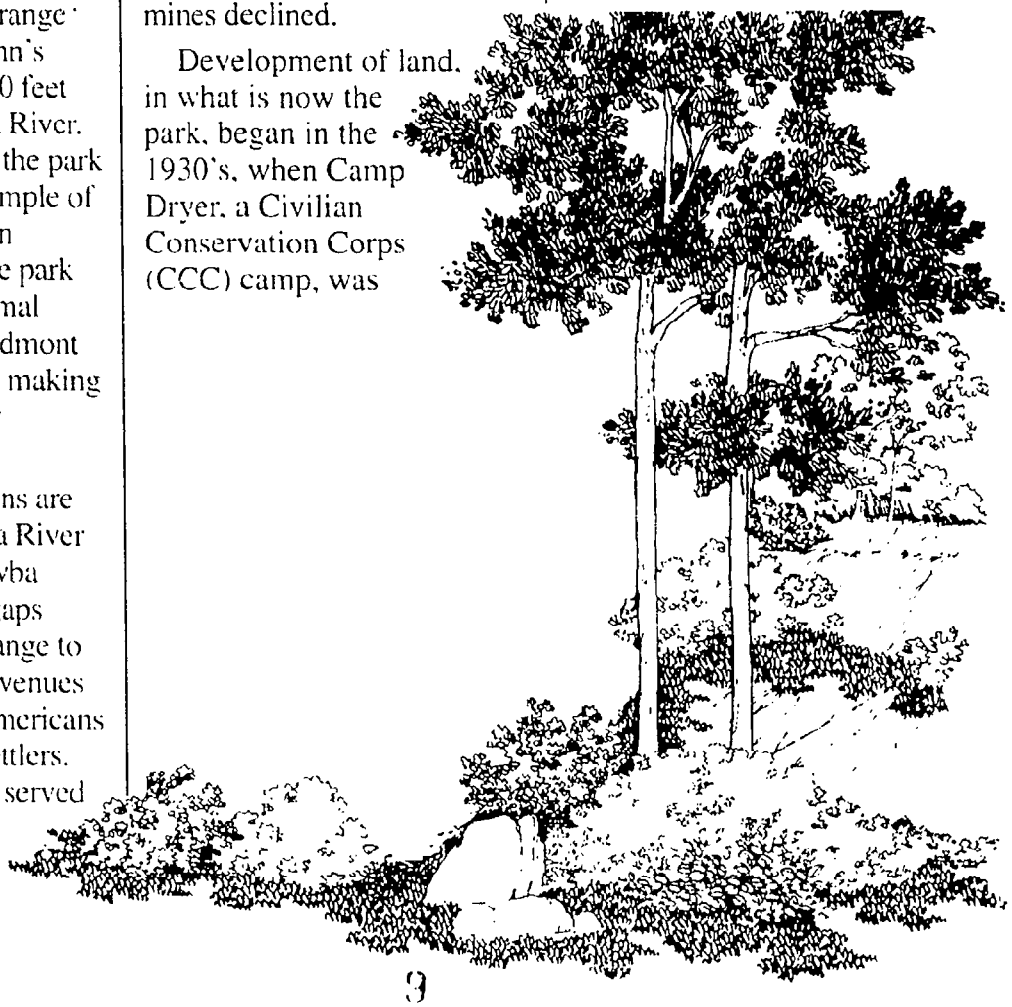
Introduction to South Mountains State Park

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 Catawba River watershed. The Catawba 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 streambeds 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 in cultural resources as well, and provides a wonderful outdoor classroom for learning about the history of Native Americans, European immigrants, 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 (EELE). 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.

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 ranger will be happy to welcome your group and answer any questions the students may have, or present a short talk. Park staff will make every effort to accommodate persons with disabilities.

Park Facilities

The park has numerous facilities available for visitors.

Restrooms: Restrooms with running water and access 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 backpacker 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 behavioral 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 activities in this 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 c re 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. Remov l 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 activities in this 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 8.3, and send it to the park.

Park Information

South Mountains State Park
3001 South Mountains
Park Avenue
Connelly Springs, NC 28612
Tel: (828) 433-4772
FAX: (828) 433-4778
e-mail:
southmountains@hci.net

Hours of Operation

Nov. - Feb.	8:00 a.m. - 6:00 p.m.
March, Oct.	8:00 a.m. - 7:00 p.m.
April, May, Sept.	8:00 a.m. - 8:00 p.m.
June - Aug.	8:00 a.m. - 9:00 p.m.

Introduction to the Activity Packet for South Mountains State Park

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 4th through 7th grades, meets established curriculum objectives of the North Carolina Department of Public Instruction. It includes three types of activities:

1) pre-visit activities
2) on-site activities
3) post-visit activities

The on-site activities will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom or school grounds. The Environmental Education Learning Experience, "Wild, Wonderful Water," will acquaint students with the following major concepts:

- **Water quality**
- **Indicator species**
- **Stewardship of natural resources**
- **Watershed**
- **Natural resource management**
- **The Jacob's Fork River**
- **River basin**
- **Riparian area**
- **Water pollution (point and nonpoint sources)**

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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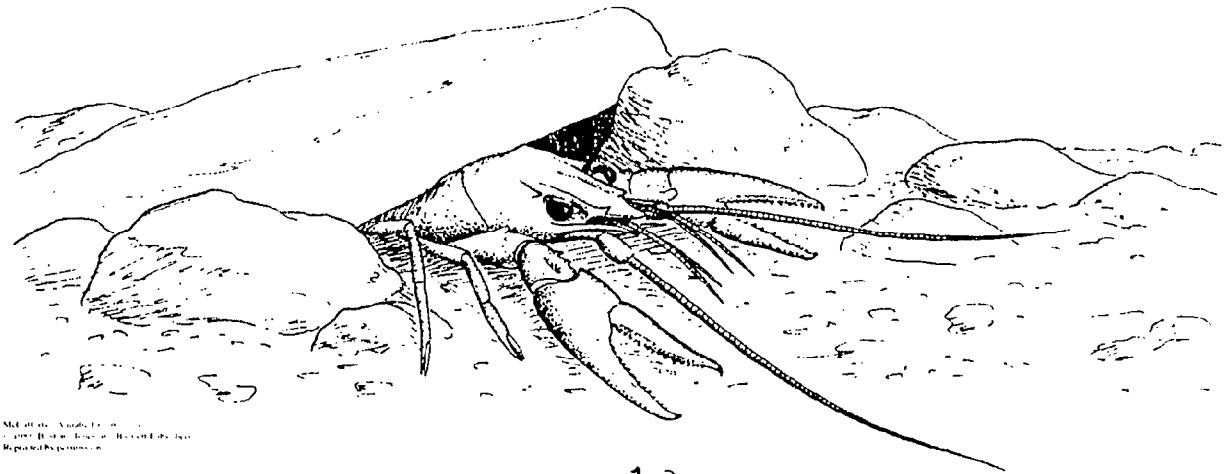
NOTE. On-site activities, weather and river conditions permitting, will be held on the banks of the river and in the river. Students will wade in shallow rocky areas. They should dress appropriately (long pants and tennis shoes) and bring a change of clothing. The students may encounter ticks, poison 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.



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 Activities

#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

Learning Skills:

- Observing, classifying and communicating
- Reading informational materials (scientific keys)

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.

#2 Edible Watershed (page 3.2.1)

Students will understand the concept of watersheds by constructing their own three-dimensional watershed models. They will then trace the path water takes on a map of a local watershed.

Major Concepts:

- Watershed

Learning Skills:

- Observing, communicating, and using models
- Reading maps
- Participating effectively in creative interpretations.

Objectives:

- Define the term watershed.
- Construct a three-dimensional watershed model and orally describe the path that liquid takes within the model.
- Explain how a watershed and a river are interrelated.

#3 Journey Down River (page 3.3.1)

Using map legends and identifying key geographical locations along the water course, students will trace the Catawba River from its headwaters to the Atlantic Ocean.

Major Concepts:

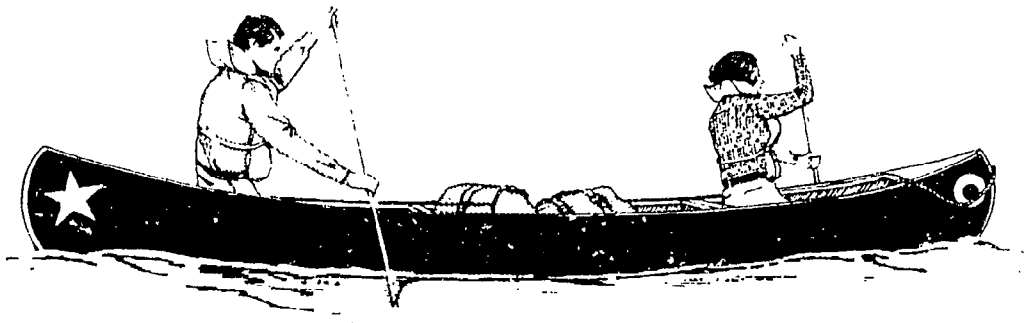
- Watershed
- River basin

Learning Skills:

- Observing, communicating, and inferring
- Reading maps
- Responding creatively to an experience

Objectives:

- Locate the Jacob's Fork River on a map and identify the larger river basin to which it belongs.
- Locate dams, lakes, cities and other points of interest within the Catawba River Basin on a state highway map.
- On a map, trace the movement of a drop of water from the origin of the Jacob's Fork River to the Atlantic Ocean, then write a story to describe its journey.



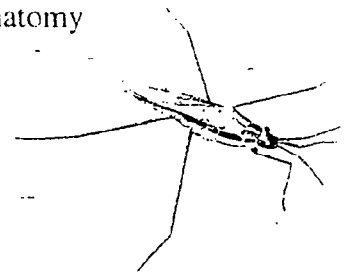
II. On-Site Activities

#1 What's in the Water? (page 4.1.1)

Students will use different methods to collect and identify aquatic organisms and make inferences concerning the quality of the water based on their findings.

Major Concepts:

- Water quality
- Dichotomous key
- Macroinvertebrate external anatomy
- Indicator species



Learning Skills:

- Observing, classifying and communicating
- Interpreting data and making inferences

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.

#2 Streamside Hike (page 4.2.1)

Students will hike through a riparian area then up to High Shoals Falls, a spectacular waterfall cascading 80 feet to the pools of water below. At different locations along the hike, they will make observations and determine the temperature, pH, and turbidity of the stream.

Major Concepts:

- Watershed
- Riparian area
- Aquatic plants & animals
- Water quality
- Indicator species
- Stewardship

Learning Skills:

- Observing, communicating, and inferring
- Reading a map
- Collecting, analyzing and evaluating information

Objectives:

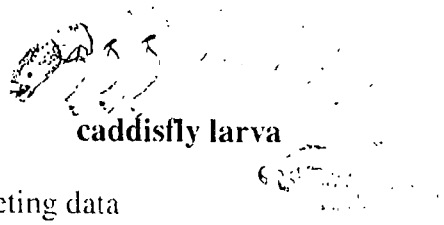
- Identify the Jacob's Fork River watershed on a map of the park.
- Define riparian area.
- Define indicator species.
- Identify three examples of riparian plants in the field.
- Identify three examples of aquatic animals in the field.

#3 Streambed Silhouette (page 4.3.1)

Students will learn a simple method for creating a cross-sectional depth profile of a stream. They will then use this information to explore how the profile of a stream affects water quality and the types of aquatic plants and animals that are living in the stream.

Major Concepts:

- Depth profile
- Streambed
- Siltation
- Habitat



caddisfly larva

Learning Skills:

- Observing, classifying, using numbers, interpreting data
- Measuring depths and plotting points
- Working in cooperative learning groups

Objectives:

- Complete a cross-sectional depth profile of a section of the Jacob's Fork River.
- Describe three events that might alter the depth profile of a stream.
- Explain the relationship between streambed topography and the numbers and diversity of animals that can live in a stream.
- Describe two problems that can result from siltation of streams.
- List three ways people can help protect rivers and water quality.

III. Post-Visit Activities

#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

Learning Skills:

- Interpreting data, communicating, evaluating
- Organizing and analyzing information

Objectives:

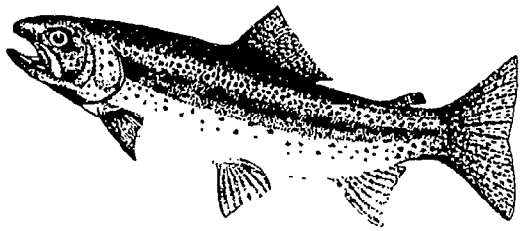
- Evaluate the effects of different imaginary land uses on Caddisfly Creek.
- Discuss and evaluate the effects of three different land use methods on the river.
- List three ways people can change their lifestyles to decrease damaging effects on water quality and on the river.
- List three ways local 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.

#2 Mountain Trout Journeys (page 5.2.1)

Students role-play mountain trout species and limiting factors in a high involving physical activity. They experience many of the different situations trout must contend with today. Special emphasis has been placed on the availability and amounts of food sources for fish and pressures from streamside development, pollution, erosion and fishing.

Major Concepts:

- Habitat degradation
- Predation
- Limiting factors
- Sedimentation
- Fisheries management



Learning Skills:

- Role-playing
- Predicting and inferring
- Comparing and analyzing
- Graphing

Objectives:

- List the four elements of habitat that must be present in a stream for it to support mountain trout species: food, clean water, shelter, and space.
- Explain how past logging methods affected trout habitat.
- Predict how given human activities might affect trout habitat today.
- Through role-play, experience some of the major factors which affect the survival of mountain trout populations.
- Describe at least two ways people can protect or improve trout streams.

#3 A River Runs Through It (page 5.3.1)

Students discuss ways water becomes polluted and learn the difference between point source pollution and nonpoint source pollution. Then, as the educator tells a water pollution story, they place various pollutants onto a river model and learn how these pollutants affect the river.

Major Concepts:

- Water pollution
- Nonpoint source pollution
- Point source pollution

Learning Skills:

- Interpreting data, communicating, evaluating
- Organizing and analyzing information
- Listening, following directions

Objectives:

- Discriminate between point and nonpoint source pollution, giving examples of each type.
- Describe at least three ways individuals can protect water quality in their river basin.

Correlation Chart

Note to classroom teachers: The following Correlation Chart shows how each activity in this Environmental Education Learning Experience (EELE) correlates with the North Carolina Department of Public Instruction (DPI) objectives in science, mathematics, social studies and English language arts. The activities are listed in the order in which they appear in this EELE. The recommended grade levels are listed along the side of the chart. Notice that only the objective numbers are listed. Use your DPI Teacher Handbook for each subject area to get a complete description of the objectives in that subject area.

Pre-Visit Activity #1: The Keys to Knowing, p. 3.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1, measuring
5	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 5.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		
6	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		
7	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1, measuring

Pre-Visit Activity #2: Edible Watershed, p. 3.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.1, 2.4, 2.14, 3.2, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1	3.1, 3.2 Skill Goal I	
5	2.1, 2.4, 2.14, 3.2, 4.1, 4.2, 5.3, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 4.1	3.1, 3.2 Skill Goal I	
6	2.1, 2.4, 2.14, 3.2, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1		
7	2.1, 2.4, 2.14, 3.2, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1		

Correlation Chart

Pre-Visit Activity #3: Journey Down River, p. 3.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.1, 2.1, 2.4, 2.6, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1	3.1, 3.2, 3.3, 4.1, 4.2, 5.2 Skill Goals I & II	
5	1.1, 2.1, 2.4, 2.6, 4.1, 4.2, 5.3, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 4.1	3.1, 3.2, 5.2 Skill Goals I & II	
6	1.1, 2.1, 2.4, 2.6, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1		
7	1.1, 2.1, 2.4, 2.6, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1		

On-Site Activity #1: What's in the Water? p. 4.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 6.1, 6.2, 6.4, 7.7
5	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 6.2, 7.1
6	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 6.1, 6.2, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 5.4, 5.5, 6.6, 7.1, 7.8
7	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 6.4, 7.1, 7.4, 7.5

Correlation Chart

On-Site Activity #2: Streamside Hike, p. 4.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.1, 2.1, 2.2, 2.3, 2.3, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3	3.2, 5.2, 5.3, 9.4 Skill Goals I, II, III	4.11
5	1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3	3.2, 5.2, 5.3 Skill Goals I, II, III	4.6
6	1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		
7	1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1

On-Site Activity #3: Streambed Silhouette, p. 4.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 5.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1	2.3, 5.2, 5.3, 9.4 Skill Goals I & II	4.1, 4.6, 6.1, 6.2, 6.5, 6.6
5	1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1	2.3, 5.2, 5.3 Skill Goals I & II	4.5, 6.1, 6.2, 6.6
6	1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 6.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1		4.1, 4.2, 6.1, 6.4
7	1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1		4.2, 6.1

Correlation Chart

Post-Visit Activity #1: Caddisfly Creek, p. 5.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2	2.2, 2.3, 3.2, 3.3, 5.2, 5.3, 7.5, 8.2, 8.3, 9.1, 9.2, 9.4, 10.1, 11.2, Skill Goals I,II,III & IV	
5	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2	2.3, 3.2, 5.1, 5.2, 5.3 7.3, 8.2, 9.2 Skill Goals I,II,III & IV	
6	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.1, 6.3	1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2		
7	1.1, 2.4, 2.6, 2.7. 2.14, 4.1, 4.2, 4.4, 5.1, 6.8	1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2		

Post-Visit Activity #2: Mountain Trout Journeys, p. 5.2.1

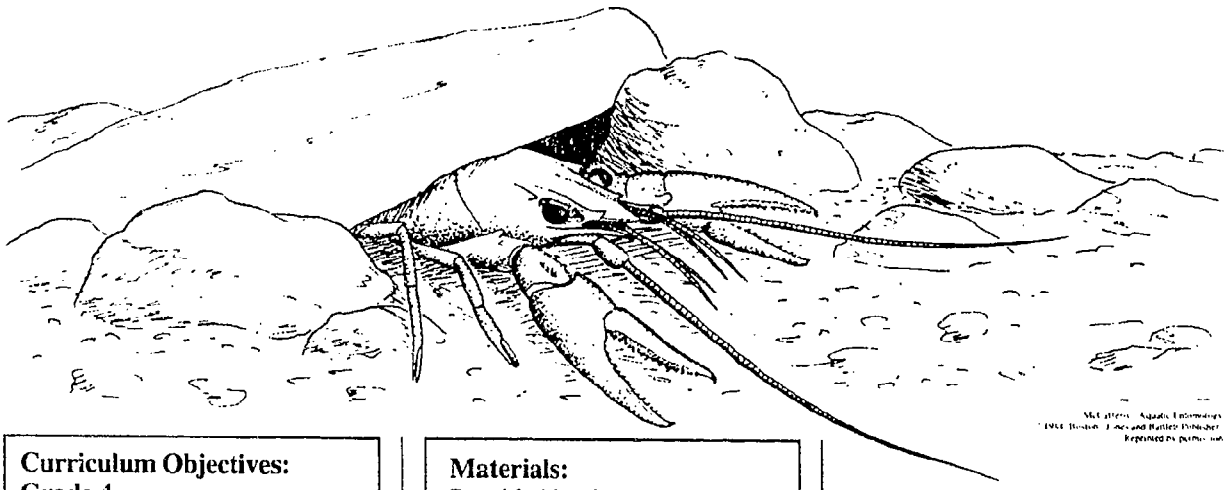
Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.1, 1.2, 2.1, 2.3, 2.4, 2.6, 2.7, 4.2, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3	1.3, 2.3, 3.2, 4.2, 5.1, 5.2, 5.3, 7.5, 8.2, 9.1, 9.2, 9.4, 11.2, Skill Goals I,II,III	6.1, 6.2, 6.3
5	1.1, 1.2, 2.1, 2.3, 2.4, 2.6, 2.7, 4.2, 5.3, 5.4	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3	2.3, 5.1, 5.2, 5.3, 7.3, 9.2 Skill Goals I,II,III	6.1, 6.2
6	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 4.2, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3		6.1
7	1.1, 1.2, 2.1, 2.3, 2.4, 2.6, 2.7, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3		6.1

Correlation Chart

Post-Visit Activity #3: A River Runs Through It, p. 5.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	2.3, 3.1, 3.2, 3.3, 5.2, 5.3, 9.4 Skill Goals I & II	
5	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	2.3, 3.1, 5.2, 5.3, 9.2 Skill Goals I & II	
6	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2		
7	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2		

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:

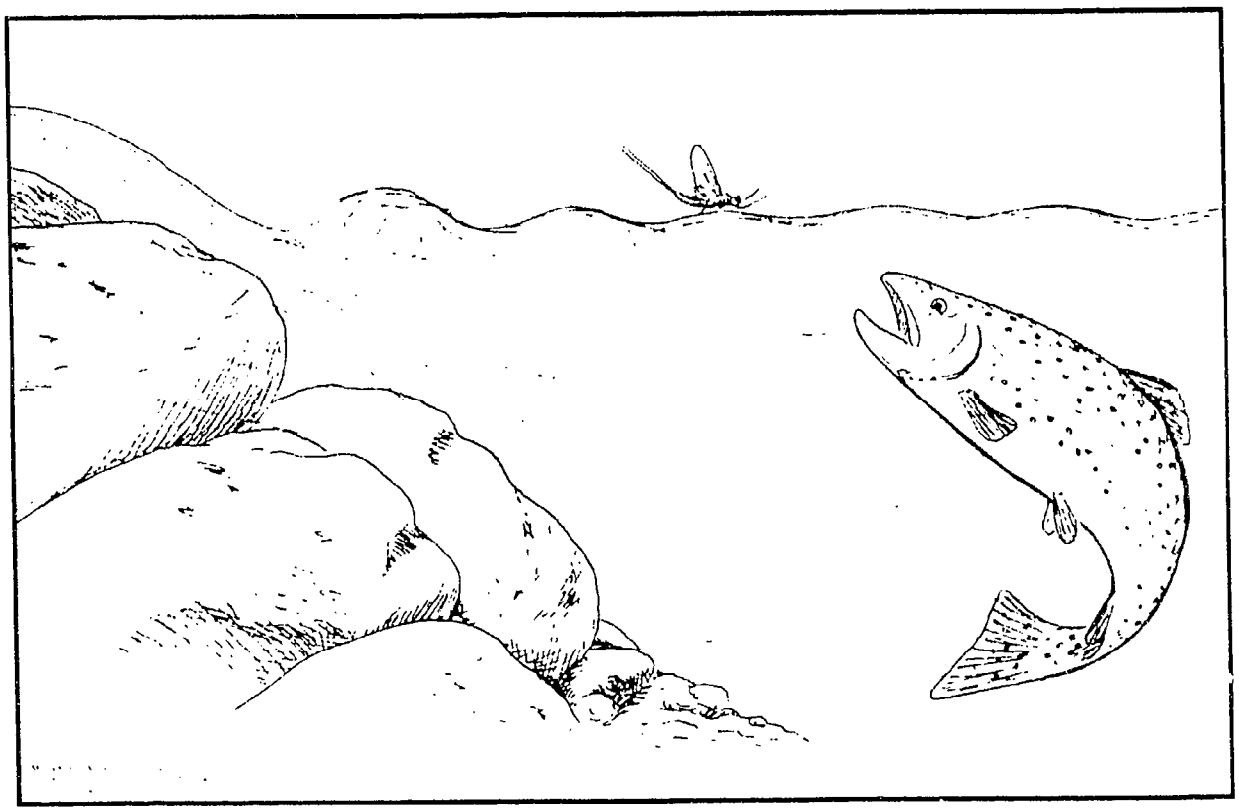
Part I
- Dichotomous key
- How to use a key
- Importance of keys for identification

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.



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.

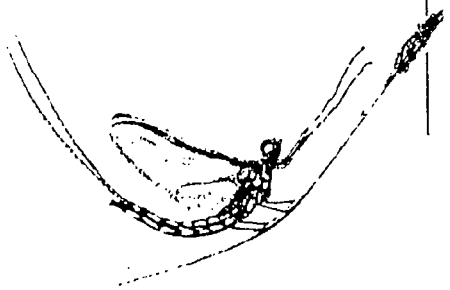
2. Have the students create macroinvertebrate "flash cards" to learn identification.

Student's Information

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:

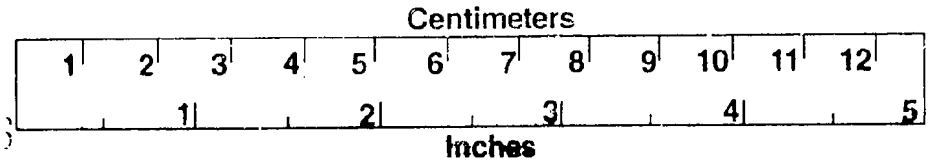
1. Leaves not long or needle-like
2. Leaves long and needle-like

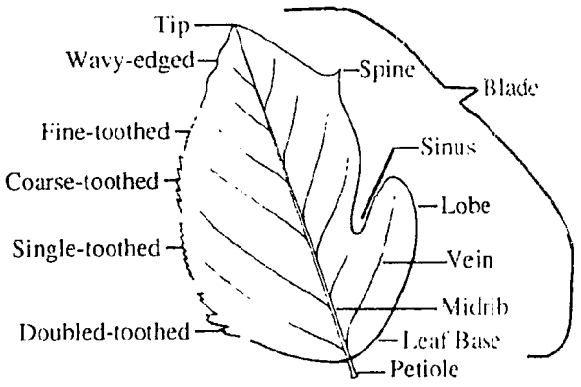
Of course, a pine leaf (or needle) is long and needle-like so you would choose option #2 and continue to the next choice under that side of the dichotomous key.

Key to 10 Common Leaves

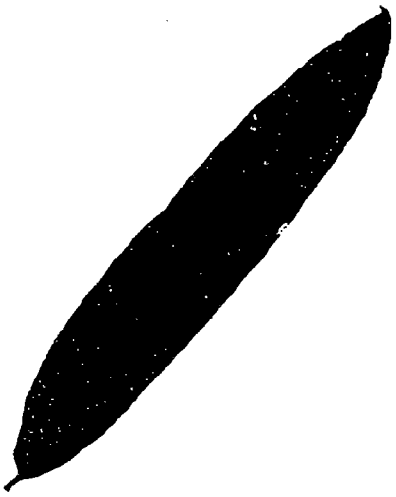
(Tree Leaves)

- Leaf long & needle-like
  - Leaves in group of 2; less than 10 cm long — *Shortleaf pine*
  - Leaves in group of 3; more than 10 cm long — *Loblolly pine*
- Leaf not needle-like
  - Leaf with lobes
    - Edge of leaf without teeth
      - Petiole of leaf 1 cm or longer
        - Leaf petiole less than 2 cm — *Sassafras*
        - Leaf petiole longer than 2 cm — *Tulip poplar*
      - Petiole of leaf less than 1 cm — *White oak*
    - Edge of leaf with teeth
      - Leaf with 5 lobes; petiole 3.5 cm or longer — *Sweet gum*
      - Leaf with 3 lobes; petiole shorter than 3.5 cm — *Red maple*
  - Leaf without lobes
    - Leaf edge with teeth
      - Each tooth with spine — *American holly*
      - Teeth without spines — *River birch*
    - Leaf without teeth — *Willow oak*

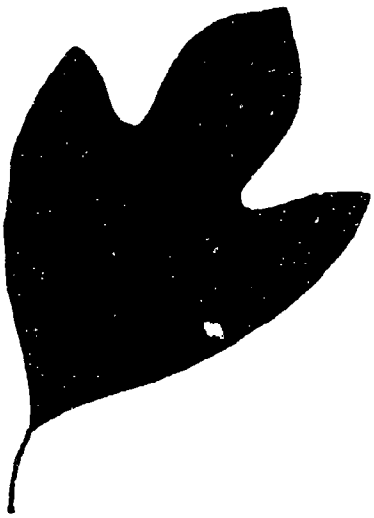




10 Common Leaves



1. _____



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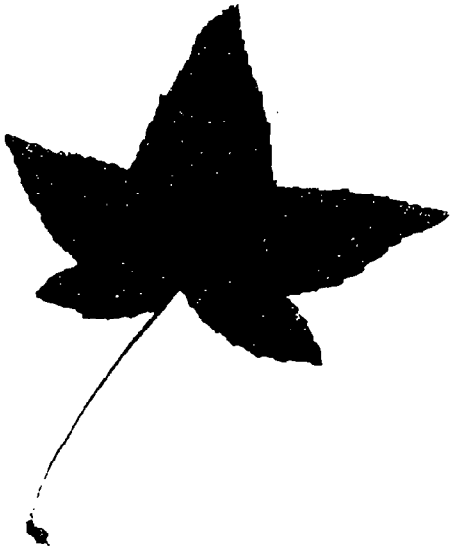

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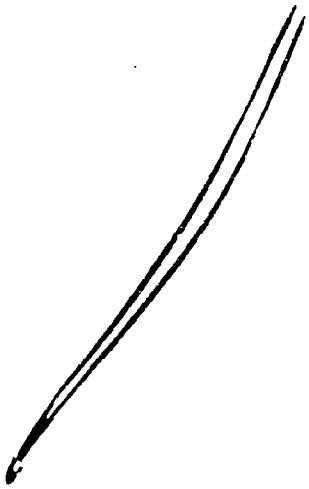

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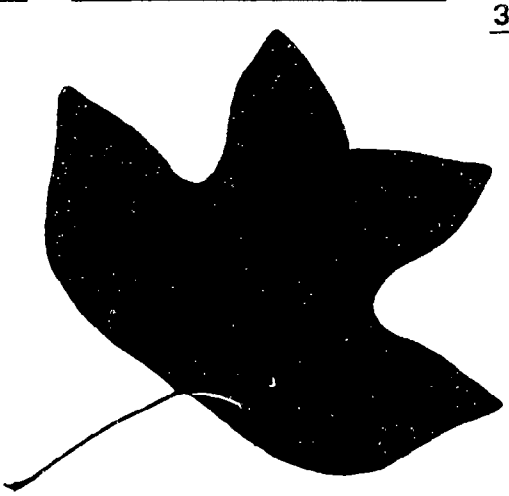

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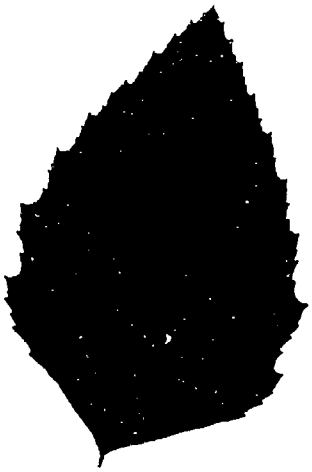

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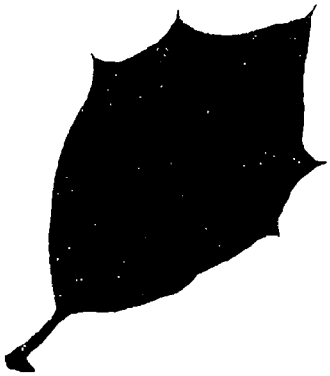

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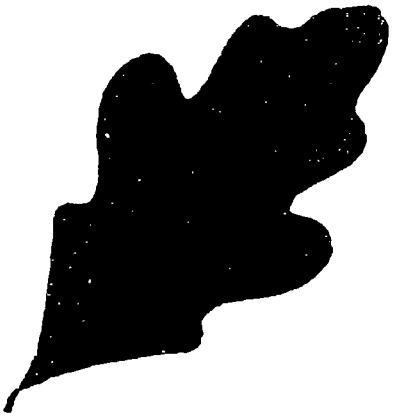

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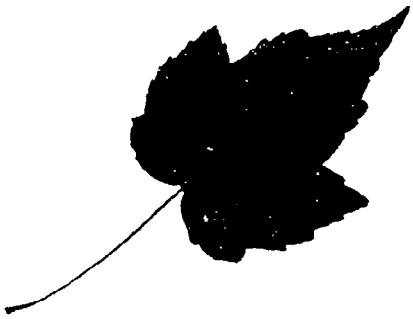

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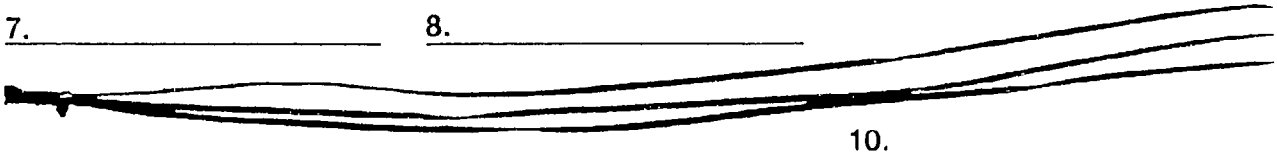
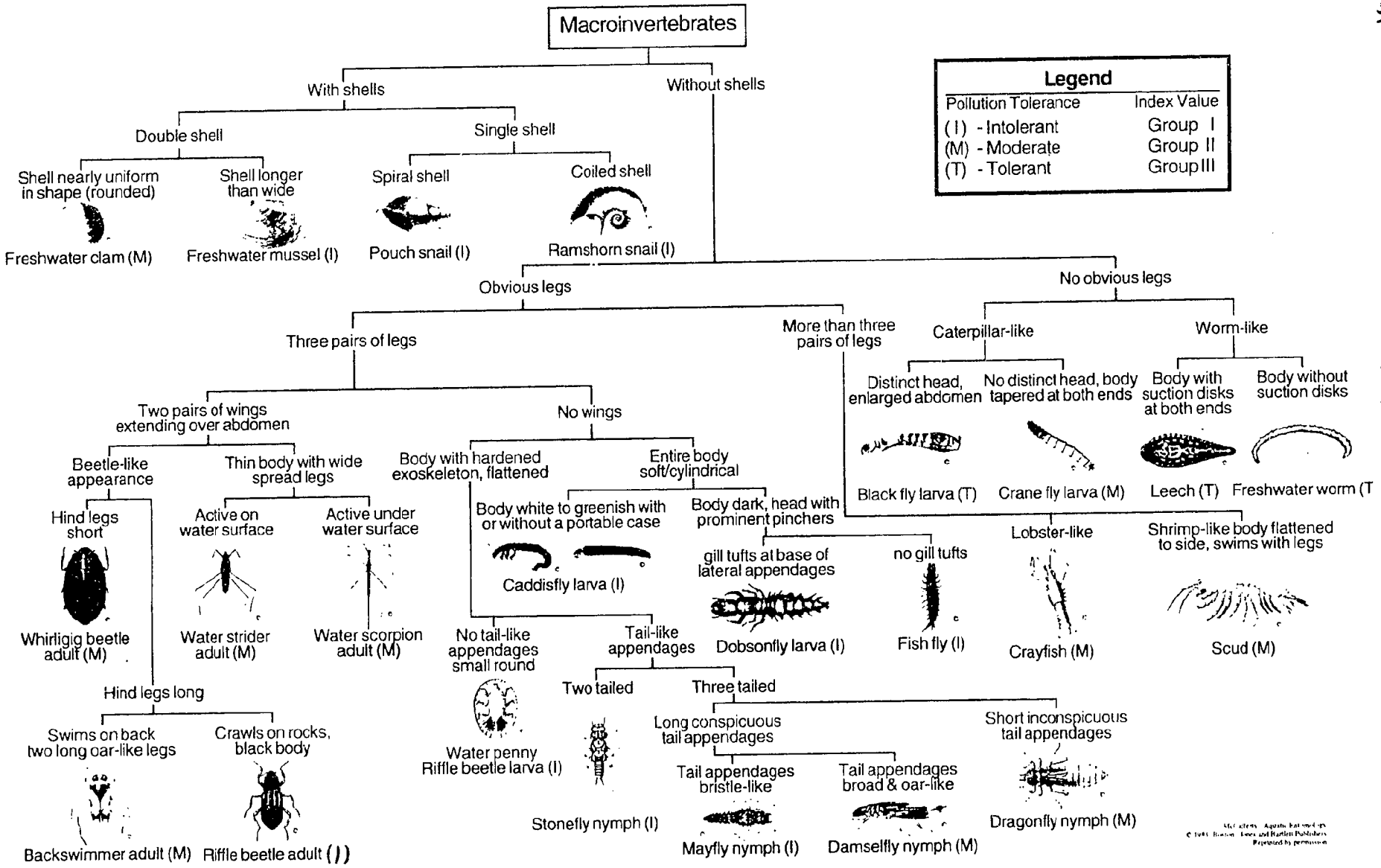


10. _____

Key To Aquatic Macroinvertebrates of the Jacob's Fork River



Legend

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

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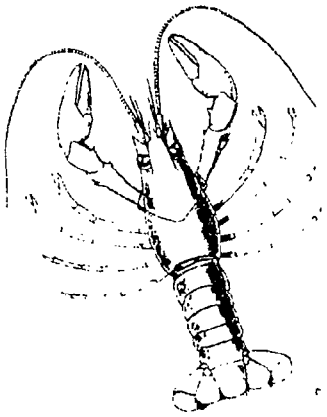
Aquatic Life Illustrations



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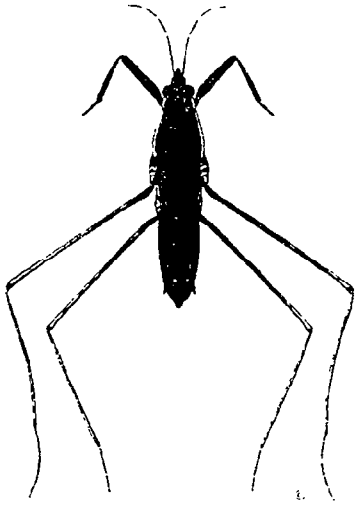

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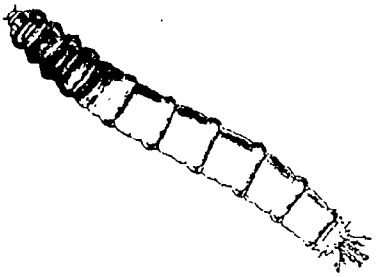

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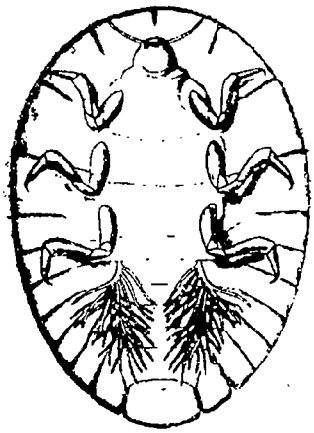

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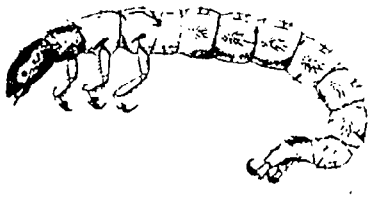

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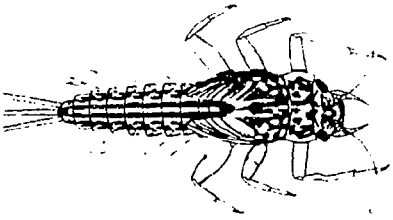

6. _____

[illegible]
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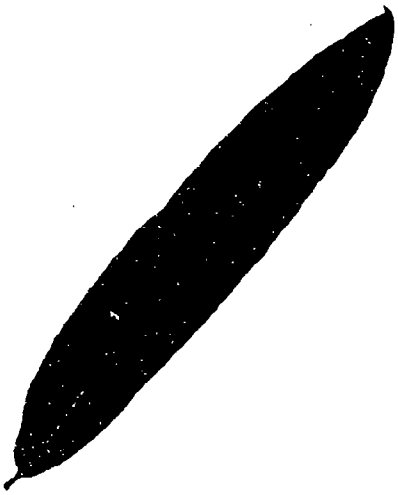
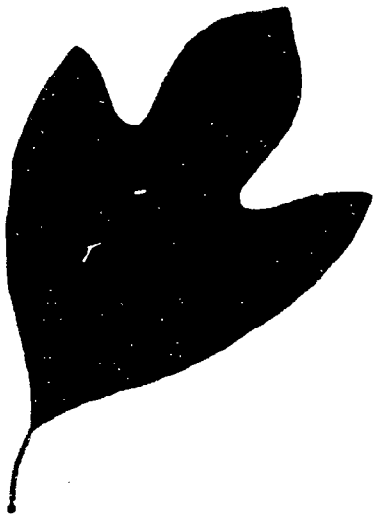
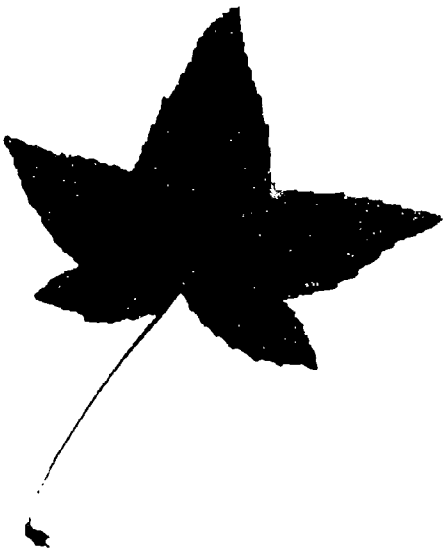
Answer Sheet to 10 Common Leaves



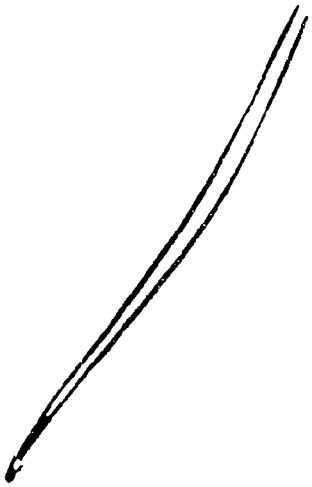
1. *Willow oak*



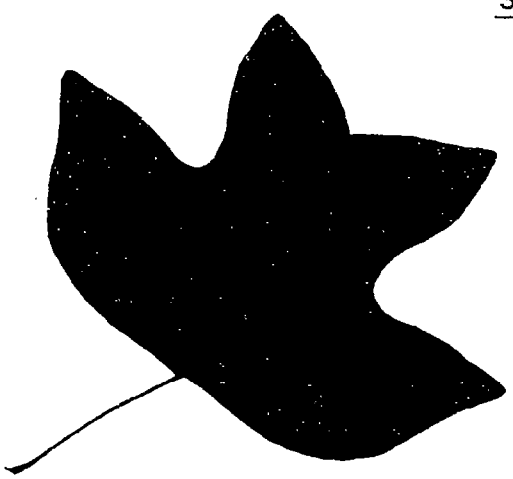
2. *Sassafras*



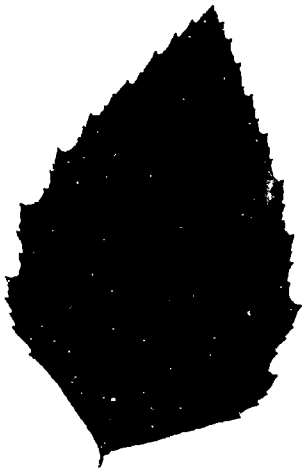
3. *Sweet gum*



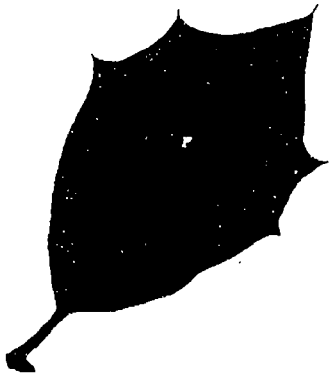
4. *Shortleaf pine*



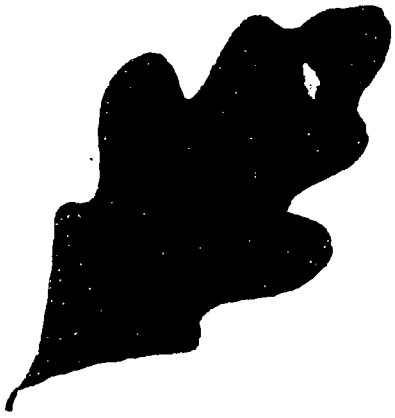
5. *Tulip poplar*



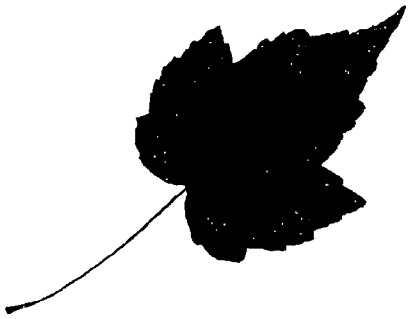
6. *River birch*



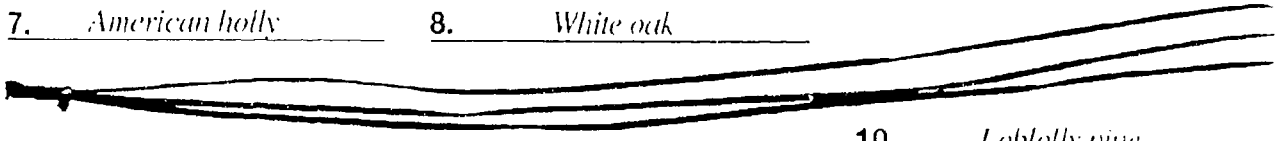
7. *American holly*



8. *White oak*

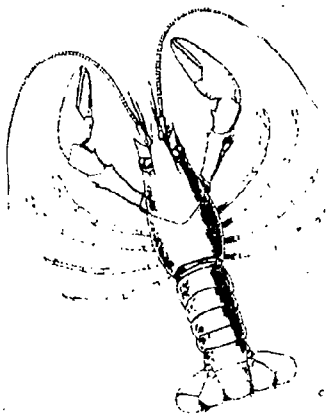


9. *Red maple*

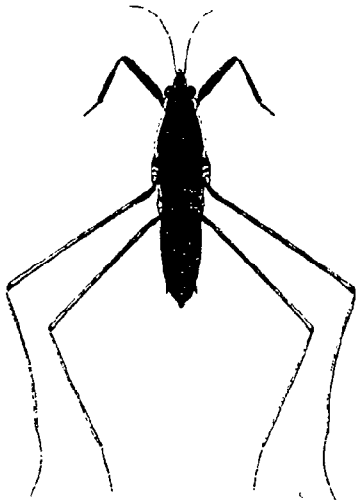


10. *Loblolly pine*

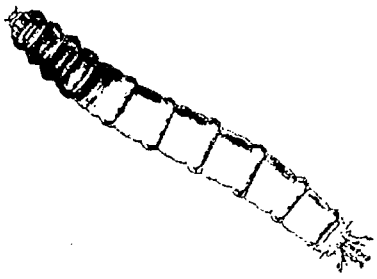
Answer Sheet to Aquatic Life Illustrations



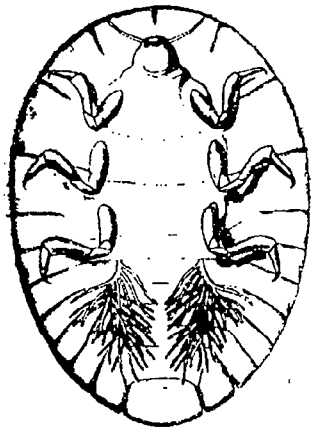
1. *Crayfish*



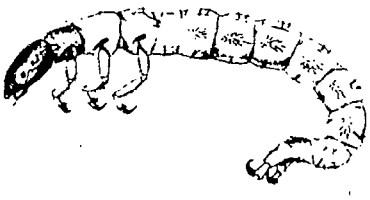
2. *Water strider*



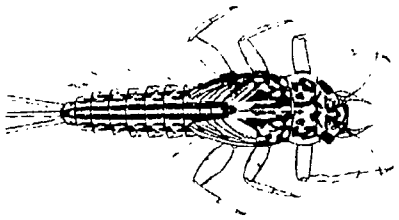
3. *Cranefly larva*



4. *Water penny*



5. *Caddisfly larva*



6. *Mayfly nymph*

[illegible]

Pre-Visit Activity #2 — Edible Watershed

Major Concepts:
- Watershed

Learning Skills:
- Observing, communicating, and using models
- Reading maps
- Participating effectively in creative interpretations

Subject Areas:
- Science
- Social Studies
- English Language Arts
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Classroom

Group Size: 30 students

Estimated Time: 60 minutes

Appropriate Season: Any

Materials:
Provided by the educator:
Per class: picture of a river and surrounding area, jar or pitcher of water
Per group: map of your local watershed area, half-gallon of ice cream, ice cream scoop, chocolate or caramel syrup
Per student: bowl, spoon, napkin, Student's Information, paper, pencil

Note: Maps may be ordered by contacting the North Carolina Geological Survey at (919) 715-9718.

Objectives:

- Define the term watershed.
- Construct a three-dimensional watershed model and orally describe the path that liquid takes within the model.
- Explain how a watershed and a river are interrelated.

Educator's Information:

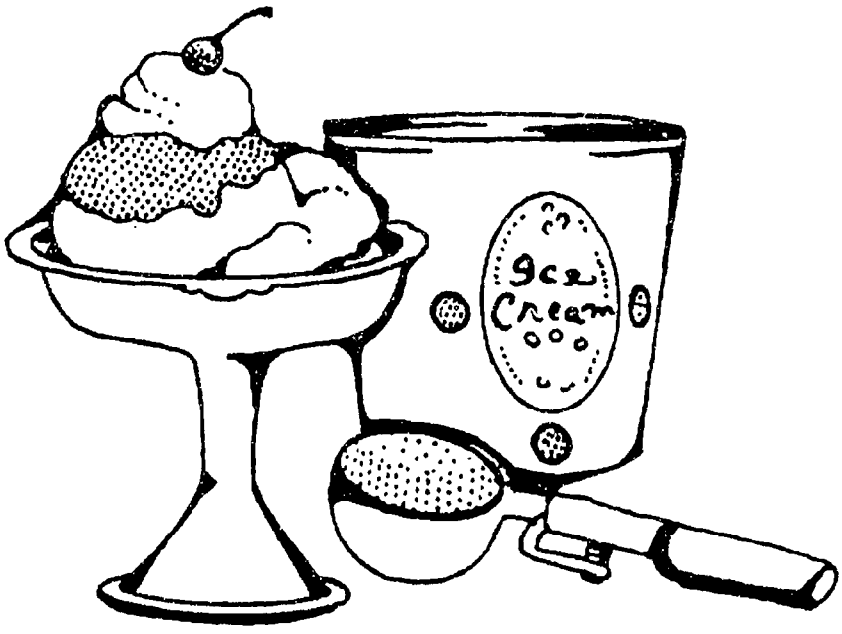
This activity is designed to help students understand the concept of **watersheds** by constructing their own three-dimensional watershed models. They will then trace the path water takes on a map of a local watershed.

Instructions:

1. If possible, show students pictures of many different kinds of watersheds: lakes, rivers, etc. Where does the water in the rivers come from? Explain that most of the water has drained off the surrounding land. A watershed is all the land that drains directly into a creek, river, lake or other body of water. Have students compare the watersheds in the pictures you have provided — how are they similar or different?

2. Distribute one copy of the Student's Information to each student. Read and discuss the information.

3. Ask two students to come to the front of the class, stand about three feet apart facing each other, than raise their



arms into the air and join hands. Explain to the class that the point at which their hands join represents the **ridge line** between two adjoining watersheds. The students' bodies represent steep mountainsides that slope down to two different rivers. Hold a pitcher of water menacingly over the volunteers' heads and ask the class where the water would go if you poured it at different points along each "mountainside." Your students should be able to see that water poured on one student would run into the "river" behind him or her and would not affect the student (watershed) on the other side of the ridge line.

4. Tell the class that each student will use ice cream to build a model representing a watershed or adjacent watersheds. Each student should make a sketch of his/her watershed before receiving the ice cream. Give them some suggestions on how to create a 3-D model. For example: To depict a mountain watershed, mold the ice cream so that is has very steep, definite ridges and valleys. For a piedmont watershed, smooth the ice cream into rolling hills. A coastal watershed would have only a slight incline. To depict two separate watersheds, create a ridge line within the container.

5. Divide the class into groups of four or less. Distribute a half-gallon of ice cream, a container of chocolate syrup (room temperature or warmer) and an ice cream scoop to each group. Give every student a bowl and a spoon. The students should divide the ice cream equally among group members.

6. Each student should constuct his/her own watershed model. After the students have completed their model watersheds, have them take turns pouring the chocolate syrup over the ice cream, starting at the top of the watershed. Ask them to observe how and where the syrup flows within the watershed model. Finally, they should go back to their sketches and draw arrows to indicate the path that the syrup actually took when poured on the models.

7. After clean up, give each group a laminated copy of a watershed map or other topo map. If the students do not know how to read a contour map, spend a few minutes on a guided practice. Then, randomly pick a point on the map. Ask students to use water-based markers to trace the path that water will take from this point to other areas within the watershed. Remember, water flows downhill. Also ask the students to outline the boundaries of this watershed (and adjacent watersheds) on their maps.

Assessment:

1. How are a watershed and a body of water (such as a river) interrelated? Ask students to write a paragraph explaining their answer. Or, they can draw and label a watershed surrounding a body of water. Students should use arrows to show the path that water will take within their watershed.

2. Using laminated topo maps that students have not seen, repeat the activity described in #7 under instructions.

Modification:

Use modeling clay or papier-mâché to construct the watershed models. Spray colored water onto the models and observe where the water collects and how it moves.

Extension:

Take a walk on the school grounds to see how the water flows and where it goes. You can take your class outside after a rainstorm or have them look for evidence of where water has flowed in the past. Into what river or stream does the water eventually flow? In what **river basin** does your school lie?

Student's Information

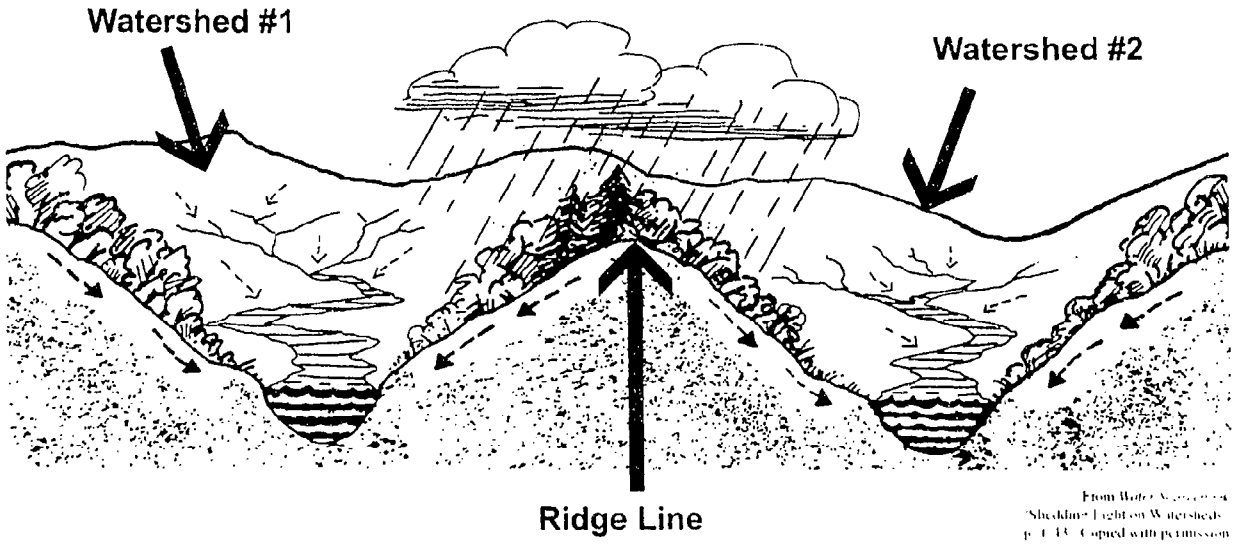
Each of us lives in a **watershed**. One way to picture a watershed is to think of a mountain valley. Imagine you are standing at the bottom of the valley, near a river. Looking up, you can see high ridges all around you. These ridges are the boundaries of the watershed. Since water always seeks the lowest level, all the precipitation that falls on the ridges and slopes will eventually end up in the river at the bottom of the valley. All the land between the high ridges and the bottom of the valley is part of this watershed. Activities that occur anywhere in the watershed will affect the river's **water quality**.

In the Piedmont and Coastal Plain, the land slopes more gradually to a river or lake. Although the watersheds aren't as obvious as those in the mountains, they do exist. One way to picture a watershed in the Piedmont is to look at a map. Find a river and its **tributaries**. If you think of the river as a giant tree and the tributaries as the tree's roots, all the land surrounding the "roots" is a part of this watershed. Whatever happens in the river's roots affects the entire river.

Watersheds are naturally self-destructive. The creeks or rivers that shape the watershed gradually erode the land. Human actions such as land clearing, dam building, farming, water diversion, and industrial development can speed up this natural process. If not carefully done, these activities can loosen the soil, allowing excessive amounts of **sediment** to run into the creeks and tributaries of the watershed.

It is important to realize that although we study individual watersheds, the watersheds are actually connected to one another. If one watershed becomes contaminated, it will eventually affect the watershed downstream. As water flows downstream, contaminants can accumulate and cause even greater damage to watersheds near the ocean.

In this activity, you will create your own watershed. When you visit South Mountains State Park, you will explore the Jacob's Fork watershed firsthand.



From Water Watershed
"Shedding Light on Watersheds"
p. 1-13. Copied with permission

Pre-Visit Activity #3 Journey Down River

Major Concepts:
- Watershed
- River basin

Learning Skills:
- Observing, communicating, and inferring
- Reading maps
- Responding creatively to an experience

Subject Areas:
- Science
- Social Studies
- English Language Arts
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Classroom

Group Size: 30 students

Estimated Time:
60 minutes or longer

Appropriate Season: Any

Materials:
Provided by the educator:
Per group:
current North and South Carolina State Transportation Maps, Journey Down River Worksheet, North Carolina River Basins map, pencil
Per student:
one copy of the Student's Information
Note: Free transportation maps may be ordered by calling: North Carolina — (919) 733-7600; South Carolina — (803) 737-1501. Poster-size North Carolina River Basins maps are available from the North Carolina Office of Environmental Education, 1-800-482-8724 (one free per school, additional copies $5 each).

Objectives:

- Locate the Jacob's Fork River on a map and identify the larger river basin to which it belongs.
- Locate dams, lakes, cities and other points of interest within the Catawba River Basin on a state highway map.
- On a map, trace the movement of a drop of water from the origin of the Jacob's Fork River to the Atlantic Ocean, then write a story to describe its journey.

Educator's Information:

This activity should help the students understand the concept of a **river basin**, which encompasses many smaller **watersheds**. The example given here is the Catawba River Basin which includes the Jacob's Fork watershed. Using map legends and identifying key geographical locations along the water course, students will trace the Catawba River from its headwaters to the Atlantic Ocean. Students will work in cooperative learning groups to complete the worksheet.

Important Note: The Catawba River becomes the Wateree River in South Carolina. Technically, it is more accurate to call the river basin the Catawba-Wateree River Basin. In this activity, we are mainly examining the upper part of this basin (the Catawba River section). The Catawba-Wateree River Basin empties into the Atlantic Ocean at Charleston, South Carolina.

Instructions:

1. Photocopy the Student's Information and distribute one copy to each student. Read and/or discuss this information with the class.

2. Divide the class into groups of three to five students per group. Provide each group with transportation maps for North and South Carolina and the Journey Down River Worksheet. (See the Materials section on this page for information on obtaining these maps.) The students should tape the two maps together so they fit correctly, then complete the Journey Down River Worksheet. The educator may provide one worksheet per group or one worksheet per student.

3. Have the students draw a line connecting the beginning of the Jacob's Fork River to South Mountains State Park, crossing the road that goes through the Pleasant Grove community. (Reason: the Jacob's Fork River actually begins in the park, although

this is not indicated on the transportation map.)

4. When the students have completed the worksheets, check their answers.

5. Using the North Carolina River Basins map as their guide, ask students to outline the boundaries of the Catawba River Basin on the North Carolina transportation map.

6. Look at the North Carolina River Basins map. What river basins in North Carolina contain waters that will eventually flow into the Atlantic Ocean? Which basins contain waters that will ultimately empty into the Gulf of Mexico? *Hint: Look for the Eastern Continental Divide. In the eastern United States, all the land to the east of the* ***divide*** *channels water to the Atlantic. All the land to the west of the divide channels water into the Mississippi River Basin and eventually to the Gulf of Mexico.*

Answer: Atlantic Ocean — Broad, Cape Fear, Catawba, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Savannah, Tar-Pamlico, White Oak, Yadkin. Gulf of Mexico — New, Watauga, French Broad, Little Tennessee, Hiwassee.

6. Write a story about your imaginary journey as a water drop, or other object or person, as you travel from South Mountains State Park to the Atlantic Ocean. Did you use a boat or other means of transportation? What was your favorite part of the water journey and why?

Extension:

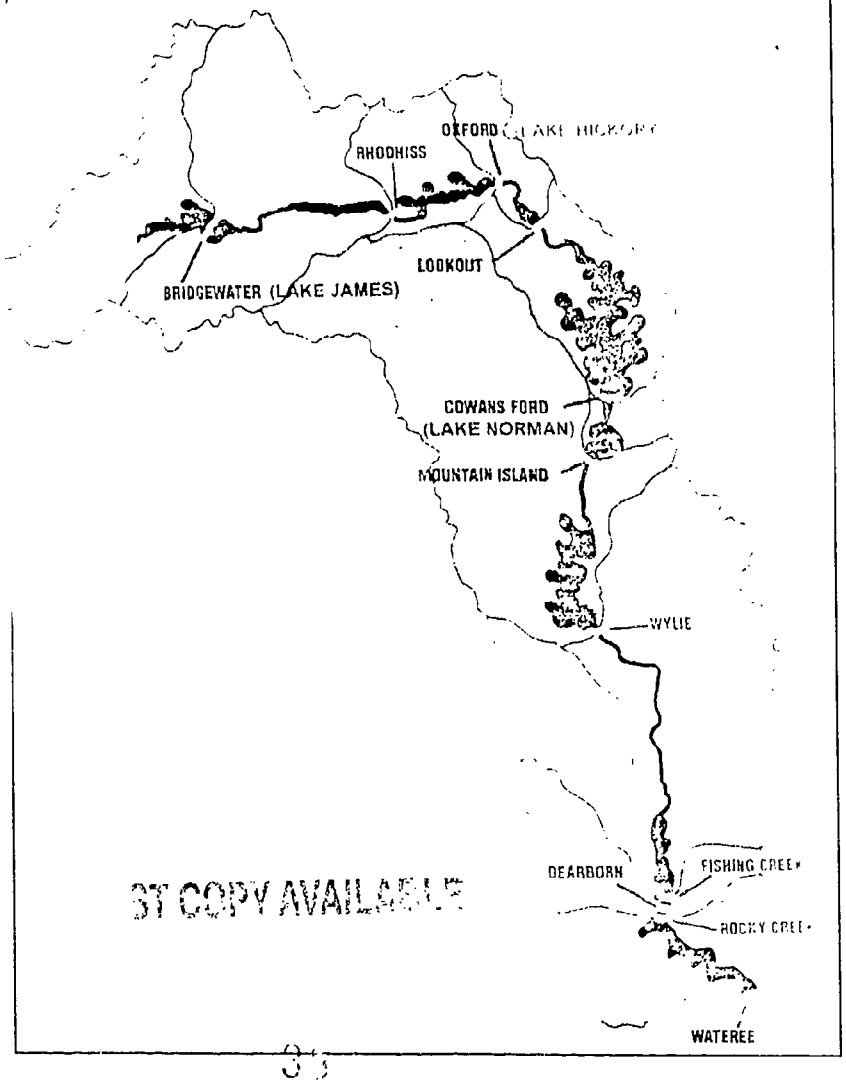
Learn more about North Carolina's 17 designated river basins by visiting the Division of Water Resources' website at: www.dwr.ehnr.state.nc.us/~rivers/ncbasins.htm

Assessment:

Give each student a state highway map. As a quiz, ask students to work independently to locate predetermined points of interest within another North Carolina river basin such as the Neuse or Tar-Pamlico. The educator could list the map questions on the chalkboard, overhead or quiz paper.

Reservoirs of the Catawba River Basin

(The Upper Portion of the Catawba-Wateree River Basin)



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Student's Information

A **watershed** is all the land that contributes to a particular body of water. It is a catch basin that guides all the precipitation and **runoff** into a specific river system. The simplest watershed is a stream that flows from a spring and goes through a valley. All the precipitation that falls into that valley eventually goes into that stream. This one valley is the watershed for this stream. When this stream joins up with another stream, then the watershed would consist of two valleys. A **river basin** is the watershed of an entire river. It encompasses the many smaller watersheds of the river's **tributaries** or branches.

Perhaps the single most important thing to remember about watersheds is that they are single units, connected to other watersheds as they join together downstream. What affects a watershed in one place eventually affects other sites downstream.

As you follow the course of the Jacob's Fork River on a map, you will see that it is part of the much larger Catawba-Wateree River Basin. The Catawba-Wateree River Basin does not receive runoff from any of its neighboring river systems.

Dark gray area is the Catawba River Basin -- the upper portion of the Catawba-Wateree River Basin

The upper part of the Catawba-Wateree River Basin, the Catawba River portion, includes 11 man-made lakes (reservoirs) and stretches 220 miles from the eastern slope of Grandfather Mountain near Boone, North Carolina, to Camden, South Carolina. This upper section of the Catawba-Wateree River Basin drains over three million acres of land!

The volume of water that passes through each of the 11 reservoirs in the Catawba River Basin is not just the runoff of the local land area. It is the sum of all the water that washes into the Catawba River from upstream, plus the runoff from the local land area. The further downstream you go, the greater the volume of water passing through each reservoir. After a heavy rainstorm, the amount of water in the lower part of the river basin can increase dramatically. Dams along the Catawba River allow people to control some of this water and prevent serious flooding downstream.

Journey Down River Worksheet

Student Names: _____

1. In what park does the Jacob's Fork River begin? _____

2. What is the name of the county where the Jacob's Fork River begins?

_____

3. Name the seven counties bordering this county. _____

_____ _____ _____

_____ _____ _____ _____

4. What is the name of the river that joins the Jacob's Fork River near Startown, North Carolina? _____

5. What is the name of the river that the Jacob's Fork River and the river in question #4 flow together to become? _____

6. In what county do these rivers join? _____

7. What is the name of the lake that the South Fork Catawba River flows into?

_____

8. What is the name of the city found northwest of this lake? _____

9. What is the name of the large city found east of this lake? _____

10. Name the counties that the Jacob's Fork River and the South Fork Catawba River flow through before emptying into the lake in question #7. _____

_____ _____ _____

11. What two states border this lake? _____ _____

12. The North Carolina transportation map shows seven of the eleven lakes (man-made reservoirs) in the upper part of the Catawba-Wateree River Basin. Name these seven lakes. _____ _____

_____ _____

_____ _____ _____

Journey Down River Worksheet (page 2)

13. Name the four lakes (man-made reservoirs) indicated on the South Carolina transportation map through which the waters of the Jacob's Fork River eventually flow.

_____ _____ _____
_____

14. The water in the Jacob's Fork River eventually flows into the ocean close to what city? _____

15. What is the name of the ocean into which the waters of the Jacob's Fork River eventually flow? _____

16. How many state parks are found along the North Fork of the Catawba River in North Carolina? ____ What are their names?
_____

17. How many United States routes or Interstate Highway routes cross the South Fork of the Catawba River ? ____ What are their names? _____

18. Which of the two lakes might have a greater problem with **siltation** and other forms of pollution, Lake James or Lake Wylie? _____ Why?
_____
_____
_____

19. Hickory, North Carolina is located in what compass direction of Rock Hill, South Carolina? _____.

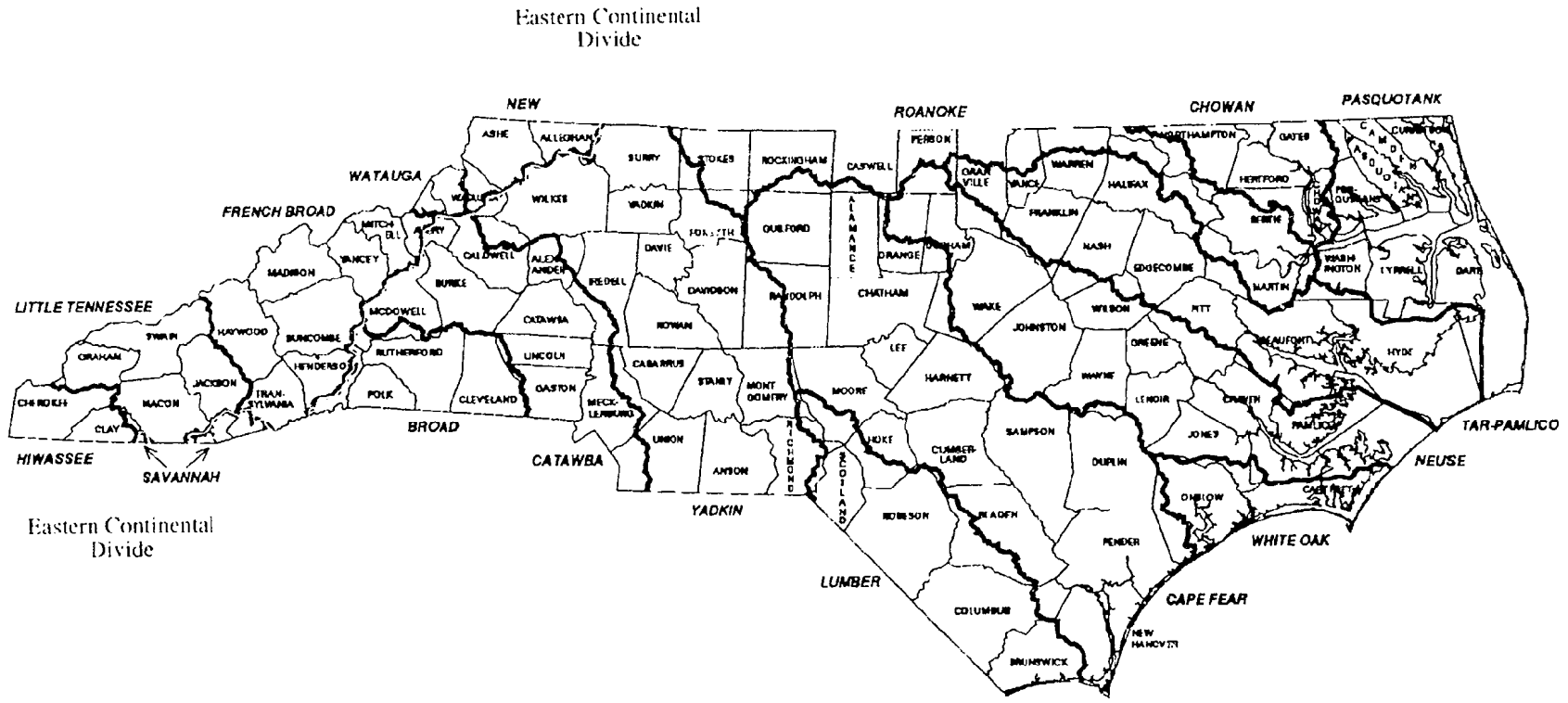
20. The South Carolina transportation map shows the Wateree River between what two lakes? _____ _____

21. Bonus: Name the four state parks that lie within the Catawba River Basin.
_____ _____ _____
_____

Journey Down River Worksheet — Answers

1. South Mountains State Park
2. Burke County
3. Caldwell, Catawba, McDowell, Lincoln, Cleveland, Rutherford, and Avery Counties
4. Henry River
5. South Fork Catawba River
6. Catawba County
7. Lake Wylie
8. Gastonia
9. Charlotte
10. Burke, Catawba, Lincoln, and Gaston Counties
11. North and South Carolina
12. Lake James, Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie
13. Lake Wylie, Lake Wateree, Lake Marion and Lake Moultrie
14. Charleston, South Carolina
15. Atlantic Ocean
16. Two, Lakes James State Park, Duke Power State Park
17. Two, U.S. Route 321 and Interstate 85
18. Lake Wylie is downstream from Lake James; therefore, a greater amount of pollution drains into Lake Wylie than Lake James. (Also Lake Wylie is just below Charlotte, the largest metropolitan area in the Catawba River Basin.)
19. Northwest
20. Lake Wateree and Lake Marion
21. South Mountains, Duke Power, Lake James, and Crowders Mountain state parks

North Carolina River Basins



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N.C. Department of Environment and Natural Resources
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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."

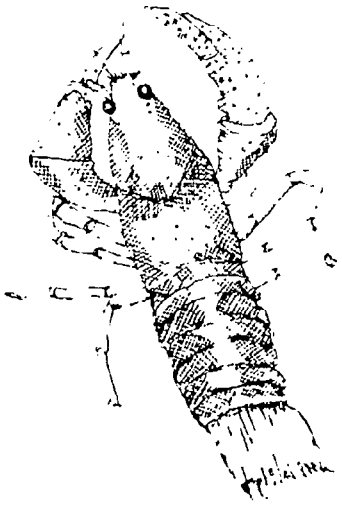
Materials:
Provided by park:
Per student: life jacket, pencil
Per group: kick net, wide mouth plastic jars, aquariums, plastic tubs, dissecting scope, magnifying glass, tweezers, clipboards, field guides to aquatic life, laminated fish keys, laminated invertebrate key, aquarium nets, plastic spoons, 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.

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.).

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.



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.

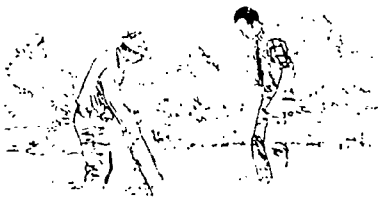
In the early days of coal mining, canaries were taken into mines. Canaries are more sensitive than humans to the presence of dangerous gases in the air, therefore their discomfort or death indicated the air was unsafe for the miners to breathe. Although this practice no longer exists, it stands as an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

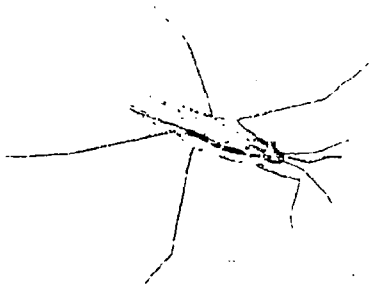
Student's Information

"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 everywhere 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 saying "Water is life." Think about that for a minute. Can you think of any living organism 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 emptying 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 **watershed**. A **healthy** river must have a well protected watershed because any kind of disturbance to the watershed has an effect on the river.

Life in a River:

The various forms of life found in a river can be compared to a fine stew or soup. A fine stew or soup needs lots of different ingredients. Usually the more you add, the better 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, diatoms 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 caught 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 **macroinvertebrates** (macros), such as stonefly **nymphs**, mayfly

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 rivers **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.

a prime dumping ground for dead leaves, a surpassing reservoir of oxygen and calcium. It will then also, and thereby, be a good osprey stream, a favorite among otters, a salvation to dippers and kingfishers and bank swallows and heron, mergansers and Canada geese and water shrews, mink and muskrat and beaver. Not to

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,

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

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.

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.

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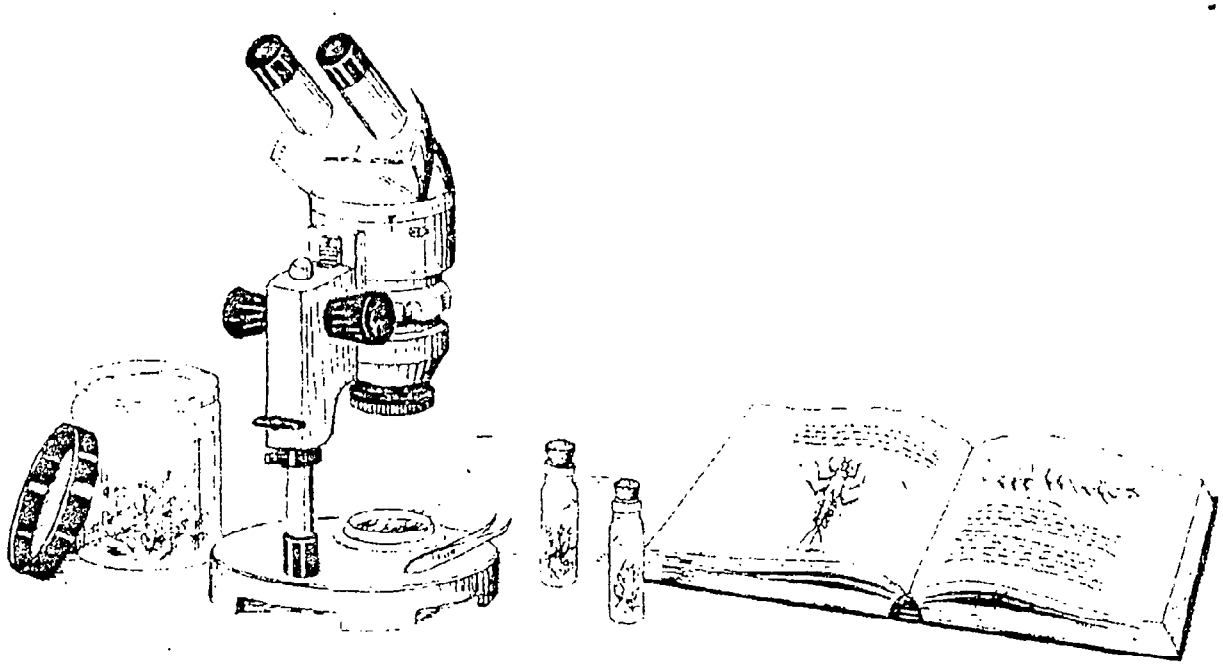

The students can calculate the Biotic Index Value by using a simple formula:

(3 x no. of Group I)
(2 x no. of Group II)
+ (1 x no. of Group III)
= **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 by some; luck of the hunt, 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.

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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.)

Group I	**Group II**	**Group III**
1._____	1._____	1._____
2._____	2._____	2._____
3._____	3._____	3._____
4._____	4._____	4._____
5._____	5._____	5._____
6._____	6._____	6._____
7._____	7._____	7._____
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).

(3 x no. of species - Group I)
(2 x no. of species - Group II)
+ (1 x no. of species - Group III)
= **Biotic Index Value**

Cumulative Index Values	**Biotic Index Rating**
23 and above	Excellent
17 to 22	Good
11 to 16	Fair
10 to less	Poor

Group I	**Group II**	**Group III**
1. hellgrammite 4. caddisfly	*1. dragonfly*	*1. blackfly larva*
2. mayfly	*2. crayfish*	*2. freshwater worm*
3. snail	*3.*	*3.*

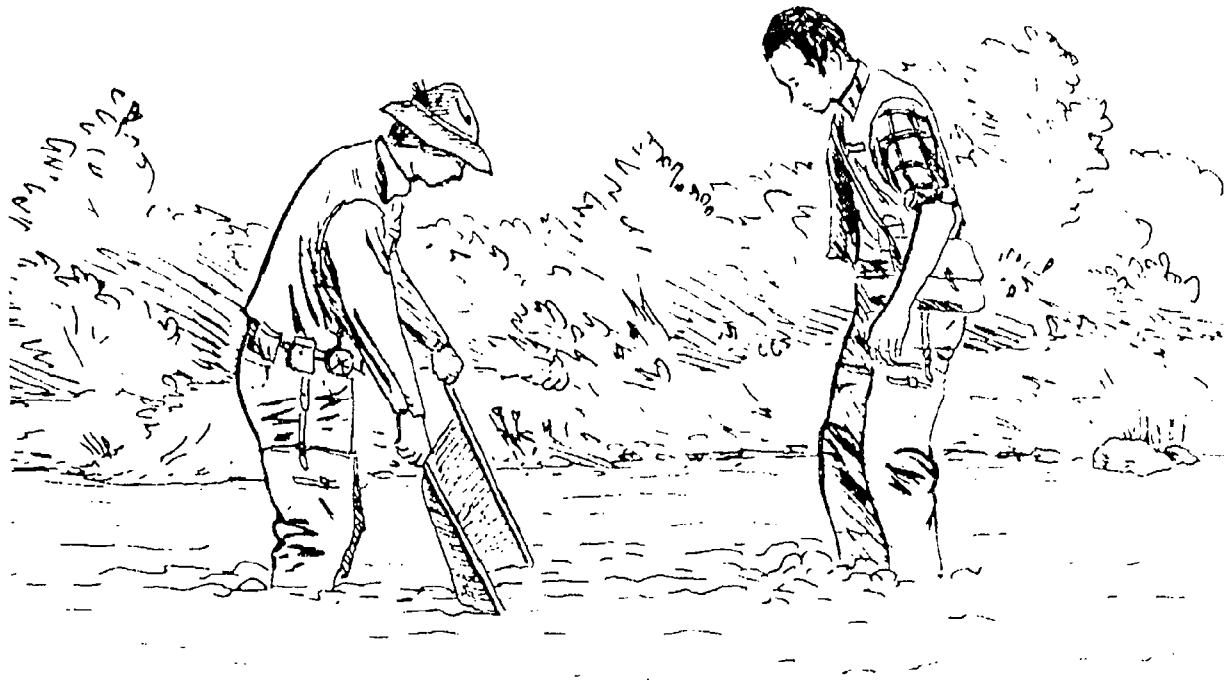
(3 x 4) + (2 x 2) + (1 x 2) = 18

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

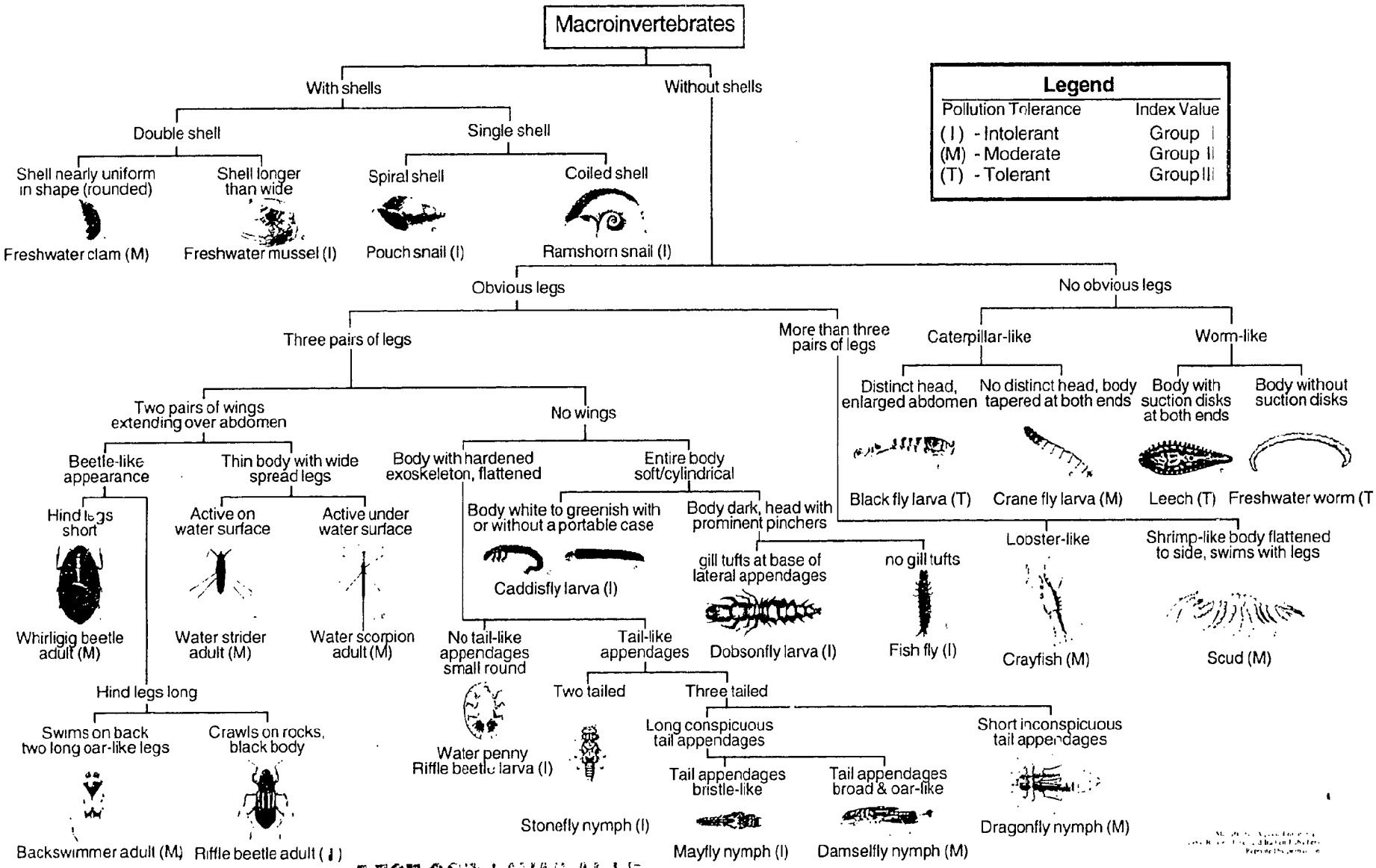
Adapted from *A Field Manual for Water Quality Monitoring*, An Environmental Education Program for Schools by Mark K Mitchell and William B Stapp

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



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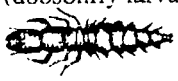
Pollution Tolerance of Macroinvertebrates key

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

Hellgrammite
(dobsonfly larva)



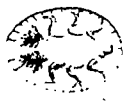
freshwater mussel

stonefly nymph

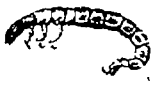
riffle beetle adult

right-handed pouch snail

water penny
(riffle beetle larva)

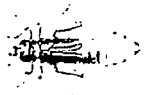


caddisfly larva

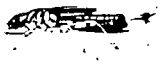


Group II - Index Value = 2
These macroinvertebrates can exist in a wide variety of water quality conditions.

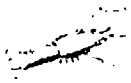
dragonfly nymph



damselfly nymph

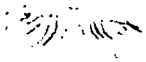


crayfish



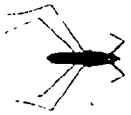
freshwater clam

scud



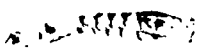
whirligig beetle

water strider



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

black fly larva



leech

freshwater worm

On-Site Activity #2 Streamside Hike

Major Concepts:
- Watershed
- Riparian area
- Aquatic plants & animals
- Water quality
- Indicator species
- Stewardship

Learning Skills:
- Observing, communicating, inferring
- Reading a map
- Collecting, analyzing and evaluating information

Subject Areas:
- Science
- English Language Arts
- Social Studies
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Hemlock Nature and High Shoals Falls trails

Group Size: 30 or less, preferably in groups of 10 or less with a minimum of one adult leader per group.

Time: 1 - 1 1/2 hours

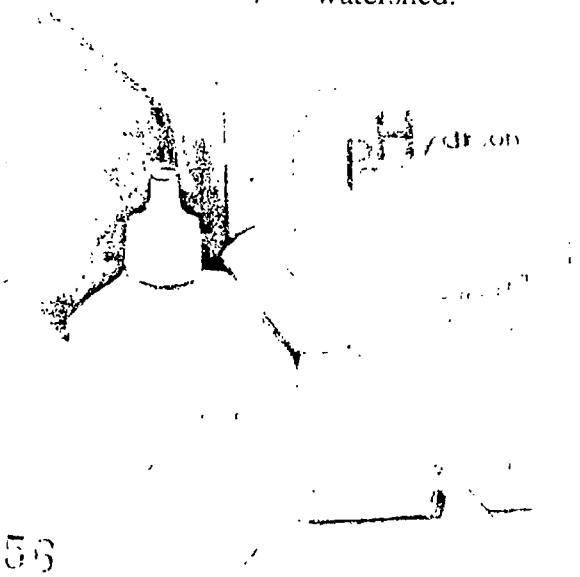
Appropriate season: April through October

Special Considerations:
- Leaders should scout trail before the walk to become familiar with recommended stops and to recognize potential hazards (i.e. slippery rocks, poison ivy, etc.)
- Leaders should carry first aid kit and water.

Materials:
Provided by park:
Per each adult leader: one backpack containing a *Pond Life* guide, trail map, thermometer, pH kit, clear plastic bottle, sheet of white paper, laminated "Key to Macroinvertebrates of the Jacob's Fork River from pre-visit activity #1, trout photos.
Provided by the school:
Per class: one first aid kit and water bottle
Per adult leader: one copy of the Streamside Hike Teacher's Guide

Objectives:

- Identify the Jacob's Fork watershed on a map of the park.
- Define riparian area.
- Identify three examples of riparian plants in the field.
- Identify three examples of aquatic animals in the field.
- Name and describe three characteristics of water that contribute to the overall quality of a water sample or body of water.
- Determine the pH, temperature and turbidity of Jacob's Fork River samples and make inferences regarding the overall quality based on the test results.
- Name three indicator species and explain how they are used to determine water quality.
- Explain the designation, "Outstanding Resource Water" and how it relates to the Jabob's Fork River watershed.
- Identify three species of trout inhabiting South Mountains State Park.
- Explain how the park protects the water quality in the Jacob's Fork River watershed.



Educator's Information:

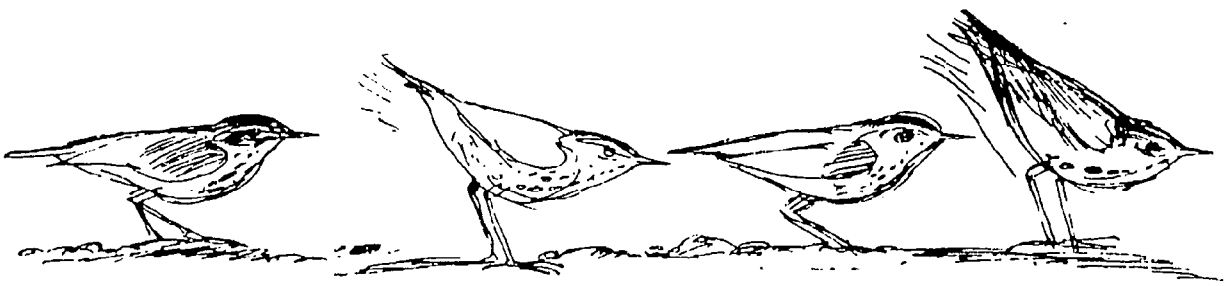
In this activity, educators will guide students along the Hemlock Nature Trail and the High Shoals Falls Trail. (The hike will be very easy for the first half-mile and moderately strenuous for the next mile.) Participants will hike through a **riparian area** then up to High Shoals Falls, a spectacular waterfall cascading 80 feet to the pools of water below. At different locations along the hike, they will make observations and determine the temperature, **pH**, and **turbidity** of the stream.

The purpose of this activity is to provide students with a first-hand look at some of the factors that affect **water quality** and to help them understand and appreciate the **diversity** of **aquatic** plants and animals found in this particular riparian environment. To ensure the success of this activity, teachers should conduct all of the pre-visit activities in this EELE. These activities will help students identify **macroinvertebrates** and provide them with a basic knowledge of **watersheds**.

A brief overview of the hike follows:

- **Stop 1** — students identify the Jacob's Fork River watershed on a raised relief map.
- **Stop 2** — students define a riparian area.
- **Stop 3** — students identify and observe three riparian plants.
- **Stop 4** — students use a thermometer to measure temperature, an indicator of water quality.
- **Stop 5** — students will measure the pH of the Jacob's Fork River and learn about the different factors affecting the pH of a body of water.
- **Stop 6** — students observe the stream and conduct a turbidity test using a clear jar and piece of white paper.
- **Stop 7** — students observe and classify macroinvertebrates living in the river.
- **Stop 8** — students use their senses of sight, touch, and smell to observe the stream.
- **Stop 9** — students observe the shallow pools of water typically inhabited by trout and review identifying characteristics of the three mountain trout species.
- **Stop 10** — students discuss the reasons for the outstanding quality of the water in the Jacob's Fork River and learn that the watershed is protected from development and **pollution**. At this point, they begin their optional ascent to High Shoals Falls, where they'll be asked to reflect on what they have learned during the hike and consider the importance of protecting our watersheds.

This hands-on interaction with the riparian **ecosystem** will help students appreciate the natural resource and encourage them to become stewards of their environment.

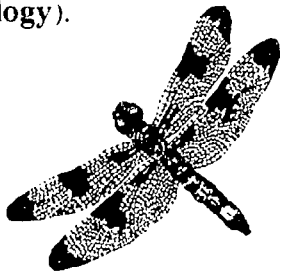


Instructions:

1. To ensure the success of this on-site activity, we recommend you conduct all of the pre-visit activities in this EELE.

2. Before bringing students to the park, study the Streamside Hike Teacher's Guide. Visit the park to scout the trail your self. Ideally, this should be done at least one week prior to your class' visit and at the same time of day. This will help you identify potential trail hazards (slippery areas, steep banks, etc.) and become familiar with the exact locations of the stops described in the Streamside Hike Teacher's Guide. You could also look for additional stops to view plants and wildlife.

If you are unfamiliar with aquatic environments, you will need to carry a field guide or request assistance from park staff. An excellent all-purpose guide is *Pond Life* by the Golden Press. (See Reference section). A list of commonly-observed wildlife is also included in this activity. Remember that it's less important to identify the specific name of a plant or animal than it is to appreciate its place in nature (**ecology**).



3. Divide the class into small groups of ten students or less. Provide one adult leader per small group. Give each leader a copy of the Streamside Hike Teacher's Guide and backpack containing the items included in the materials list prior to the hike.

4. During the hike, one of the group leaders should carry the first aid kit and water bottle. Each student should have a "buddy" in his/her group.

5. Begin the hike with a brief introduction during which you will cover topic, trail distance, time, difficulty, and special rules. Here are some rules to teach your students:

a. Stay on the trail until told otherwise.

b. Watch for roots, stumps, sloped walking areas, and other hazards. Running is **not** allowed on the trail.

c. Do not pick, injure or destroy any plants or animals in the park. (The purpose of the state parks system is to preserve and protect our natural resources.)

d. Being quiet will help you see more wildlife.

e. The adult leader should always be at the front of the group.

f. When picking up litter along the trail, do not touch broken glass, twisted metal or fishing line containing hooks.

6. When conducting the hike, start each small group at five-minute intervals so that the groups do not get too close to one another. Make sure all the leaders know the amount of time that they have to conduct the hike and visit all the stops. All groups should have a designated place to meet at the end of this activity.

Remind the leaders that when pausing to view an interesting object along the trail, they should lead the first half of their group beyond the object so that all will have a good view.

Assessment:

1. Back in the classroom, ask the students to write about their experien on the Streamside Hike. The essays should include the following terms: riparian, water quality, indicator species, and Outstanding Resource Water.

2. Ask students to compare/ contrast a stream on their school grounds or in their neighborhoods with the Jacob's Fork River. They should use the same water quality indicators that they practiced on their Streamside Hike at the park.

Streamside Hike Teacher's Guide

NOTE TO TEACHER: The suggested script for the guide is labeled as such. Discussion questions are indicated by bullets (•).

Stop 1: Raised Relief Map at Outdoor Display Area — The Jacob's Fork Watershed

Script — Today we are going to hike along the Hemlock Nature Trail and part of High Shoals Falls Trail to study the Jacob's Fork River and the plants and animals living along the river here at South Mountains State Park. Before we begin, however, I want you to understand exactly where you are in terms of the **watershed**.

• **Who can tell me what a watershed is?**
A watershed is all the land area from which water drains to a particular water body; a catch basin that guides all the precipitation and **runoff** into a specific river system.

Script — The high area of land that separates two adjacent watersheds is called the **divide**. Look at this raised map depicting South Mountains State Park.

• **Can you point out approximately where we are?** Students should locate the Jacob's Fork River near the park office.

• **Show me the watershed for the Jacob's Fork River.**
Students should follow the Jacob's Fork River on the map up to the top of the highest ridge — the divide. The divide will be on the western edge of the relief map. (Lower CCC Road follows the **ridge line**.) The map area on the eastern side of the divide is the Jacob's Fork watershed. The map area to the west is the Henry Fork Watershed.

Script — Water quality is critically impacted by everything that goes on within a watershed. Mining, forestry, agriculture and construction practices all affect a watershed. Runoff from streets and parking lots; chemicals from lawns and gardens; failing septic systems and improperly treated municipal **sewage** all affect water quality. As we hike today we will learn more about land use in the Jacob's Fork watershed and its effect on the quality of the water in the streams at South Mountains.

Stop 2: Bridge at Beginning of Hemlock Nature Trail — What is a Riparian Area?

Script — We are now at the beginning of the Hemlock Nature Trail. Look around you at the plant life.

• **Do you see many different kinds of trees and plants or very few different species?**

Many different species.

• **Why do you suppose this is the case?**

rich **soil**, water available, cool and shady, etc.

Script — As we hike along the stream banks of the Jacob's Fork River, we will be hiking through a **riparian area**. Riparian areas are the "green zones" along the banks of rivers and streams and around springs, bogs, wetlands, lakes, and ponds — the land areas directly influenced by the presence of water. They are called green zones because they are some of the most productive **ecosystems** in nature, supporting a wide **diversity** of plant and animal life.

Stop 3: Area With Dog Hobble, Eastern Hemlock and Rosebay Rhododendron (See Marker) — Riparian Plants

Script — Dog hobble or fetterbush (*Leucothoe axillaris* var. *editorium*) is a riparian plant. It is found along mountain streams and moist areas, usually in large tangled masses. It grows two to three feet high.

- **Does anyone see the dog hobble near where we're standing?**

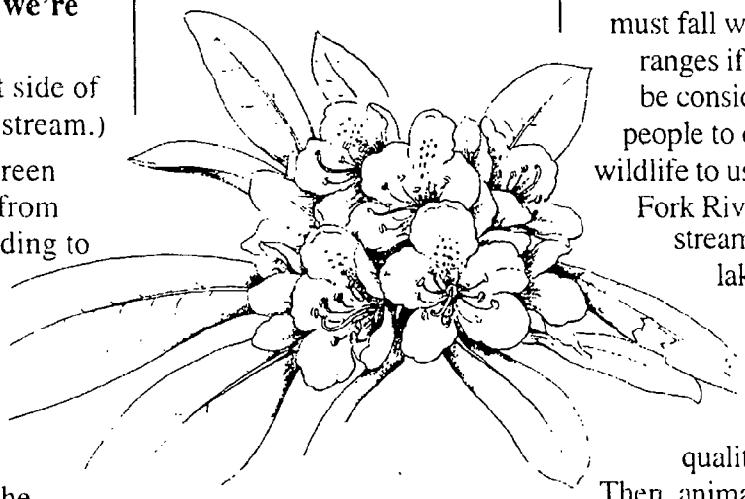
(It will be on the left side of the trail traveling upstream.)

Script —This evergreen shrub gets its name from bear hunters. According to legend, the hunter's dogs would sometimes be led into an entwined patch of this shrub by a wily old black bear. The bear would wait in the center for the dogs to close in, then attack as the dogs became entangled or "hobbled" by this plant.

- **Feel the texture of the dog hobble leaves.**

Script — This area is ideal for another riparian species, the eastern hemlock (*Tsuga canadensis (L.) Carr.*) This tree thrives in the high humidity and rich, sandy soil, and the seedlings grow well in low light conditions. Do you see any trees around you that are green and tall with branches that are drooping and feathery? These are eastern hemlocks. Let's get close enough to touch one. Feel the flat, round-tipped needles. Flip the needles over. See the two pale lines (stomata) underneath.

Note to Teacher: Now locate a mature hemlock (approximately 20 feet on the right).



Script — Feel the dark gray bark on this old hemlock. It is divided into narrow, rounded ridges.

Now, look across the Jacob's Fork River to the other side.

- **What do you see?**

A beautiful stand of rosebay rhododendron (*Rhododendron maximum*). In early summer, this shrub produces large white to pinkish flowers spotted with darker pink.

- **Why do you think it is such a dominant plant in this riparian environment?**

Because it grows best on cool, moist, well-drained, north-facing slopes, and all of these conditions are found at this location.

Stop 4: Streamside Area (See Marker) — Temperature Test

Script —Water quality is a term used to describe the ability of a body of water to support life. Several characteristics of the water must fall within certain ranges if the water is to be considered "safe" for people to drink or for wildlife to use. The Jacob's Fork River and other streams, rivers, and lakes can only absorb a certain amount of **pollution** before the overall quality goes down. Then, animals die and people get sick.

At this point along the Jacob's Fork River we are going to conduct some tests that will tell us about the quality of the water here.

First, let's conduct a very unscientific but useful test. Everyone come over and put your hand in the water.

- **How does it feel?**

very cold

Script — The stream is always cold, even in summer, because it is fed by **groundwater**. The temperature of the groundwater, which

enters the stream through springs, is always around 55° Fahrenheit (13° Celsius). The steep hillsides and the trees shade the creek so that the sun does not have a chance to warm the water until the stream reaches more open areas.

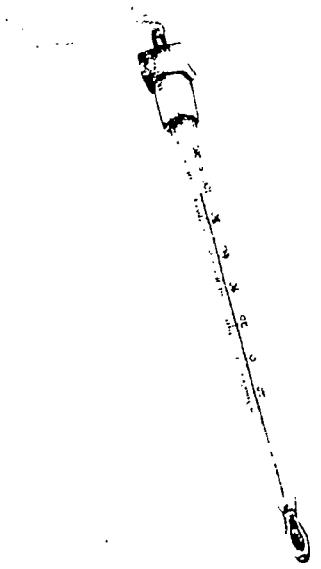
Now, let's use this thermometer to take a temperature reading.

To measure the temperature of the water:

1. Have a student grasp the end of the thermometer and place the bulb into the water.

2. Ask the student to hold this position for two minutes.

3. Tell the student to tell the rest of the group the Celsius temperature reading, and ask them what that temperature is in Fahrenheit. (The formula for conversion is: $f = 1.8(c) + 32$). The temperature should range between 38° - 72° Fahrenheit (3° - 22° Celsius), depending on the time of day and year.



Script — Why is this information important? Because water temperature is a life or death factor for many plants and animals living in water. Most trout are cold water **species** and will die if the water temperature gets as warm as 77° Fahrenheit. Their eggs won't hatch if the water is any warmer than 57°F.

Temperature also affects **dissolved oxygen**, or the amount of oxygen dissolved in water. Why does that matter? Because fish and other **aquatic** animals need the oxygen that is dissolved in water to breathe.

Remember this general rule — the warmer the water, the less oxygen it can hold.

Let's move on to our next stop where we'll conduct another water quality test.

Stop 5: Streamside (See Marker) — pH Test

Script — At this location we are going to conduct a **pH** test.

- **Who can tell me what pH stands for?**

potential of hydrogen.

Script — pH is a measure that indicates the relative acidity or alkalinity of a substance. The pH scale is a logarithmic scale ranging from 0 to 14. The lower the number the more acidic the substance; the higher the number the more alkaline or basic the substance. A pH of 7 is considered neutral.

Most plants and animals cannot survive for very long in water that is below a pH of 6 or above a pH of 9. Trout can't survive in a pH below 6.5 or above 8.5.

Many factors affect the pH levels in a body of water. Cars emit **nitrogen oxide** which mixes with water vapor in the air to create **acid rain**. Some factories and coal-fired electric power plants emit sulphur dioxide into the air that creates more acid rain. Runoff also affects the pH of water. When it rains, fertilizers from farms and homes run into water and affect the pH.

To conduct the pH test:

1. Give a student a pH kit. Ask the student to remove the test tube from the kit and collect a sample of the stream water in the tube, filling the tube to about a quarter-inch from the top.

2. Have another student place one drop of the indicator solution in the tube, place the lid on the tube, shake it and wait 10 seconds.

3. Have the two students compare the color of the

solution in the tube with the chart on the front of the pH kit and choose the number of the color it most closely resembles. This is the pH reading. (The pH reading will probably be between 6.5 and 7.0, a level conducive to a variety of aquatic species.)

Stop 6: Streamside Near Rock Bar (See Marker) — Turbidity Test

Script — Another thing to look for when trying to determine the quality of a body of water is how muddy or turbid the water is. **Turbidity** refers to the amount of **sediment** or foreign particles suspended in water. Very muddy or dark water has high turbidity.

- **Look at the stream water and tell me how you would describe it. Is it muddy or clear?**

clear

- **Does it look like there are a lot of sediments floating around in the water?**

no

Let's conduct a simple turbidity test using this clear jar and a white piece of paper.

To conduct the turbidity test:

1. Give a student the clear plastic jar and have the student collect a sample of the Jacob's Fork River water in the jar, making sure it is free of any obvious debris.

2. Have another student put a piece of white paper against the jar of water so that the water is easier to see.

Additional Questions:

- **How would you describe the color? Is it colorless, greenish, murky tan, a clear tea or coffee color?**

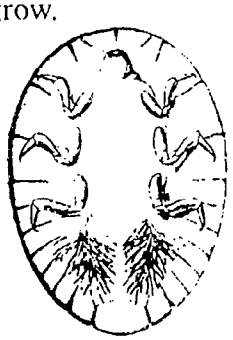
The water will probably be clear, an indication that it is free of suspended sediment.

- **How does this compare with the streams near your home or school?**

- **Why do you think it is so important for a stream or other body of water to be clear? How would increased turbidity affect the plants and animals in the stream?**

If too much sediment collects on the bottom of the streambed it will suffocate fish eggs and other aquatic organisms. Also, turbid water can irritate the gills of fish and disrupt their ability to breathe.

In addition, if water becomes too muddy, sunlight can no longer reach the stream bottom. If this occurs, submerged aquatic plants can no longer survive and grow.



Let's move on to our next stop where we'll conduct another water quality test.

Stop 7: Rocky Area Along Stream (See Marker) — Looking for Aquatic Animals

Procedure:

1. Ask three of the students to come to the edge of the stream, reach into the water, pick up a stone, and show the underside to the rest of the group.

2. Using the Key to Aquatic Macroinvertebrates from pre-visit activity #1 or on-site activity #1, ask the students to identify some of the **macroinvertebrates** attached to the rocks. (They will probably see species like the mayfly **nymph**, stonefly nymph, water penny, caddisfly **larva**, and/or others.)

Script — In streams or other aquatic environments, the presence or absence of certain organisms, called **indicator species**, reveals much about the quality of the water. Macroinvertebrates like the mayfly nymph, stonefly nymph, water penny, and caddisfly larva cannot survive in water that is polluted. These creatures are indicators of excellent water quality.

The data or results of the four tests we just performed (temperature, pH, turbidity, and macroinvertebrates) indicate that this stream has very high quality water. This is indeed true. The

North Carolina Division of Environmental Management (DEM) has classified this stream as **Outstanding Resource Water** or ORW. The ORW classification is given only to unique and special waters which have excellent water quality and some special resource value, such as a diversity of plant and animal species. This ORW classification is given to the stream as a means of protecting it from practices that might harm the stream.

DEM uses many of the same tests we used here today in determining the quality of a body of water.

Stop 8: Benches Near Rippling Area — Sensory Stop

Script — Find a quiet spot near the stream and try to sit very still.

- **What plants and animals do you see around you?**
- **Does this location along the stream look much different than it did at the beginning of our hike?**
- **Is the stream fast or slow moving here?**
- **What sound does the stream make?**
- **Can you hear any animals?**
- **What does the wind sound like?**
- **How do the smells near the stream compare to those on a road or in a home?**
- **Does the water smell the same as the water that comes out of your faucet?**

Script — Get up and touch the environment around you.

- **How does the soil feel? Compare it to the soil in the woods or schoolyard.**
- **Are the rocks in the stream smooth or rough?**
- **How does it make you feel to be in a place like this?**

Stop 9: Pier Above Whitewater and Pools — The Trout of South Mountains

Script — See the areas of water below the fast-moving whitewater? Trout often stay in these areas because oxygen is more abundant there than in very slow moving water. In addition, they feed on aquatic insects that float over the rapids into the pools.

The trout living at South Mountains are not native to these streams. Three species inhabit these waters: brook, rainbow, and brown trout.

Note to Teacher: Hold up and pass around the different photos as you discuss the fish.

Script — Let's learn how to tell these three species apart. The brook trout (*Salvelinus fontinalis*) is often a brilliantly colored fish. It is readily identifiable by the white leading edge, backed by black, on its lower fins.

The brown trout (*Salmo trutta*) has become North Carolina's most dominant trout, due to its size and hardy appetite. It can be identified by its brownish-yellow color and the scattered black, red, and orange spots on its sides.

The rainbow trout (*Oncorhychus mykiss*) is identified by its black spots and the pinkish to red band running the length of its body. This fish is quite a fighter, often jumping from the water when hooked.

You'll learn more about these trout and their **habitat** needs during Post-Visit Activity #2.

To fish at South Mountains State Park, you need a state fishing license and a special trout license, unless you are under the age of 16. Children under 16 do not need any kind of license if they are accompanied by a licensed adult.

Stop 10: Just Before Bridge Over Shinny Creek — The Protected Watershed

Script — From this location we can see where Shinny Creek and the Jacob's Fork River converge. (Shinny Creek is the water flowing under the bridge. The Jacob's Fork can be seen to the left.) Shinny Creek is one of many **tributaries** of the Jacob's Fork River within the park.

Through all of our observations and tests today we have learned something about the water here.

- **What have we learned about this river?**

The Jacob's Fork River (within the park) is a very clean, **healthy** stream with a diversity of plants and animals.

- **We haven't really discussed why the river is so clean, however. Does anyone have any ideas?**

Because the watershed is protected from development and other potentially harmful land use activities.

- **What kind of land use activities could potentially contribute to water pollution and how?**

1. Farming — pesticides, chemical fertilizers, and animal waste; sediment or soil runoff from fields.

2. Homes — human waste from malfunctioning septic systems and treated sewage from wastewater treatment plants, fertilizers and pesticides from lawns, improperly disposed of household chemicals.

3. Logging — runoff from poor logging operations (not replanting or using silt fences, or, cutting trees right up to the stream bank — not leaving a buffer.

4. Parking Lots — motor oil that has leaked onto parking lots and run into streams during periods of rain.

5. Landfills and waste disposal sites — landfills may leak chemicals into groundwater.

6. Air pollution — pollutants in the air can enter streams via precipitation or runoff. For example, acid rain may lower the pH of the streams in the watershed and adversely affect water quality for the trout and other aquatic animals.

Script — Let's look at how this particular watershed is protected? Look around you — most of the watershed is forest. The plants in the forest work together like a giant filtering system, collecting and trapping sediment and other pollutants in stormwater runoff. The well-developed root systems of this mature forest protect the stream banks from **erosion** during floods and lessen the effect of flooding further downstream.

The fact that this entire watershed is in a state park means that it will be protected from potentially harmful land use activities. South Mountains State Park is a very large park (over 13,000 acres), containing the Jacob's Fork River, the Henry Fork River, and all of their tributaries from the headwaters to the park boundary. More than 30 miles of streams are protected by this park. The mission of the state parks system is to preserve and protect our natural resources. As long as this land remains a state park, the watershed will not be exposed to development, farming, logging, and other activities that may lower the water quality.

Beginning of Optional Hike to the Falls

Script — The trail will get much steeper now as we make our way up to High Shoals Falls. This 80-foot waterfall cascades over a cliff of bare rock. As we enjoy this beautiful natural sight, think about the forest's role in protecting our water quality. We wouldn't enjoy the waterfall very much if it were a torrent of nasty, muddy water! In addition to being vital to all forms of life, clean water is also a thing of beauty.

I want you to carefully observe the falls so that you can write about your experience later. What does the water look like as it cascades over the rocks? Do you notice any smells — does it smell like the river downstream? Can you feel the spray as the water hits the rocks? What does it sound like — does it splash, pound or roar? Try to capture the waterfall in your memory.

C-1

Hemlock Trail – Common Aquatic Plants and Wildlife

MAMMALS

RACCOON

MINK

BIRDS

BELTED KINGFISHER

EASTERN PHOEBE

LOUISIANA WATERTHRUSH

TREES

EASTERN HEMLOCK

TAG ALDER

RHODODENDRON

FISH

TROUT

SMALLMOUTH BASS

ROSEYSIDE DACE

INSECTS

MAYFLY

STONEFLY

CADDISFLY

WATER STRIDERS

REPTILES

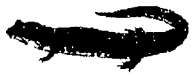
NORTHERN WATER SNAKE

QUEEN SNAKE

COPPERHEAD

AMPHIBIANS

DUSKY SALAMANDER

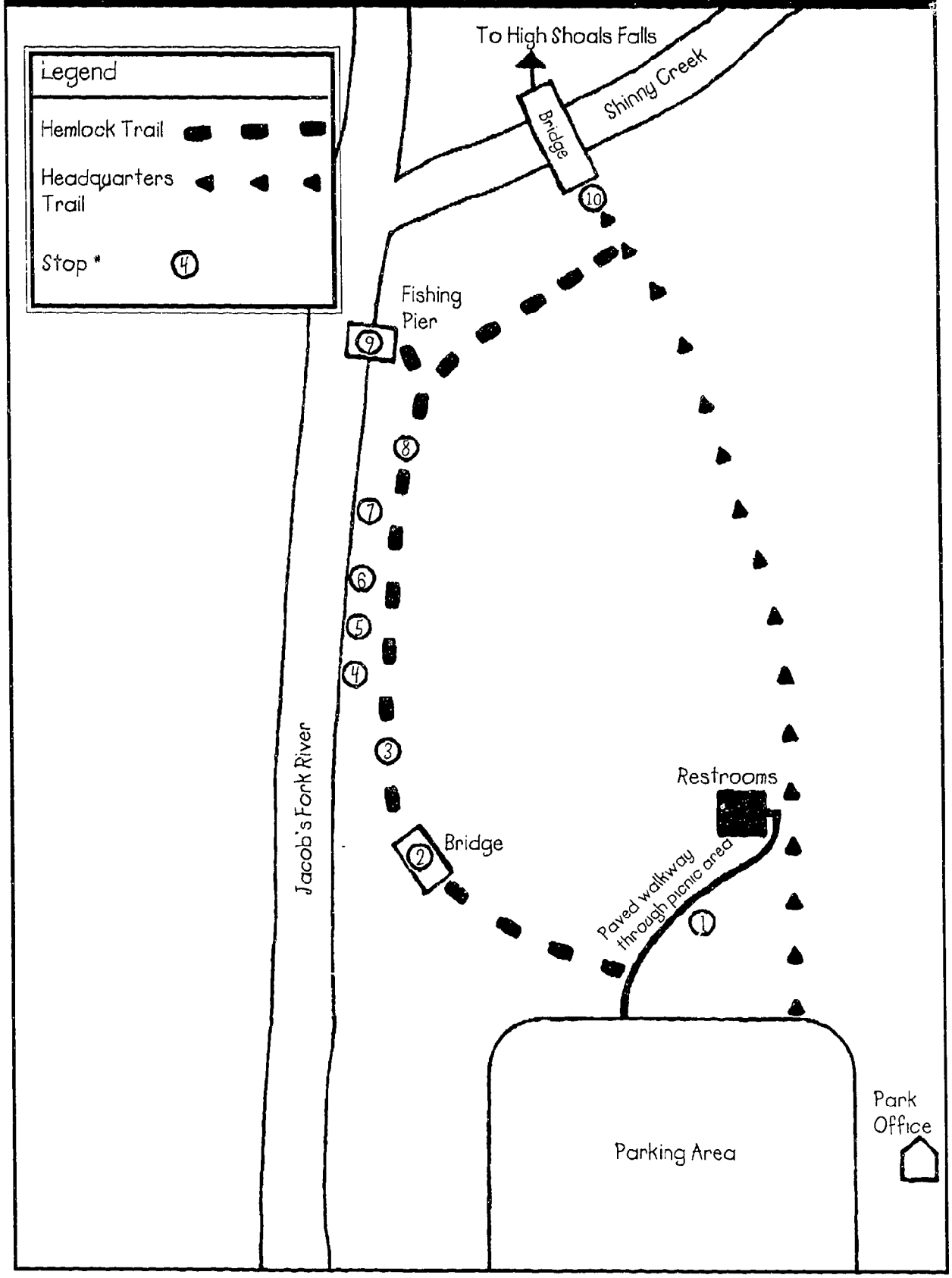


WOOD FROG

PLANTS

DOGHOBBLE
CARDINAL FLOWER
JEWELWEED
MAYAPPLE

Streamside Hike Trail Map



On-Site Activity #3 Streambed Silhouette

Major Concepts:
- Depth profile
- Streambed
- Siltation
- Habitat

Learning Skills:
- Observing, classifying, using numbers, interpreting data
- Measuring depths and plotting points
- Collecting, analyzing and expanding information
- Working in cooperative learning groups

Subject Areas:
- Science
- Mathematics
- English Language Arts
- Social Studies
- * See Activity Summary for a Correlation with DPI objectives in these subject areas.

Location:
Jacob's Fork River, near park office

Group Size:
30 or fewer

Estimated Time:
1 hour

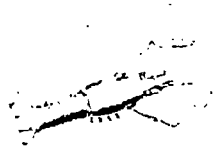
Appropriate Season:
Late May to early October

Materials:
Provided by park:
Per educator: flagging tape
Per group: Key to Aquatic Macroinvertebrates, 25 ft. tape measure, metal yardstick, pencil, Streambed Silhouette worksheet, clipboard
Provided by the educator:
Per student: Student's Information, Streambed Silhouette — Graph Paper (two sections), scissors, tape
Provided by each student: Clothes and shoes that you can wear into a stream; and a complete change of clothes and shoes
Note: There is a public restroom located close to the activity site where the students can change clothes.

Special Considerations:
For safety, arrange to have at least one adult supervisor for every group.

Remind the students of the appropriate dress for the on-site activity (i.e. old shoes without holes in them, old jeans, etc.)

It is the responsibility of the educator and group leaders to be aware of special considerations, medical needs, disabilities, 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.



Objectives:
- Complete a cross-sectional depth profile of a section of the Jacob's Fork River.
- Describe three events that might alter the depth profile of a stream.
- Explain the relationship between streambed topography and the numbers and diversity of animals that can live in a stream.
- Describe two problems that can result from siltation of streams.
- List three ways people can help protect rivers and water quality.

Educator's Information:

In this activity, the students will learn a simple method for creating a cross-sectional depth profile of a stream. They will then use this information to explore how the profile of a stream affects **water quality** and the types of **aquatic** plants and animals that are living in the stream. They will look at ways streambeds are affected by human activities and weather events.

Be sure to read/discuss the Student's Information with the class prior to your visit.

Instructions:

1. Before you come to the park: Using the Student's Information as a guide, lead a brief discussion concerning the importance of streambed topography in determining what types of aquatic life can live in a stream. Tell the students that when they visit South Mountains State Park, they will do a depth profile of a section of the Jacob's Fork River. This will help them learn more about streambed topography and the animals that live in the stream. At this time, you may wish to divide students into cooperative learning teams of four to five students. Assign the team roles described in step two below and listed on the data sheet. Make sure each team has two members who are prepared to enter the water: one will take the depth measurements and the other will cross the stream with the measuring tape.

2. At the park, use one of the cooperative learning teams to help you demonstrate the following method of taking a cross-sectional depth profile in a stream.

a. Have two students (one on each side of the stream) stretch the measuring tape across the stream, making sure it is level and just at the surface of the water. The student who is crossing the stream to get to the opposite bank should move slowly so that the bottom is not disturbed. This student will call out the width of the stream to a third student, the data recorder.

b. A fourth student will use a yardstick to take depth readings at 12-inch (one-foot) intervals along the measuring tape. The person taking the readings should call out the depth at each interval to the data recorder. Obviously, this activity will require walking in the stream. To avoid disturbing the **habitat**, the depth taker should move slowly and carefully along the measuring tape.

c. Finally the depth taker and the students holding the tape should let the data recorder know of any animals they see in the water. They could each remove a small rock from the stream and examine it for the presence of **macroinvertebrates**. Use the Key to Aquatic Macroinvertebrates to help identify the different **species** that are found. The students should be very careful to replace the rocks and animals gently in the same location that they were found.

3. When the students understand the procedure, divide the class into their learning teams. (The fifth student in a team could be the "animal identifier" using the Key to Aquatic Macroinvertebrates.) Each team should have a clipboard, data sheet, pencil, tape measure, yardstick, and the Key to Aquatic Macroinvertebrates (from on-site #1). Ask the teams to choose a section of the stream (within the boundaries of the flagging tape) to take readings for their depth profile. Make sure all the teams start taking their depth measurements from the same side of the stream.

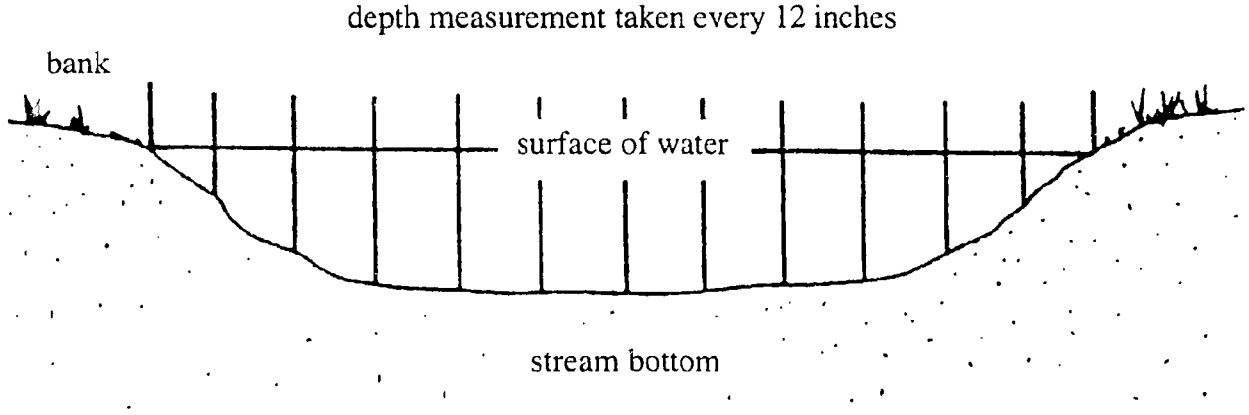
4. The teacher should make a sketch of the study section of the stream and record where each team has taken measurements. Teams should be numbered beginning with the team furthest upstream.

5. When the teams have completed their measurements and filled out their data sheets, ask each student to graph his/her team's data. (The teacher should photocopy the two graphing sheets provided at the end of this activity.) Ask each student to cut and tape the graphing sheets together (on the back side) before plotting points. Refer to the "Section of a Sample Graph" on the Student's Information page for an example of how to plot and connect the points. Also ask students to write the names of the animals they found in the stream, underneath their graphs. Display the depth profiles (one per team) on a bulletin board in sequence

from upstream to downstream within the study area. [Note: On the enclosed graph, one interval on the x-axis is six inches, while one interval on the y-axis is only three inches. The depth has been deliberately exaggerated with respect to stream width to help the students see changes in the bottom more easily.]

6. Help students interpret the data they have collected. Ask each team to describe the depth profile for their section of the study area. Are all the profiles the same?

- Is the profile in your section smooth and straight after the initial drop-off, or does it go up and down? (Answers will vary.)
- What do the humps represent? (Rocky areas)
- Why are rocky areas important to the aquatic life in the stream? (Provide a hiding place for **predators**. Provide a stable surface for macroinvertebrates to attach so they are not swept downstream by the current. Create rapids in the stream which allow more oxygen to be dissolved in the water.)
- What do the flat, straight sections of the profile indicate? (Sandy flat area)
- Why are these flat areas important? (These are places where plants can take root and grow providing food and shelter for some animals.)
- Let's compare the kinds and numbers of aquatic animals that each team observed in their study section. Were all the sections alike? If not, what could account for the differences? (One section may have had more rocks; some sections may have been shallower than other sections; some sections may have had more shade or cover along the stream banks, etc.)
- How would periods of flooding affect the stream profile? (The stream would be deeper and wider; the current may carry away smaller rocks, altering the habitat.)
- How would periods of drought affect the stream profiles? (The stream would be shallower and narrower. Rocks currently providing shelter may be above the surface of the water and no longer available to aquatic animals.)
- If livestock were allowed to drink from this stream, how might it be affected? (The animals might destroy the **riparian** vegetation and destabilize the stream banks, causing **soil** to wash into the stream that might cover rocks. This is called **siltation**.)
- If all the land surrounding the stream were developed or logged, how might the stream profile change? (If **silt** fences and vegetative buffers were not used, the soil would wash into the stream covering rocks and making the profile flatter.)



Assessment:

Have the students do a depth profile of a stream near their school. Compare this profile with the depth profile of the Jacob's Fork River. If this is not possible, give students depth readings from an imaginary stream, along with information on the aquatic animals living there. Have students plot the depth profile and interpret the data by answering questions similar to the discussion questions provided in the instructions.

Extension:

As a class project or school project, adopt a stream. If the stream lacks cover, ask fisheries biologists in your area to recommend what could be provided to increase the amount of cover in the stream. If the stream lacks shady areas, plantings could be done to improve the stream banks.

Student's Information

The streambed is a vital **habitat** for many **aquatic** animals. The topography of the streambed influences water temperature, **dissolved oxygen**, and the **diversity** of animals in the stream.

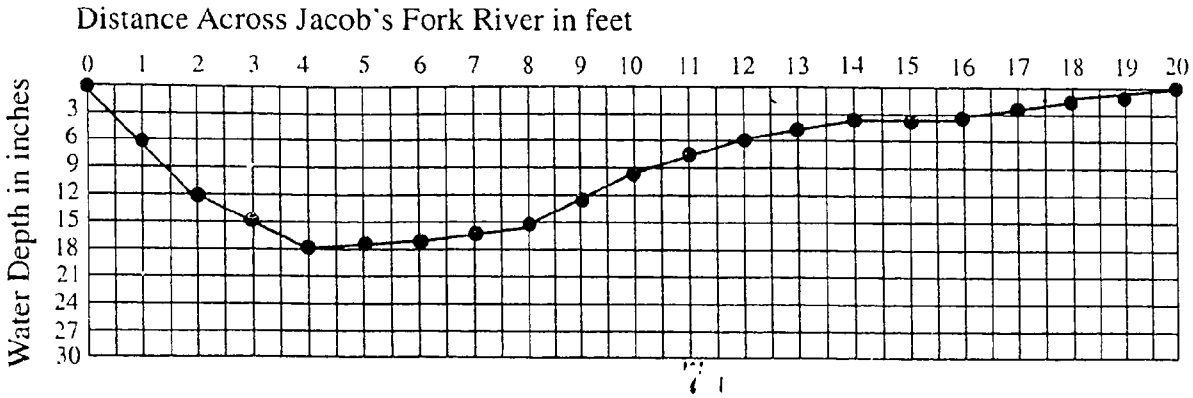
Mountain streams usually have an uneven topography with shallow **riffle** areas interspersed with cold, deep pools. Large animals like trout feed in the riffles and rest or hide in the pools. The rocky bottoms of mountain streams provide excellent shelter for smaller fish and **macroinvertebrates**. Rocks provide both a hiding place from **predators** and a stable surface to hold onto in the fast-moving current. The rocks in the streambed also cause fast-moving water to ripple and fall, maintaining high levels of dissolved oxygen needed by many animals.

Compare the topography of a mountain stream with a piedmont stream. Mountains provide the needed fall in elevation to keep water flowing fast enough to wash **sediment** downstream. As the mountain streams fan out onto the flatter areas of the North Carolina Piedmont, the waters slow down and begin depositing their cargo of sediment. This sediment fills the spaces between the rocks. As the streambed flattens out, less cover is available for the animals. Some bottom dwelling animals or their eggs and **larvae** may be smothered by the sediment. As the stream grows wider, more sunlight falls on its surface, raising the water temperature. The higher the temperature of the water, the less dissolved oxygen is available for animals to breathe.

Topography, temperature, and dissolved oxygen greatly affect the amount and diversity of aquatic life. In general, mountain streams have a greater number of **species** than piedmont streams. However, this can change depending on the land use practices in the **watershed** of the stream. Consider what would happen to stream flow and topography if the stream was dammed or if large amounts of water were diverted for human use. Anything that might disturb the **soil** in the watershed of the stream could contribute to **siltation**, or the build up of **silt** in the streambed. What do you think would happen if large numbers of people or animals stepped on or moved the rocks in the stream?

When you visit the park, you will discover the topography of a section of the Jacob's Fork River by making a cross-sectional profile of the stream. You'll view some of the animals that live in the river and explore their habitat firsthand.

Section of a Sample Graph



Streambed Silhouette — Data Sheet

Team #:_____ (Your teacher will give your team a number. Write it here.)

Data Recorder:_____

Bankers (stand on banks and hold tape measure across stream): _____

_____

Depth Taker:_____

Animal Identifier:_____

Width of our section of the Jacob's Fork River is_____.

Find the depth of stream in inches at the following one-foot intervals:

0' _____	7' _____	14' _____	21' _____	28' _____	35' _____
1' _____	8' _____	15' _____	22' _____	29' _____	36' _____
2' _____	9' _____	16' _____	23' _____	30' _____	37' _____
3' _____	10' _____	17' _____	24' _____	31' _____	38' _____
4' _____	11' _____	18' _____	25' _____	32' _____	39' _____
5' _____	12' _____	19' _____	26' _____	33' _____	40' _____
6' _____	13' _____	20' _____	27' _____	34' _____	

Record names of animals seen here:_____

_____

_____

_____

_____

How many different species (different kinds of) animals did you see?_____

Other observations: (Is the streambed rocky or sandy? What else do you see on the bottom or along the stream banks?_____

_____

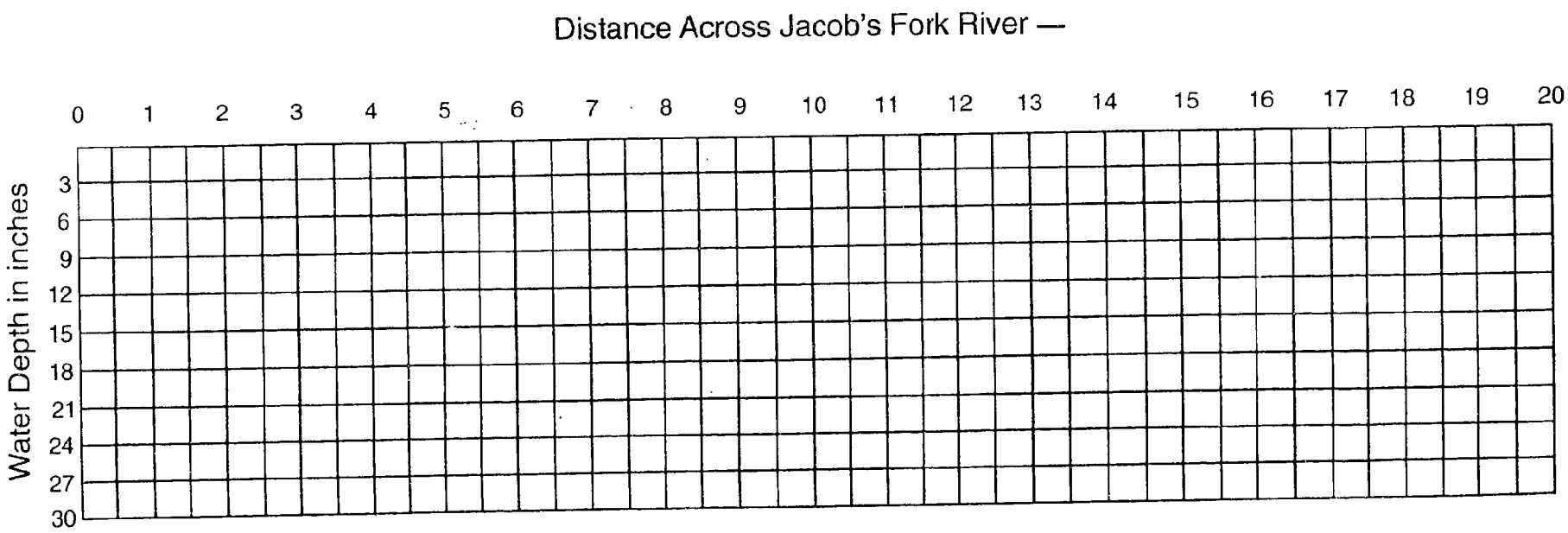
_____

_____

_____

_____

Streambed Silhouette — Graph Paper



Graph Paper continued

Water Depth in inches

3 6 9 12 15 18 21 24 27 30

— Stream Width in feet

40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21

cut along dotted line and tape to other half of graph

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.

Student's Information

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 conveniences 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).

• Increases runoff from impervious surfaces (parking lots, roofs, etc.).

• Contributes large amounts of waste products.

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.

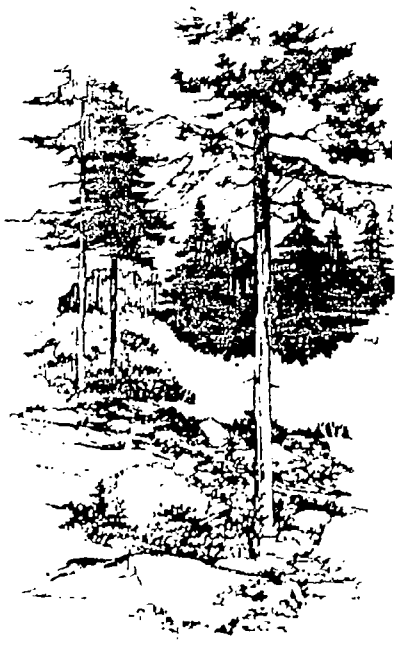
Suggested Extensions:

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?

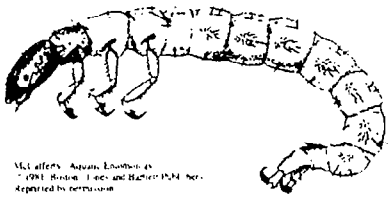
6. Send a representative sample of the students' land use plans to the park. (We would appreciate the feedback.)

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

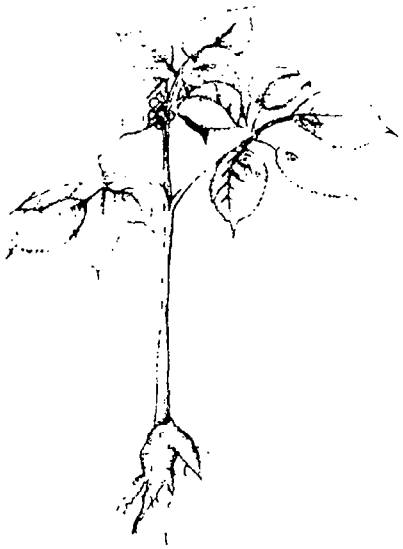
Special Species Fact Sheet

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.



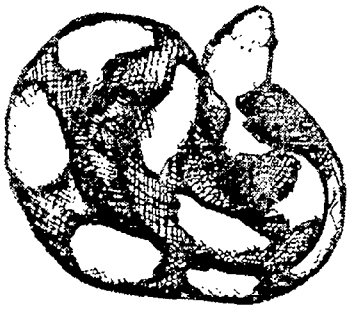
Caddisfly

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.

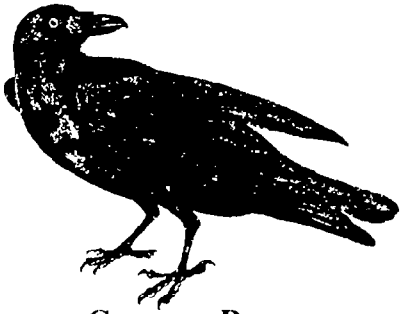


Copperhead

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

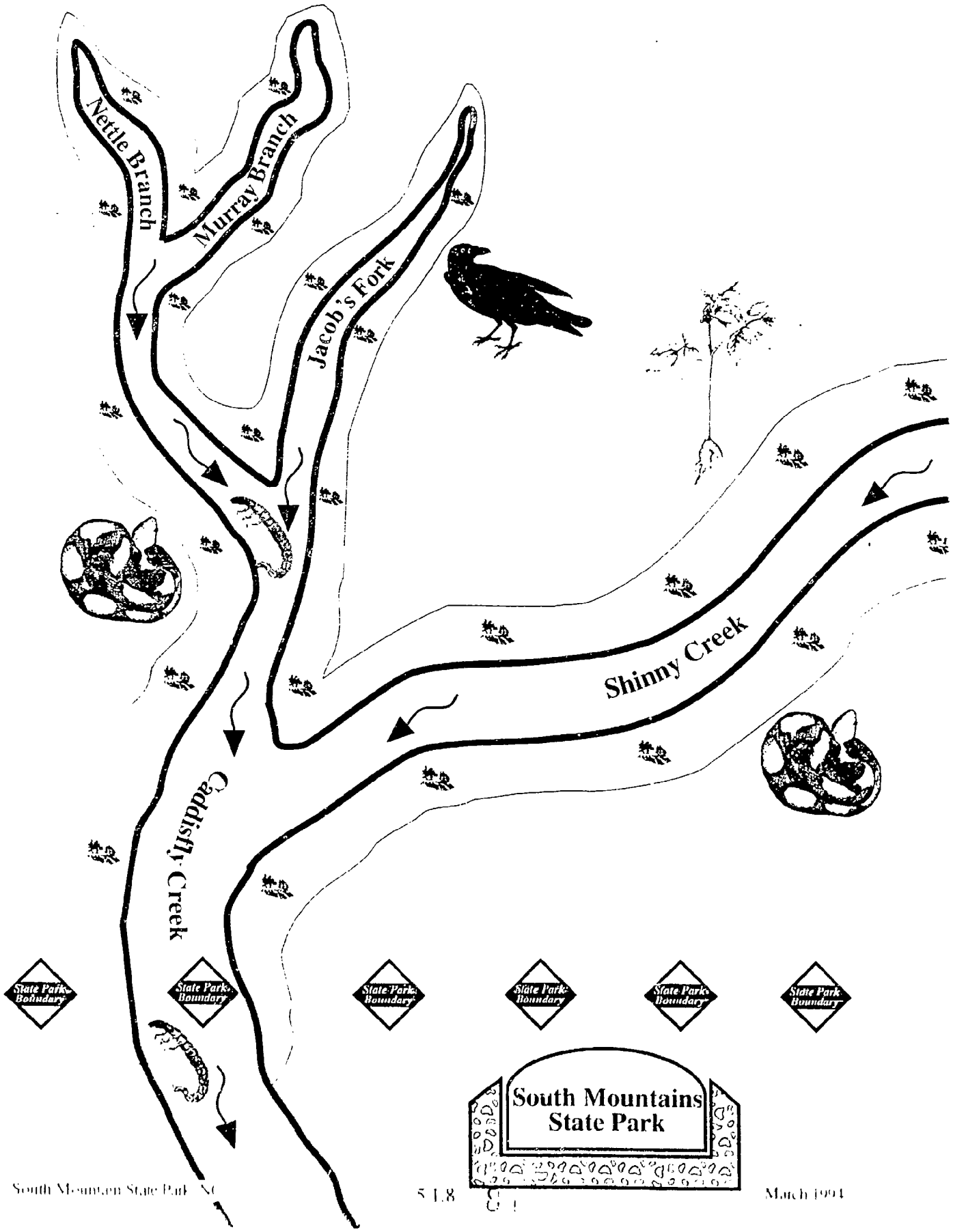
An uncommon wildflower, requiring soils that are close to a neutral pH (most soils in our region are acidic) and a mature tree canopy to give it partial shade. It takes a minimum of 15 years for this orchid to grow from a seed to a flowering plant.



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.

Caddisfly Creek Map



Map con't

Henry Fork River

S. Fork Catawba River

Legend

State Park boundary
(no development beyond this line)

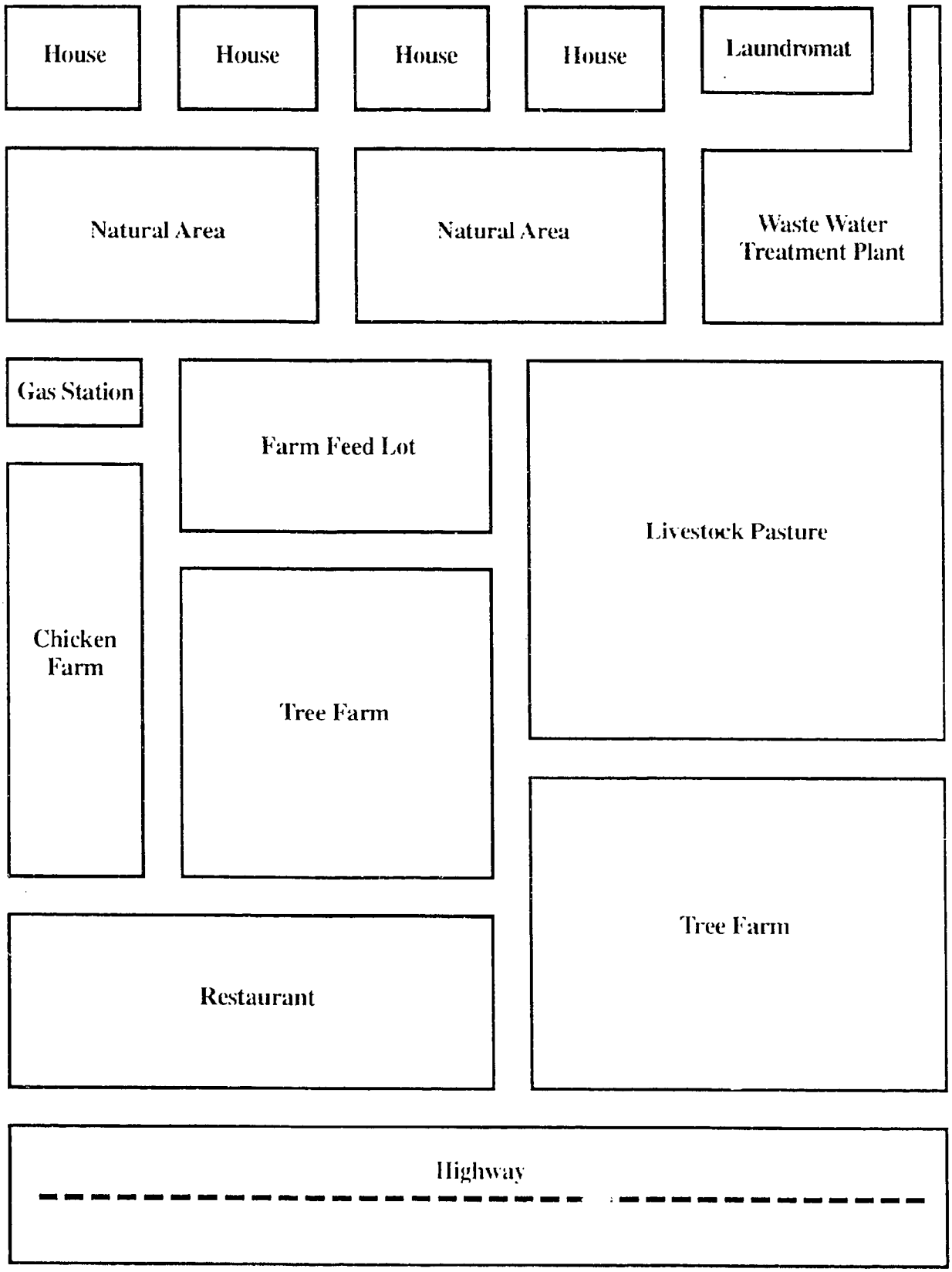
Direction of water flow

Natural area & river corridors

North Carolina / South Carolina Boundary

Lake Wylie

Land Use Cutouts



Post-Visit Activity #2 Mountain Trout Journeys

Major concepts:
- Habitat degradation
- Predation
- Limiting factors
- Sedimentation
- Fisheries management

Learning Skills:
- Role-playing
- Predicting and inferring
- Comparing and analyzing
- Graphing

Subject Areas:
- Science
- Social Studies
- English Language Arts
- Mathematics
- * See the Activity Summary for a Correlation with the DPI objectives in these subject areas.

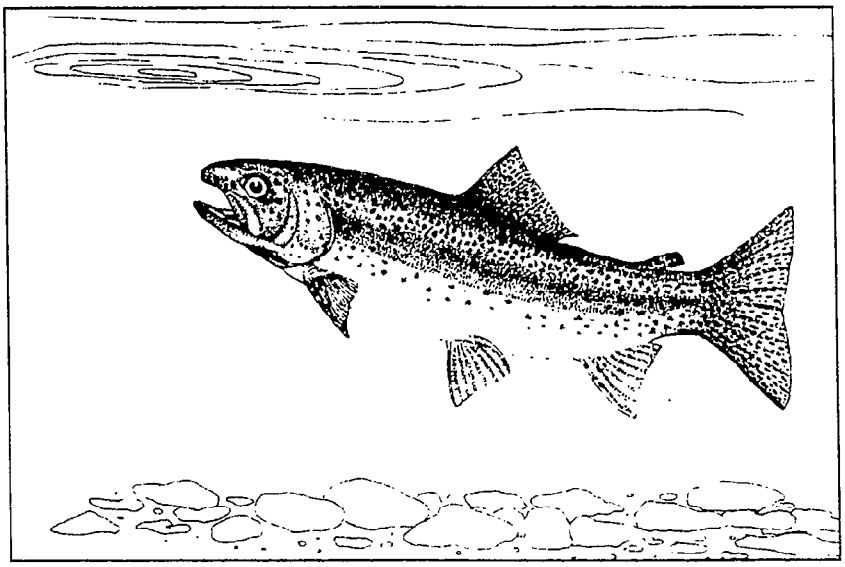
Location: Indoors or outdoors

Group Size: 25 preferably

Estimated Time: 45 minutes

Appropriate Season: Any

Materials:
Provided by the educator:
Per educator: "Mountain Trout Journeys" Script
Per class: open grassy area approximately 20 x 60 feet; large posterboard and marker to record game results; rope or cones; yarn, hole punch, and scissors; trout, pollutant, raccoon, fishermen and food cards provided in the activity; foam balls for fishermen
Per student: one copy of Student's Information, pencil, graph paper



Objectives:

- List the four elements of habitat that must be present in a stream for it to support mountain trout species: food, clean water, shelter, and space.
- Explain how past logging methods affected trout habitat.
- Predict how given human activities might affect trout habitat today.
- Through role-play, experience some of the major factors that affect the survival of mountain trout populations.
- Describe at least two ways people can protect or improve trout streams.

Educator's Information:

In this activity students role-play mountain trout species and **limiting factors** in a highly involving physical activity. Throughout the activity they experience many of the different situations trout must contend with today. Special emphasis has been placed on the availability and amounts of food sources for the fish and pressures from streamside development, **pollution**, **erosion** and fishing.

To implement this activity, follow the directions in the preparation and instructions sections and use the "Mountain Trout Journeys" script provided. NOTE: The habits of mountain trout and the practices of wildlife management agencies have been simplified to keep this simulation manageable.

Student's Information

On your visit to South Mountains State Park, you observed and studied a part of the Jacob's Fork River located within the park. This section of river and its **tributaries** provide **habitat** for a variety of **aquatic** plants and animals. The presence of trout (especially brook trout) in South Mountains' streams is an indication of excellent **water quality** because these fish require clear, cool waters with plenty of oxygen and very little **pollution**.

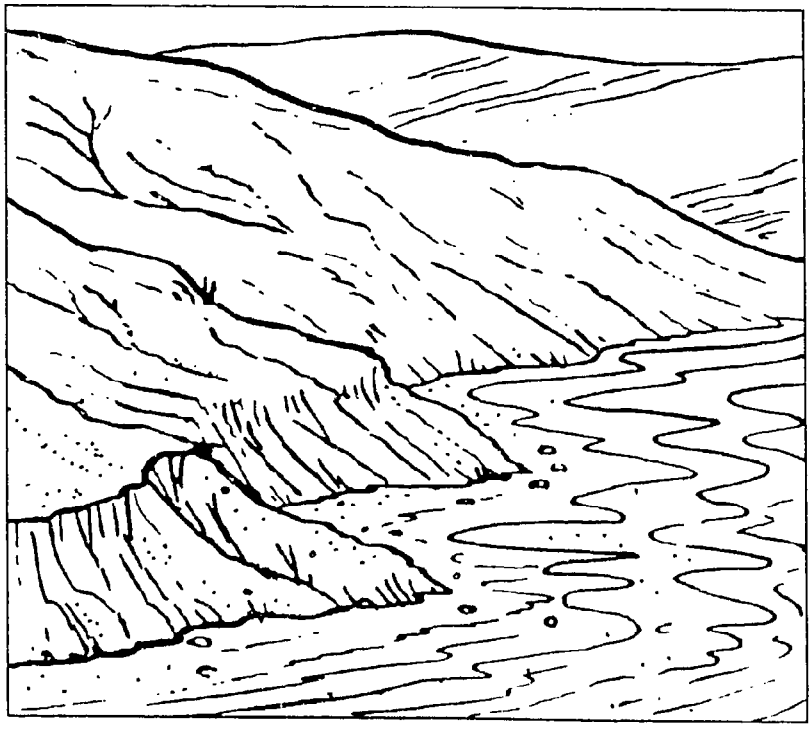
Three **species** of trout inhabit the streams and rivers of South Mountains State Park: brook trout, rainbow trout, and brown trout. Although the trout do well in these pristine waters today, historical accounts suggest trout did not naturally occur in these streams. They were **stocked**, or placed in the streams, in the 1930s and 1940s.

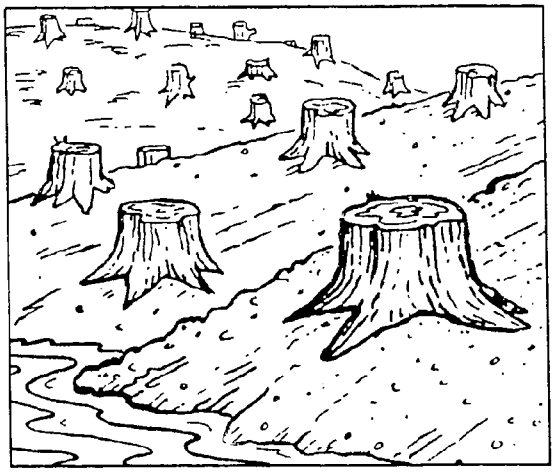
The only native, or naturally occurring trout species in North Carolina is the brook trout. The brook trout requires the cleanest, coldest water because it needs a higher level of oxygen than the other two species. In North Carolina, it naturally occurs only at an elevation of 3,000 feet or higher. The South Mountains are only 1,000 to 2,600 feet in elevation, well below the brook trout's natural range.

For years, high elevation mountain streams with dense forest cover teemed with brook trout. In the late 1800s, however, huge logging companies began to cut the vast stands of virgin timber in the South. Early loggers constructed poor rail lines up river valleys and conducted massive clearcuts on steep slopes. After the trees were cut, they were pushed over cliffs to a team of oxen below, or slid down steep slopes into a nearby stream.

Flood dams, called **splash dams**, were often constructed across the streams to retain a head of water for driving logs downstream. When enough logs were collected, the dam was opened, and away the logs floated. Dams were also constructed downstream at pick-up points or sawmills to stop the flow of water and allow easier retrieval of the logs. This caused extensive damage to stream habitats. At times, their flow was inhibited and streams became clogged with **silt** from the eroding hillsides. At other times, stream flow was drastically increased when dams were opened.

As a result of the logging operations, brook trout populations declined drastically. Because of their ability to survive in more turbid, warmer waters, rainbow trout (from the



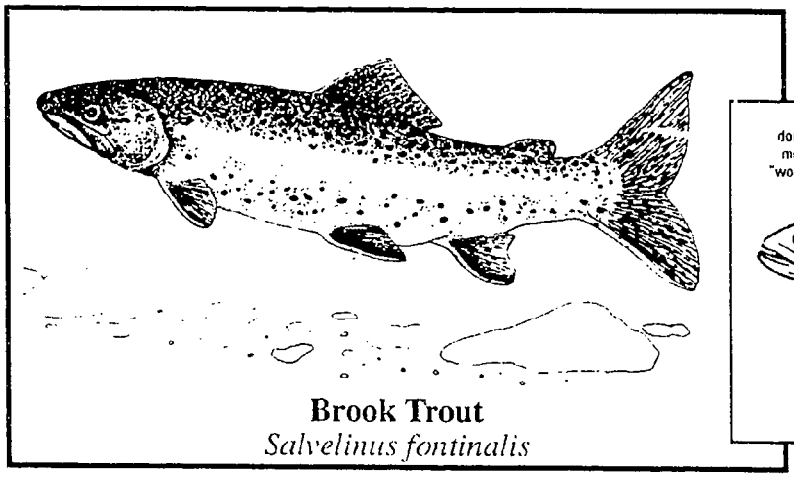


Pacific Coast) and brown trout (from Europe) were stocked in North Carolina's mountain streams.

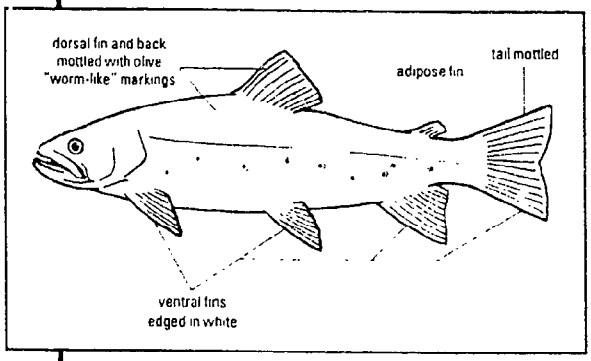
The streams of South Mountains State Park have recovered from the logging practices that occurred decades ago. Although these streams are not at the ideal elevation for brook trout, all three mountain trout species have been stocked in the streams and they are surviving. The North Carolina Wildlife Resources Commission continues to stock trout today along a 2-mile stretch of the Jacob's Fork River near the park office, primarily because this area is fished so heavily. Upstream, in the Wild Trout Waters, however, they have not stocked trout in at least 10 years, and the rainbow and brown trout continue to survive and reproduce. The brook trout can not survive in these unstocked waters as they do not compete well with other trout species.

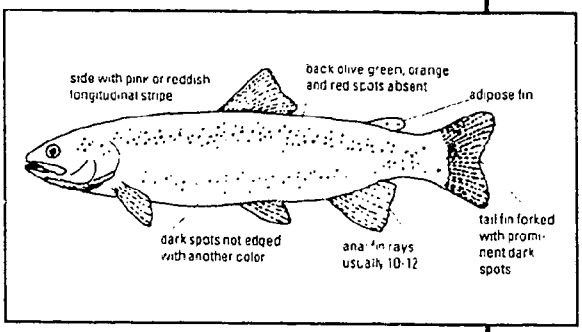
Sadly, in many of the mountain counties of North Carolina, development of the mountain region, continued **siltation**, **acid rain**, and overfishing have greatly reduced the number of wild brook trout. The future of this species is of great concern to state and federal agencies. In an effort to protect the brook trout, they are developing strategies to identify, maintain and expand existing brook trout populations to ensure their survival in North Carolina's mountain streams.

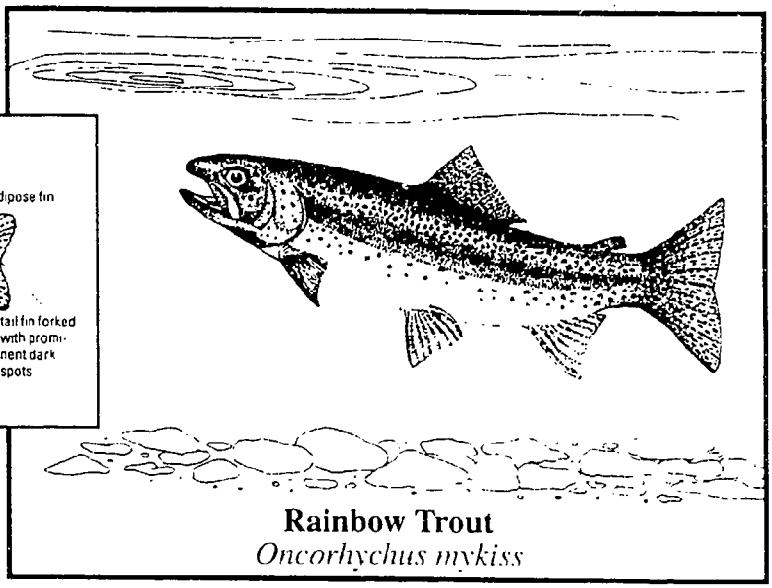
Identifying Characteristics of Mountain Trout:



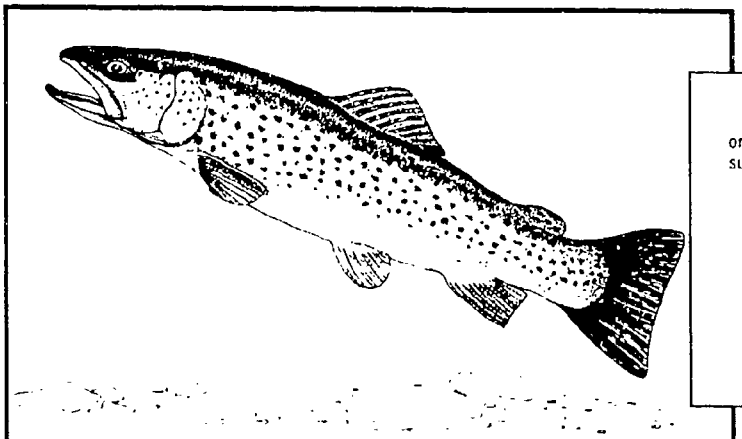
Brook Trout
Salvelinus fontinalis



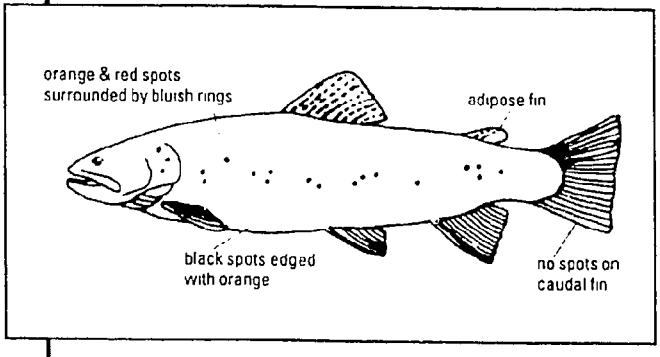




Rainbow Trout
Oncorhychus mykiss



Brown Trout
Salmo trutta



Illustrations by J.T. Newman. Source: North Carolina Wildlife Resources Commission, *Wildlife Profiles*

Preparation:

1. Make <u>two</u> photocopies of the raccoon and fishermen card. Make <u>three</u> photocopies of the trout and pollutant card pages. Cut out all of the raccoon, fisherman, trout, and pollutant cards. Laminate the cards. Tape or glue <u>only</u> the trout and pollutant cards together so that when you flip these cards over a trout is on one side and a pollutant is on the other. Punch two holes at the top of each card and tie a piece of yarn to the cards so that they can be worn as necklaces. Be sure to make the yarn long enough to slip over the students' necks.

With a class of 25, you should prepare the following:

<u>Necklace</u>	<u># of each</u>
Raccoon	2
Fisherman	4
Pollutant/Trout	19

Adjust as needed for larger/smaller classes, remembering that the fishermen should always be increased or decreased in increments of two.

2. Make <u>two</u> copies of each food card page, cut out individual cards and then laminate them.

3. Select a narrow, rectangular playing area about 60 feet in length and 20 feet wide to represent a stream. Use rope or cones to mark the perimeter of the playing area. Establish smaller rectangular areas (3 feet x 20 feet) at both ends of the rectangle. These will serve as safe zones or "cover" for the fish.

Instructions:

1. Discuss the Student's Information with the class, emphasizing that trout are subject to various natural and man-made **limiting factors**, and that as **indicator species**, their presence points to excellent **water quality**.

2. Explain to the students that they are going to be acting out mountain trout species and the various pollutants and **predators** affecting trout populations. Tell them that the rectangular area represents a trout stream, and that the smaller areas on each end represent "cover" for the trout — a place where they can escape from predators. This stream provides suitable **habitat** for trout with an abundance of food, clean water, shelter and space. At the end of each journey through the stream, the trout students should school in the cover area at one end of the stream.

3. Identify students as either raccoons, fishermen, pollutants or trout by assigning each student the appropriate symbol to be worn around the neck during play. The raccoons and fishermen will have an opportunity to switch off at some point during the game. Most of the pollutants and trout will be either one or the other throughout the game depending on what is occurring in the stream at the time, according to the teacher's script.

4. Using the rectangular playing area previously set up, identify one end of the area as upstream and the other as the downstream. Place the <u>raccoons</u> one on each side of the stream, close to edge of the stream bank. When given the command, they are to act like raccoons on the banks of the stream, grasping at any fish that may swim by. The raccoons cannot step into the stream, but may move along the sides of the stream and reach out to tag passing trout. Each raccoon must stay on his/her own side. If a trout is tagged, it has become a meal for the raccoon and dies. The dead trout move to the outside of the stream and await further instructions.

5. The fishermen or anglers will work in pairs. Give one of the fishermen in each pair a rolled up towel or soft foam ball. Place the <u>fishermen</u> on opposite sides of the stream bank (not on the ends) outside the rectangle, so that they are directly across from their fishing partner with the raccoons between the fishing pairs. Tell them that they are not to move from side to side, but should stay in that one location. When given the command, they will toss the ball back and forth across the stream to their partners. They are not to aim the ball at the passing trout, as in dodgeball, but simply throw it to each

other. (This simulates trout fishing because often the fishermen cannot see the fish in the water. They are not usually casting at a particular fish.)

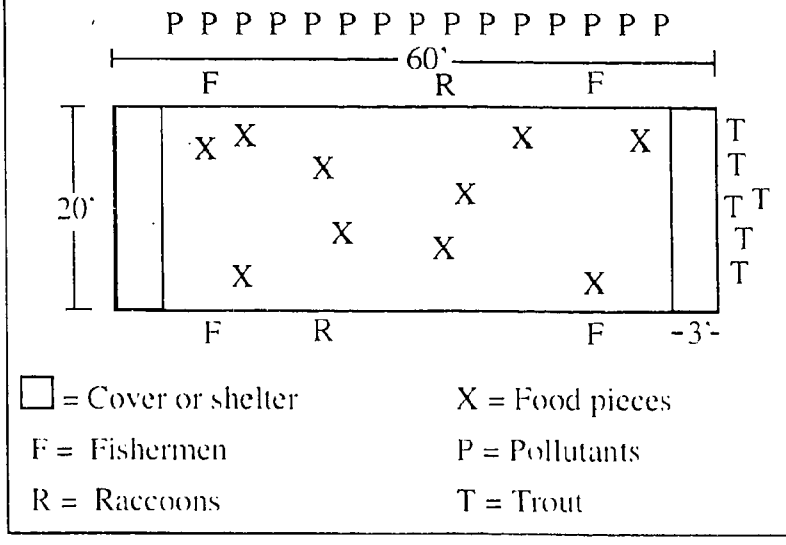
6. Tell the students with the two-sided pollutant/trout necklaces that they will be playing a dual role. In some of the rounds, they will be different types of pollutants such as **sediment**, pesticides, chemical fertilizers, animal and human waste, motor oil and **acid rain**, depending on what the situation calls for. When they are told to enter the stream as pollutants they will be expected to roam throughout the inside of the rectangle trying to tag or poison the trout. *(This will include the cover area, since pollution invades every part of a stream and trout cannot escape it.)* When they are instructed to turn their necklaces over to the trout side, they will act like trout trying to retrieve one piece of food from any of the various piles. They will swim from one end of the stream to the other (to cover) without being killed by fishermen, raccoons, or pollutants. If they are tagged by the pollutants or raccoons or hit by the foam ball, the trout die. If they make it to cover but were unable to retrieve one piece of food, they die. In either case, the dead trout move to the outside of the rectangle and await further instructions. Remind the students that while they are live trout they must stay inside the rectangle as trout cannot survive on land. *Initially, place all pollutants/trout outside the rectangle.*

NOTE: If the fishermen do not follow the rules and throw the ball directly at a trout instead of to their partner, the trout will not be considered caught and will be allowed to continue. The fishermen will be replaced with more cooperative students. If a "pollutant" is accidentally hit with the ball during play, he/she is "eliminated" and moves to the side. This represents the good things people do to clean up streams or improve trout habitat when they purchase a fishing license.

7. Explain to the students that each round will begin when the educator says, "Swim, trout!" At that point the trout will move from one end of the stream to the other, remembering to collect a piece of food and trying to avoid being tagged or hit by the ball. The round will end when all the trout are dead or have entered the cover area. At this point the students should listen as the instructor explains what just occurred in the trout stream and gives the students directions for the next round. Students then wait until they hear "Swim, trout!" again and proceed with the next round of the activity.

8. Use the "Mountain Trout Journeys" Script for specific instructions for each of the nine rounds. Also, refer to the script for discussion questions.

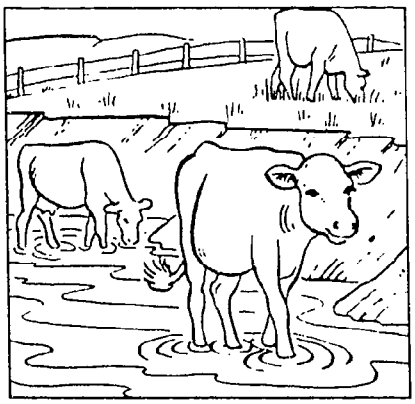
Illustration of Play Area:



Assessment:

Ask the students to predict the outcome of the following scenarios based on what they experienced during the game.

- An outbreak of rabies nearly wipes out the local raccoon population, temporarily eliminating one of the trouts' predators.
- A huge section of the forest is cleared during a logging operation. **Silt** retainment measures are not taken and trees are not replanted. Rainstorms wash an incredible amount of dirt and red clay into the stream.
- Over a series of several rounds, acid rain gradually enters the stream until it becomes so acidic all of the trout die.
- The construction of a dam changes the river **ecosystem** into a lake ecosystem.
- Water is drained from the stream for **irrigation** and to provide drinking water for the rapidly growing community.
- Motor oil runs off from roads and parking lots, or is carelessly dumped into storm drains.
- Household hazardous chemicals leak into the **groundwater** and eventually into the stream.



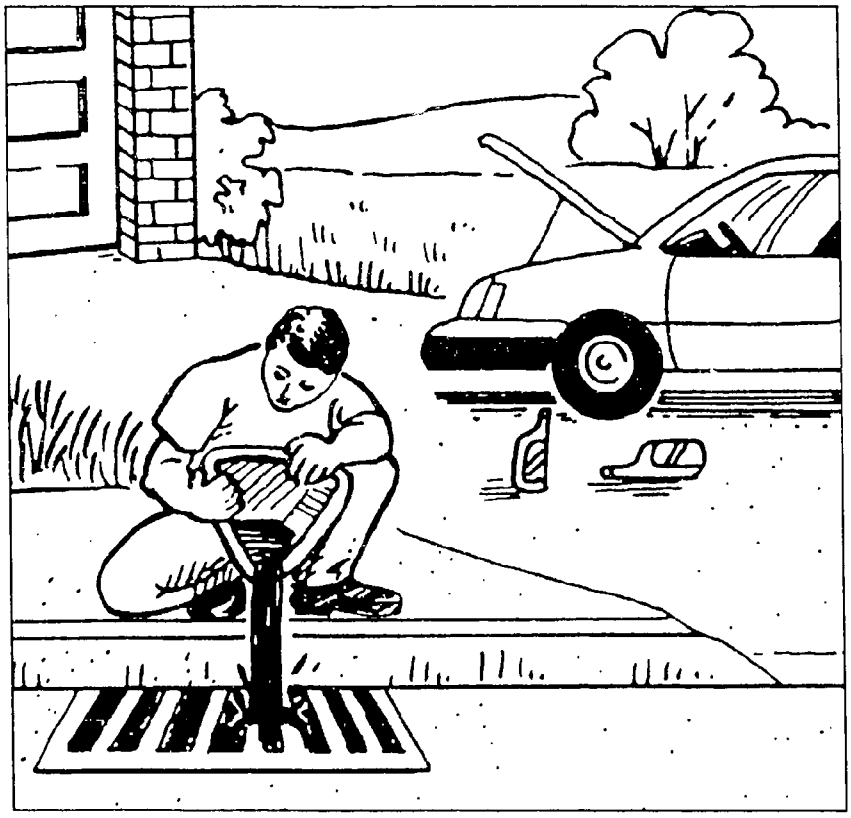
- Livestock are permitted to enter the stream.
- Animal waste runs off from the nearby chicken or pig farm.

Extensions:

1 Repeat the game with a much smaller or larger playing area to introduce the concept of space as a habitat requirement.

2. Explore the major factors affecting habitat loss and degradation, or gain and restoration, in your area. Research the causes for long-term habitat loss, as well as any major efforts underway to prevent these increasing losses.

3. Invite a member of Trout Unlimited to speak to the class.



"Mountain Trout Journeys" Script

Round One

Begin round one by scattering about 30 pieces of food from one end of the stream to the other, targeting the edges of the stream. Make sure the fishermen and raccoons are in their places. Tell the raccoons, the **predators**, to be prepared to tag any trout that swim by. Instruct fishermen not to fish (throw the ball) at all during this first round, however. Instruct all of the other students on the sidelines to turn their placards over to the "trout" side and go to the cover at the upstream end of the trout stream in preparation for their journey downstream.

Announce the start of the game by saying "Swim, trout!" On the first try, most of the trout will make it to the downstream cover safely. Tell the few trout that die to move to the stream banks and await further instructions. (Only those trout tagged by a raccoon or failing to pick up a food card die in this round.) Record the number of live trout.

Script — The **habitat** was ideal for the trout this year. The water was cold and clean, **aquatic insects** were abundant, there was no fishing pressure, the trout only had to avoid one predator, the raccoon. Get ready for the next round.

Round Two

Tell the fishermen that from now on, until they are told otherwise, they can begin fishing. Tell any trout that may have died to get back into the game as trout. Do not add any more food pieces. Say "Swim, trout!" At the end of the round, record the number of live trout.

Script — The trout population increased so much (possibly due to overstocking by the wildlife management agency or several really good reproductive years) there were simply too many trout for the food supply to support — too many fish and not enough **macro-invertebrates**. Fishing also lowered the trout population.

Round Three

Scatter 30 food pieces throughout the stream. Do not allow the dead trout from round two to return to the game yet. Say "Swim, trout!" Record the number of live trout.

Script — The stream is still clean and cold, the food supply has recovered due to lessened pressure by the trout population, some of the fish died due to normal pressures from fishing and predation.

Round Four

Tell 10 of the students on the sidelines to turn their placards to "pollutant" and enter the playing area. Remind them that their role is to tag the live trout even in the cover area. Say "Swim, trout!" Let this round continue for 30 seconds. Record the number of live trout.

Script — A significant portion of land was cleared along the edge of the stream to make way for a strip mall. No **silt** containment methods were used and when it rained the **sediment** washed into the stream, irritating the gills of the fish and eventually

killing them. Is history repeating itself? First it was logging and now it's shopping centers. What is to become of the trout?

Round Five

Tell seven of the students on the sidelines to flip their placards to "trout" and go to the end of the stream for the next round. Instruct the pollutants who are currently in the stream to remain there. Remove most of the remaining food pieces. Say "Swim, trout!" Let the round continue for 30 seconds. Record the number of live trout.

Script — The wildlife management agency brought in fish and placed them into the stream (called stocking the stream), but there was no food for the fish to eat because the silt and sediment remaining in the stream suffocated most of the aquatic insects. The trout population was once again wiped out.

Round Six

Scatter approximately 20 food pieces around the food area. Remove all but two of the pollutants from the stream. Tell the other students to flip their placards to "trout" and go to the end of the stream for the next round. Say "Swim, trout!" Let the round continue for 30 seconds. Record the number of live trout.

Script — The fish were **stocked** once again, and the stream is slowly recovering from the **siltation** problem (now that the once bare dirt along the stream from the mall construction has grass growing on it and retaining the **soil**). There are plenty of aquatic insects (food) available for the fish eat, but the fish aren't able to reproduce. The fish eggs that were laid were smothered with silt. The additional pressures of fishing and predation eliminated the trout population.

Round Seven

Add 30 food pieces. Tell the fishermen to stop fishing. Remove all the pollutants from the stream. Have all the former pollutants and dead trout join the remaining living trout at the end of the stream for another round. Say "Swim, trout!" Record the number of live trout.

Script — The stream has finally recovered and is now clean and **healthy** again. The trout were stocked again, and this time were able to reproduce. No new pollutants have entered the stream and there is plenty of food available. The wildlife management agency temporarily prohibited fishing in the stream to help the trout population recover more quickly.

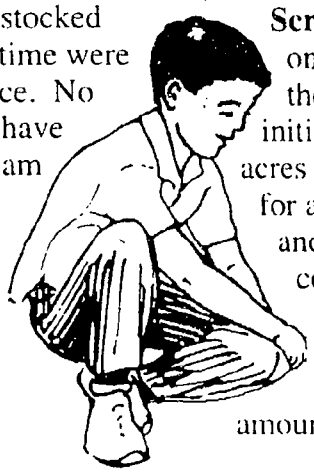
Round Eight

Begin the round with four pollutants in the stream (a few of the trout may have to become pollutants). Permit the fishermen to fish again. Say "Swim, trout!" Let the round continue for 30 seconds. Record the number of live trout.

Script — The city **waste-water treatment plant** malfunctioned, releasing untreated **sewage** into the stream. This killed the trout and macroinvertebrates by removing oxygen from the water.

Round Nine

Add 10 food pieces. Tell eight of the students on the sidelines to become trout. Add four more pollutants to the stream. Say "Swim, trout!" Let the round continue until the pollutants have tagged all the trout. Record the number of live trout.



Script — The fish were once again stocked and they had plenty of food initially. But hundreds of acres of land were cleared for a huge new vacation and retirement community with an enormous golf course. During the construction phase, massive amounts of sediment washed

into the stream. After the community was completed, the golf course and lawns were treated with fertilizers to make the grass green. During a heavy rain these fertilizers washed into the stream, increasing algae growth and reducing the amount of **dissolved oxygen** in the water.

STOP GAME HERE

Discussion:

1. After the game is finished, ask each student to graph the game results. Put the round number on the x-axis and the number of live trout at the end of each round on the y-axis. The first point or bar on the graph will be at round 0: x = 0 and y = beginning number of trout. Use the completed graph to help the class review what happened in each round.

2. How was this simulation like a real trout stream **ecosystem**? (Possible answers: the trout were subject to predators fishing pressure; their eggs were smothered with silt; their survival depended on an adequate food supply; the trout were restocked periodically; land was cleared along the stream banks without silt containment measures)

3. How was this simulation not like a real trout stream ecosystem? (Possible answer: in the activity, all the trout died if there were any pollutants at all. In reality, trout may survive in streams that are slightly polluted.)

4. What were some of the causes of the trout decline from year to year? (Answer: predators, fishing pressure, pollutants)

5. What **limiting factor** made it most difficult for the trout to survive — predators, fishing pressure, or pollutants? (Answer: pollutants)

6. What types of pollutants? (Answer: sediment or silt and untreated sewage)

7. Which limiting factor had very long-term effects? (Answer: pollutants, especially sediment)

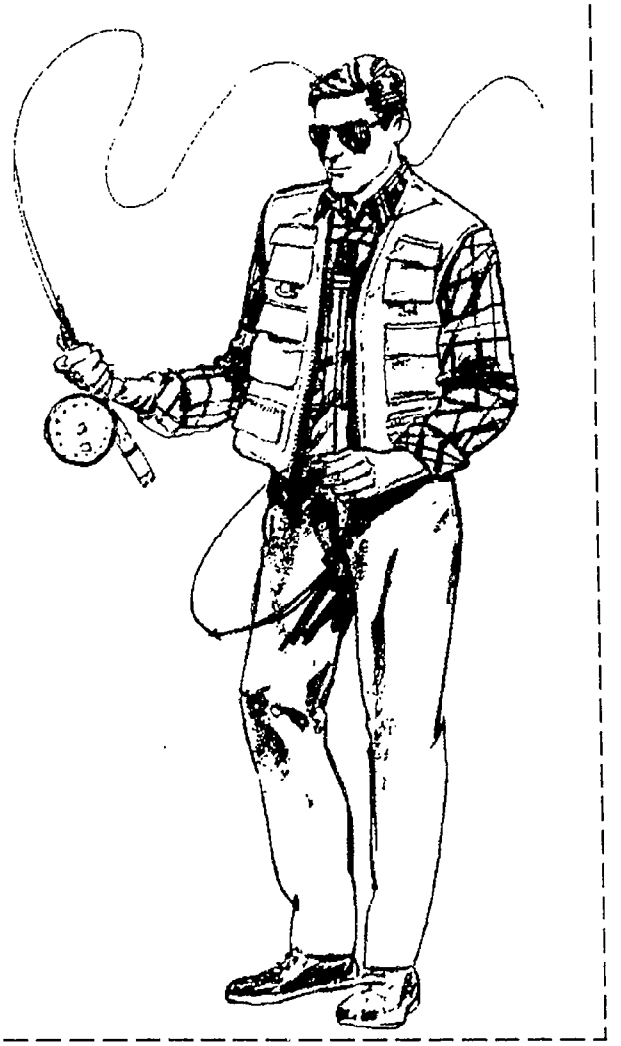
8. How did trout come back to the stream once they had all been killed? (Answer: restocking)

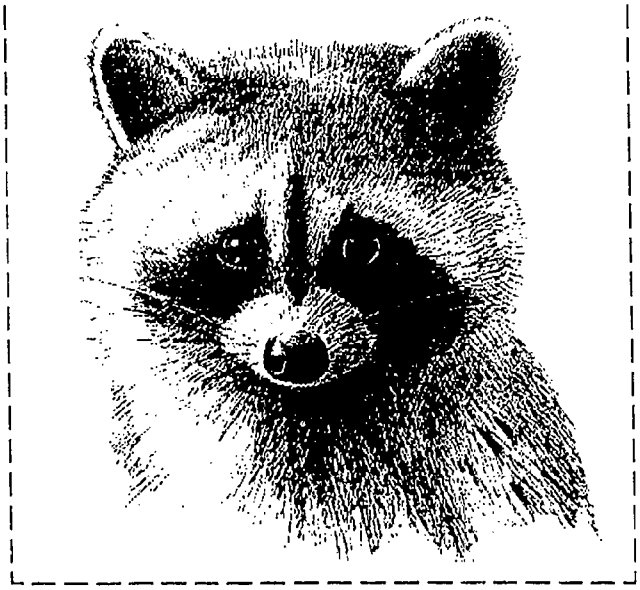
9. In the real world, what do you think would happen to trout populations if trout were not stocked in mountain streams? (Answer: They would eventually die out because high levels of sedimentation smother their eggs and prevent them from reproducing.)

10. What kinds of things can and should be done to protect and restore habitats for mountain trout species? (Possible answers: Use silt fences and vegetative buffers when clearing land; obey fishing regulations; create cover for trout and their prey by dropping logs into streams; plant vegetation along eroding stream banks to stabilize them; leave trees around streams to keep the water shaded and cool for the trout; don't fish at all, or put back every fish you catch.)

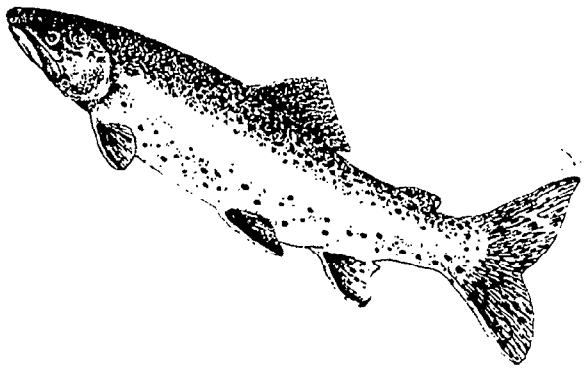
11. What are the potential trade-offs concerning these recommendations? (Possible answers: It takes time and money to put up silt fences; following fishing regulations takes away the freedom of fishing whenever I want; placing logs across streams and rivers makes them difficult to canoe; not fishing at all means giving up an enjoyable recreational activity; putting every fish back means not having fish to eat.)

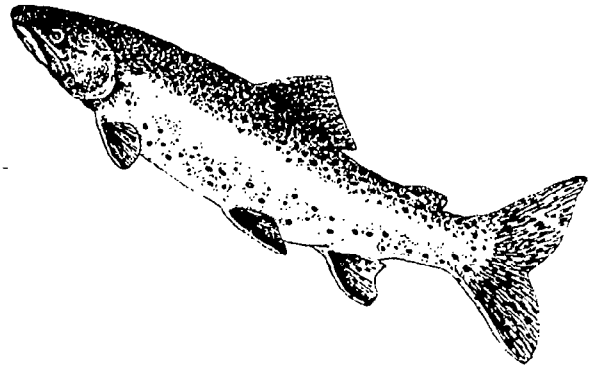
Fishermen & Raccoon Cards

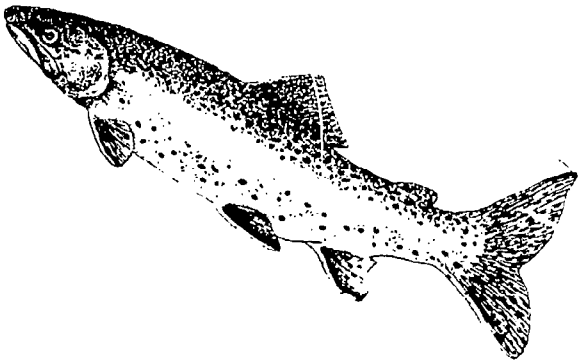


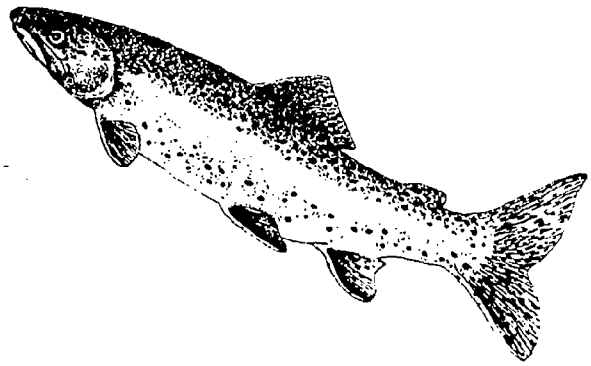


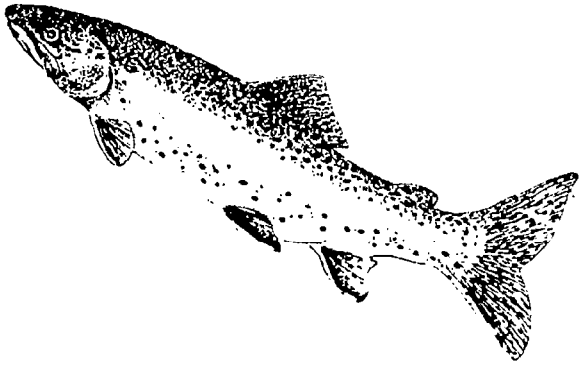
Brook Trout Cards

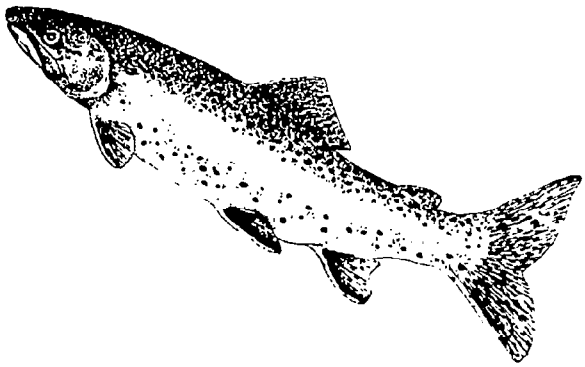




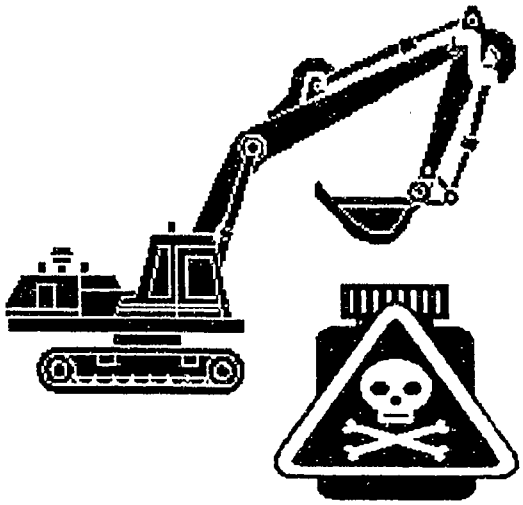


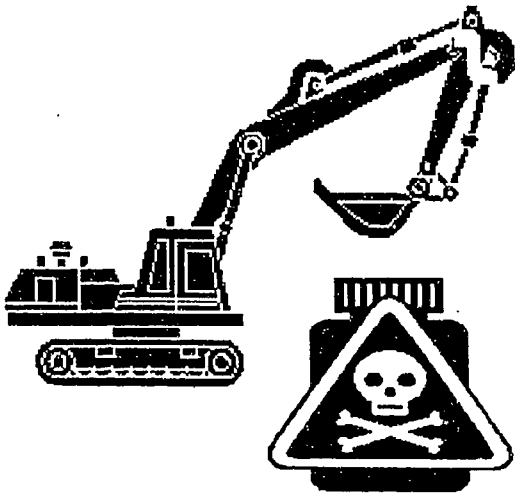


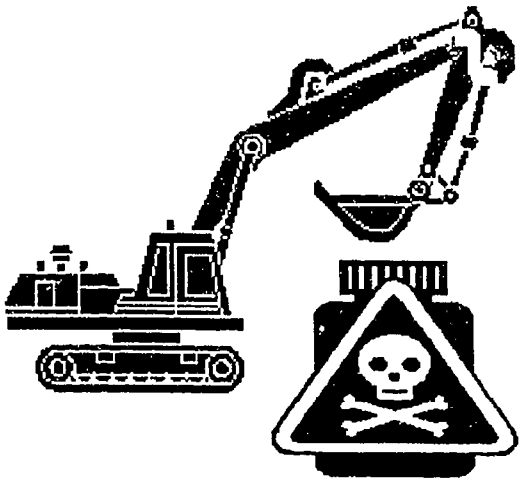




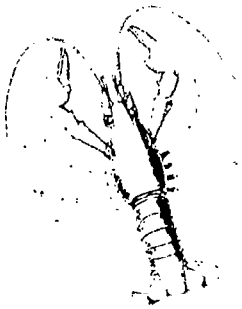
Pollutant Cards



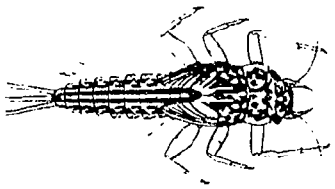




Food Cards



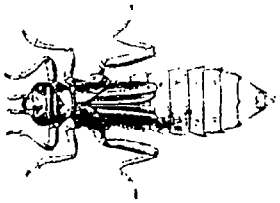
crayfish



mayfly nymph

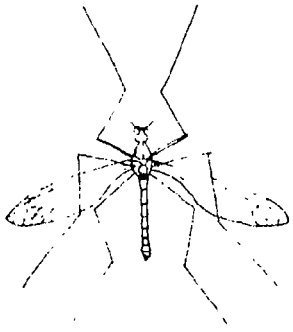
black fly larva

mayfly



dragonfly nymph

caddisfly larva



cranefly

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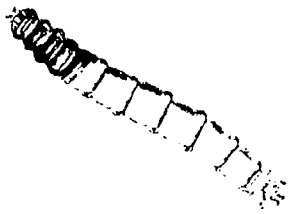
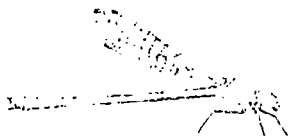


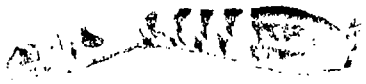
cranefly larva

Food Cards continued

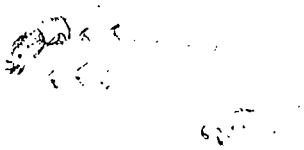
damselfly nymph



damselfly



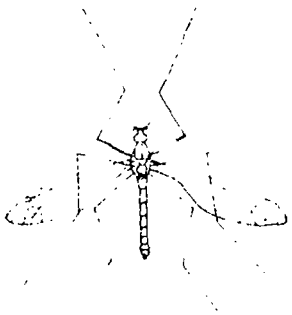
black fly larva



caddisfly larva

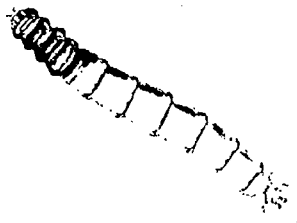
caddisfly

dragonfly



cranefly

crayfish



cranefly larva

Post-Visit Activity #3 A River Runs Through It

Major concepts:
- Water pollution
- Nonpoint source pollution
- Point source pollution

Learning Skills:
- Interpreting data, communicating, evaluating
- Organizing and analyzing information
- Listening, following directions

Subject Areas:
- Science
- Social Studies
- English Language Arts
- * See the Activity Summary for a Correlation with the DPI objectives in these subject areas.

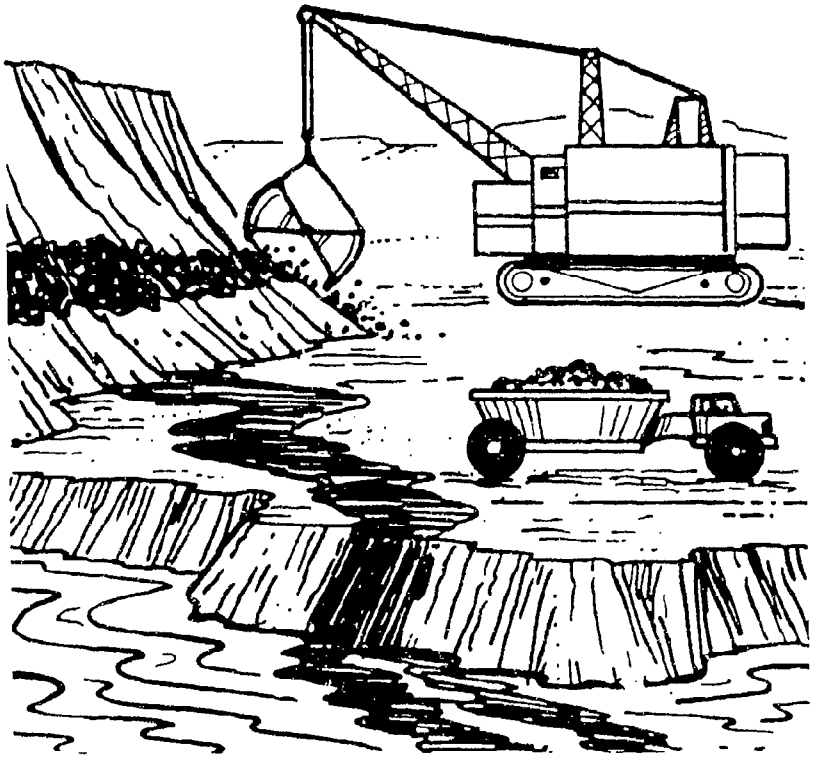
Location: Indoors or outdoors

Group Size: 25 preferably

Estimated Time: 1 hour

Appropriate Season: Any

Materials:
Provided by the educator:
Per class: can or bottle labeled "chemicals" or "oil"
Per group: one can of play dough or clay; a cup of water; set of six film canisters, one each filled with: finely ground black paper = sediment; red drink mix powder = chemicals; green drink mix powder = fertilizer; blue drink mix powder = air pollution; cocoa powder = human and animal waste; and soy sauce = oil, one "spatula" for each film canister (a diagonally cut drinking straw), transparent tape
Per student: Student's Information, laminated Catawba River Map, 8 1/2" x 11", piece of cardboard, paper towels for cleanup.



Credits: Adapted from an activity of the same title written by Sheila Jones, Environmental Education Specialist with Wake County Soil & Water Conservation District, Raleigh, NC.

Objectives:

- Discriminate between point and nonpoint source pollution, giving examples of each type.
- Describe at least three ways that individuals can protect water quality in their river basin.

Educator's Information:

No matter where we all live ... we all live in a **watershed**. And usually within every watershed, a river runs through it. Our everyday activities upstream can negatively impact the **water quality** downstream, as well as the **quality** of life in the entire watershed. In this activity, students discuss ways water becomes polluted and learn the difference between **point source pollution** and **nonpoint source pollution**. Then, as the educator tells a water pollution story, they place various pollutants onto a river model and learn how these pollutants affect the river. The students learn that we all contribute to both point and nonpoint source pollution of a river as it flows through our watershed and determine actions they can take to protect water quality.

Instructions:

1. Prepare the materials as described under Materials in the shaded box. For a class of 28 students, make 7 sets of simulated water pollutants (six types per set). Photocopy and laminate the Catawba **River Basin** map, one per student. You will also need small sheets of cardboard or other sturdy material to which each student can tape his or her map.

2. Begin the activity by showing the students a can or bottle labeled "chemicals" or "oil." Tell students you need to dispose of the chemicals and plan to dump them in the street in front of the school. Ask students if they think this is a good idea. Have students describe what they think will happen to the waste material.

3. Have the students read the Student's Information.

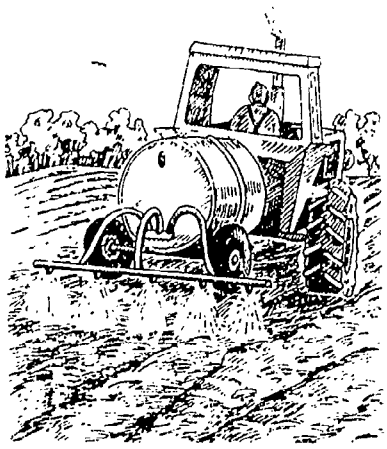
4. Define point source and noapoint source pollution for your students. Ask them to identify some common sources of water **pollution** and try to categorize them as point source or nonpoint source.

5. Write their responses on a chalkboard or piece of easel paper and tell them they'll be adding to the list later.

6. Divide the students into groups of four and place each group at a table with the six film canisters of pollutants, properly labeled. Give each student a Catawba River Map and have them tape it on top of a sturdy piece of cardboard. Each student should make two ropes of play dough or clay and use them to line the banks of the Catawba River. (This will ensure that the water drop will stay within the river channel in step #11.)

7. Explain to the students that you are going to read the story "A River Runs Through It" and that they need to listen very carefully so they can successfully complete the activity.

8. Read the story. Beginning with the fourth paragraph, pause at the end of each paragraph and ask students to identify the point source and nonpoint source pollutants that are implied or mentioned. Have the students find the film canisters that best match



those pollutants. Circulate the canisters around the table and, using small spatulas made from drinking straws, each student should place a very small dot of powder in the center of the Catawba River near the town or area mentioned. **Important:** If too much powder is used, it will absorb or block the water drop (to be added at the end of the activity) and the lesson's full effect won't be realized.

9. Continue the story and move downstream, introducing other point source and nonpoint source pollutants into the Catawba River.

10. Just before the last paragraph, have students place (using an eyedropper or their fingertips) one large water droplet at the beginning of the river near Lake James. Have them observe and describe the water drop. (At this point the water is very clean and clear.)

11. Instruct students to elevate and tilt their watersheds ever so slightly to guide and maneuver the water drop so it "flows" down river, through the point source and nonpoint source pollutants. At the end of the page, beyond Lake Wylie, again have them observe and describe the water drop.

12. Finish reading the story. Discussion questions are given below for assessment.

Discussion/Assessment:

Point out to the students that although this activity touches on some of the pollutants entering the Catawba River Basin, it only begins to reveal the true situation. In the story we were only dealing with a few select farms, families and industries that influence water quality. In reality the Catawba River Basin encompasses a total drainage area of 3,052,200 acres and is impacted every day by tens of thousands of people living in the basin.

In addition, it does not depict the true quality of water in the Catawba River Basin. For example, although the North Carolina Department of Environment and Natural Resources (NCDENR) has designated 16 percent of the 3,100 miles of free-flowing rivers and streams in North Carolina's portion of the Catawba River basin as "impaired," primarily due to the amount of **sediment** in these streams, overall the quality of the water is good. In addition, the main stem of the Catawba River generally meets or exceeds water quality standards set by the NCDENR.

1. Let's refer back to the list of point and nonpoint source pollutants we made at the beginning of this activity. Can you add some more to the list?

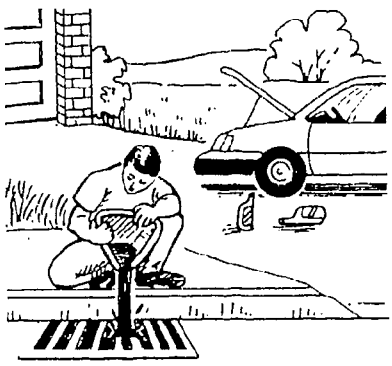
2. Do upstream users alter the water quality for those downstream? How?

3. How do you suppose the people living downstream feel? Are their feelings justified? Why/why not?

4. What can developers/businesses/municipalities/industries/farmers do to protect water quality in the Catawba River Basin?

• Farmers and developers — could use **erosion** control methods such as **silt** fences, terraces, and catchment basin ponds and reduce the use of fertilizers and pesticides;

• Municipalities — could upgrade their **wastewater treatment plants** to be sure they can handle existing and future flow levels even during periods of heavy rain;



• Developers — leave wooded areas along streambeds to reduce **runoff**. Use silt fences.

• Other ideas?

5. What are some of the ways you personally can reduce water pollution and protect your watershed?

• Encourage your parents to use less fertilizers and pesticides on lawns and gardens. Be sure they follow the directions on the products so they will be environmentally safe.

• Encourage your parents to maintain their cars so they won't burn unnecessary fuel or leak oil. Be sure they recycle used motor oil and never pour it on the ground or into storm drains.

• Plant grass in disturbed areas as soon as possible to prevent dirt and clay from running off into the water supply.

• Allow natural trees and plants to grow along streams to protect the water from runoff.

• Don't ask your parent to make take unnecessary trips in the family vehicle.

• Do not waste electricity.

• Participate in Big Sweep or the StreamWatch program.

• Stencil storm drains to educate the public.

Student's Information:

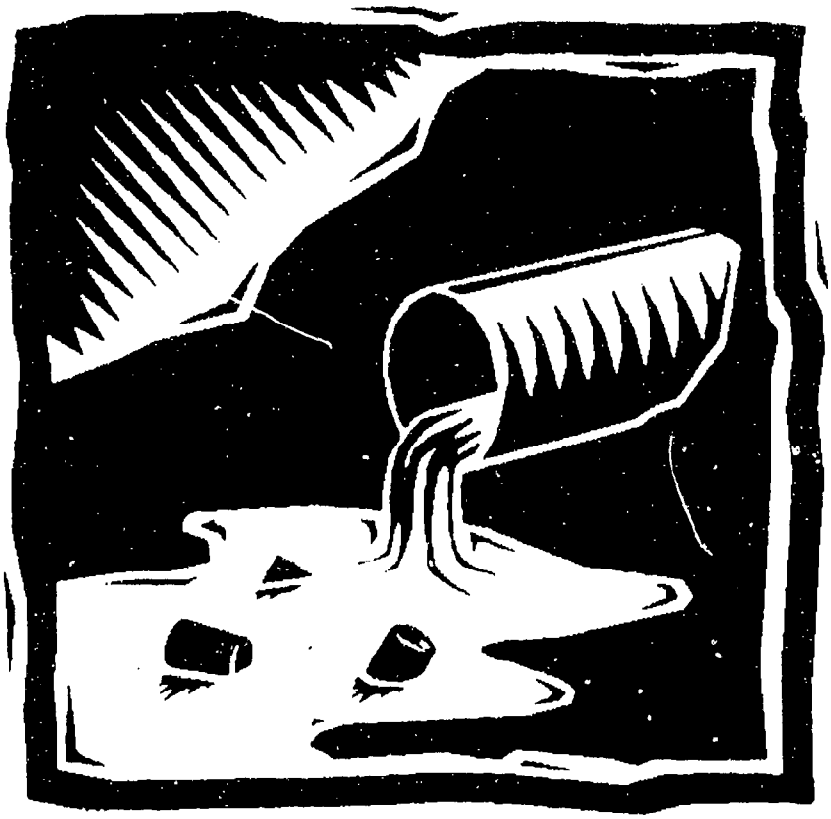
Environmental **pollution** is a global issue. Often individual citizens feel helpless given the scope of the problem. They can make a difference, however, just by educating themselves about what they can do around their homes and in their lifestyles to reduce environmental pollution and improve **water quality.**

Take a look at some common household pollutants that impact water quality.

Ruinous Runoff: Anything that's sprayed, dumped, or spilled on the ground may end up in waterways. Pesticides, chemical fertilizers, animal waste, and other compounds may flow directly into waterways or wash down storm drains, which usually empty into surface water. (In many cities in the U.S., storm drains don't empty directly into waterways. Instead, material that washes into them combines with wastewater from homes and businesses and flows to a **sewage** treatment plant for purification. During heavy storms, the wastewater can back up and overflow directly into surface water without being treated.) Many of the materials that get sprayed, dumped, or spilled on the ground can also soak into the **soil** and contaminate **groundwater.**

Car Care: A car engine may hold four to six quarts of oil. When this oil gets dumped down a storm drain, it can end up in a nearby waterway and create a slick that covers a huge area. Just a single quart of motor oil can contaminate up to two million gallons of drinking water. Other car products, including antifreeze, are also toxic and may poison **aquatic** animals if they get into waterways.

Wash It All Away: The stuff most people in the U.S. wash down their drains and flush down their toilets goes to a **wastewater treatment plant** before it's released into rivers or other waterways. These plants can remove many of the pollutants in wastewater, including food and other organic waste. Some can even remove most of the phosphates in wastewater, but many cannot. Because of the problems they can cause, phosphates have been banned from use in detergents in some states. Equipment that



can remove phosphates from wastewater is being installed in many sewage treatment plants.

Storage Problems: There are approximately five million underground storage tanks in the United States, and more than 200,000 of them may be leaking. These tanks are used to store gasoline, oil, chemical waste, and other hazardous liquids. Most of the tanks are made of steel, which can corrode, and they often develop leaks after about 20 years. Leaks in underground tanks and the pipes that lead to them are one of the most common sources of groundwater pollution.

Traffic Troubles: In most of the United States, cars are the major means of transportation. They are also one of the major causes of air pollution. Every day millions of people drive to and from work, school, church, shopping centers, etc., all the while emitting a gaseous pollutant known as **nitrogen oxide** into the air. When it rains, this pollutant combines with water to produce a nitric **acid**. The **acid rain** that falls to earth not only affects the plant life on earth but raises the acid level in lakes, rivers, and streams as well.

Electric Pollution: Most of the electricity people use in the U.S. comes from power plants that burn coal or oil. Burning these fossil fuels contributes to acid rain and other kinds of air pollution. The extraction of these fuels can harm natural areas and result in **runoff** problems. (When rain runs off land that's been disturbed by bulldozers and other equipment, it picks up dirt and **silt** and carries them into surface water. Once in the water, **sediment** can keep sunlight from reaching aquatic plants, can clog fish gills, and can smother bottom-dwelling organisms.) The more electricity we use, the more pollution we create.

Off the Streets: Oil, dirt, litter, and anything else that's on the streets washes into storm drains. In most areas of the country, these drains empty into a series of underground pipes that eventually dump directly into waterways.

Trashing the Water: When trash gets thrown overboard it can create an ugly mess — both in the water and on shore after it's washed up. Trash can also harm or even kill wildlife. For example, thousands of sea birds and marine mammals die each year after eating or becoming entangled in plastic debris floating in the ocean.

It is easy to understand that a crippled tanker leaking millions of gallons of crude oil into the ocean is polluting the water. But big industry cannot take all the blame. We are each responsible to some extent for all forms of pollution. In this activity you will discover some of the not-so-obvious ways people can pollute water every day without realizing it.

"A River Runs Through It"

Originating along the eastern slope of Grandfather Mountain, North Carolina and spanning more than 220 miles and three million acres through 14 different counties in North and South Carolina is the Catawba **River Basin**. The word *Catawba* stems from the Indian word, *kawahcatawba*, which means "people of the river." Many years ago, the Catawba Indians lived along and depended on the lands and waters of this basin for their survival.

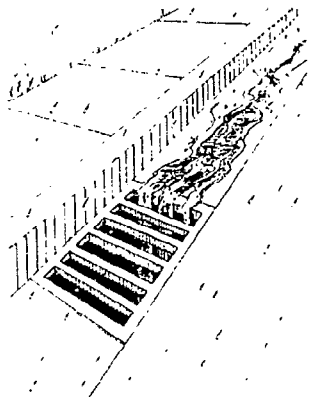
Today, the people of the river are the tens of thousands of Carolinians who use and depend on it for recreation, commercial and domestic uses everyday. The Catawba River Basin is under tremendous pressure and its waters, especially down river, aren't as clean as they used to be

Let's journey 220 miles down the Catawba to discover just a few of the pollutants affecting the river.

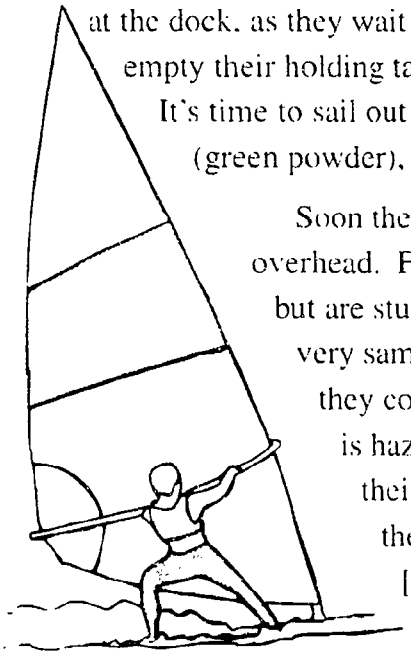
We begin our travels by looking in on the Johnson family that lives in a new lakefront home on Lake James, the most pristine lake on the Catawba chain. The Johnsons are eating breakfast and looking out their bay window. It is really raining! They look in astonishment as the deluge pounds the muddy surface of their soon-to-be lawn, washing red clay into the lake below. The family has been so busy getting settled in, they simply haven't had time to plant grass. From the looks of the new subdivision, most of their neighbors face the same dilemma. [**Nonpoint Source = sediment** (black pepper)]

About 18 miles downstream, near Lake Rhodhiss, there are many croplands and timbered areas. A large tree farm has just been cleared of every tree to meet the great demand for paper products. The once wooded land now reveals only bare **soil**. There are large crop fields, some with interesting crop patterns of wavy stripes and patchwork squares, and some with acres of recently tilled soil. Too bad a farmer just sprayed his entire 100 acre corn field with insecticide. The rain may wash it all into the river. [Nonpoint Sources = sediment (black pepper), chemicals (red powder), and possibly fertilizer (green powder)]

Meanwhile, about 40 miles downstream the Jones family of Statesville is rushing to get ready for school and work. With two teenagers and a 10-year old, there's always a waiting line for the bathrooms in the morning. Everyone wants their turn at the sink, shower, and toilet. Splash, gurgle, flush! Down the drain it goes! Under normal conditions, the local **wastewater treatment plant** can handle the influx of wastewater in the mornings, but the heavy rains combined with this normal load are too much for the outdated facility. It overflows, releasing untreated wastewater (**sewage**) into a **tributary** of the Catawba. Outside, the 10-year old entertains himself while waiting for his school bus. He marvels at the rainbows of iridescent colors on the wet road and watches as the oil washes into the storm drain which empties into a nearby stream. Although the high school bus will also stop at the curb in front of the house in another half-hour, the teenagers will do the "cool" thing and drive themselves to school. [**Point Sources** = wastewater treatment plant (cocoa); Nonpoint Sources = oil (soy sauce) and air **pollution** (blue powder)]



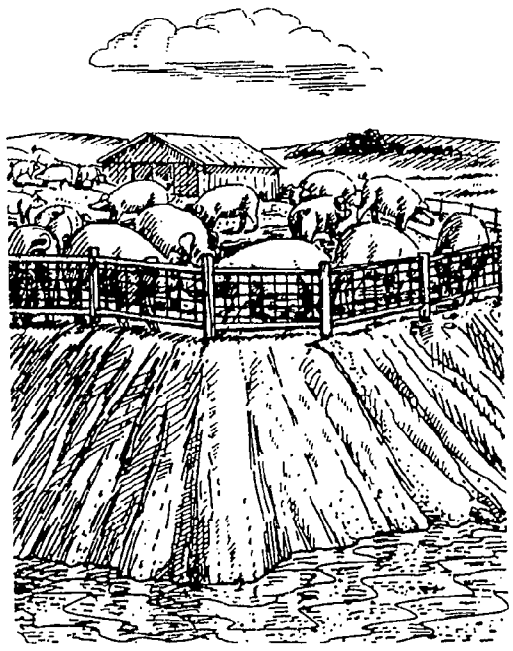
The Catawba flows on, eventually reaching Lake Norman, the largest and most rapidly developing lake in the Catawba chain. Beautiful homes in crowded subdivisions are popping up everywhere. Mr. and Mrs. Adams have retired on the lake. They enjoy playing many rounds of golf on the large green golf courses. Boating is a favorite pastime as well, although today they are landlocked because their boat motor seized and was leaking gas and oil. Back at the dock, as they wait for repairs, the are shocked that so many boaters don't need to empty their holding tanks. Where do they dispose of the waste? Oh! All aboard! It's time to sail out into 32,500-acre "Inland Sea." [Nonpoint Sources = fertilizers (green powder), oil (soy sauce) and human waste (cocoa)]



Soon the river passes near the city of Charlotte where large planes fly overhead. Four native Charlotteans, the Hensleys, are driving to the beach but are stuck in a holiday rush traffic jam with many others who had the very same weekend plans. Oh, how they wish they were in a plane so they could swoop over this convoy of bumper-to-bumper cars! The air is hazy as hundreds of cars idle impatiently in place on the highway, their tailpipes rattling with invisible exhaust. Although traffic and the Hensleys move nary an inch, the Catawba flows on for miles. [Nonpoint Source = air pollution (blue powder)]

The river flows on in a southerly direction until it reaches yet another man-made reservoir in the Catawba chain (there are 11 such reservoirs in the Catawba River Basin), Lake Wylie. In addition to handling the sediment and pollutants filtered down from the Catawba, Lake Wylie must also handle what

is flowing in from the South Fork tributary of the Catawba. The South Fork generally has a negative effect on Wylie's **water quality** due to the massive size of its **watershed** and extensive agricultural and industrial activities on and around the tributary upstream. A variety of crops and livestock are raised here to feed the hungry North Carolinians and many others across the country and world. Speaking of food, it is high noon and the Baxter family of Rock Hill decides to go to a new lakefront restaurant for lunch. Their mouths are watering for the taste of the South's famous pork barbecue, fried chicken, and ice cream. In fact, people are so wild over "Q," that North Carolina is second only to Iowa in raising the largest number of hogs. [Nonpoint Sources = animal waste (cocoa), fertilizers (green powder) and possibly chemicals (red powder)]



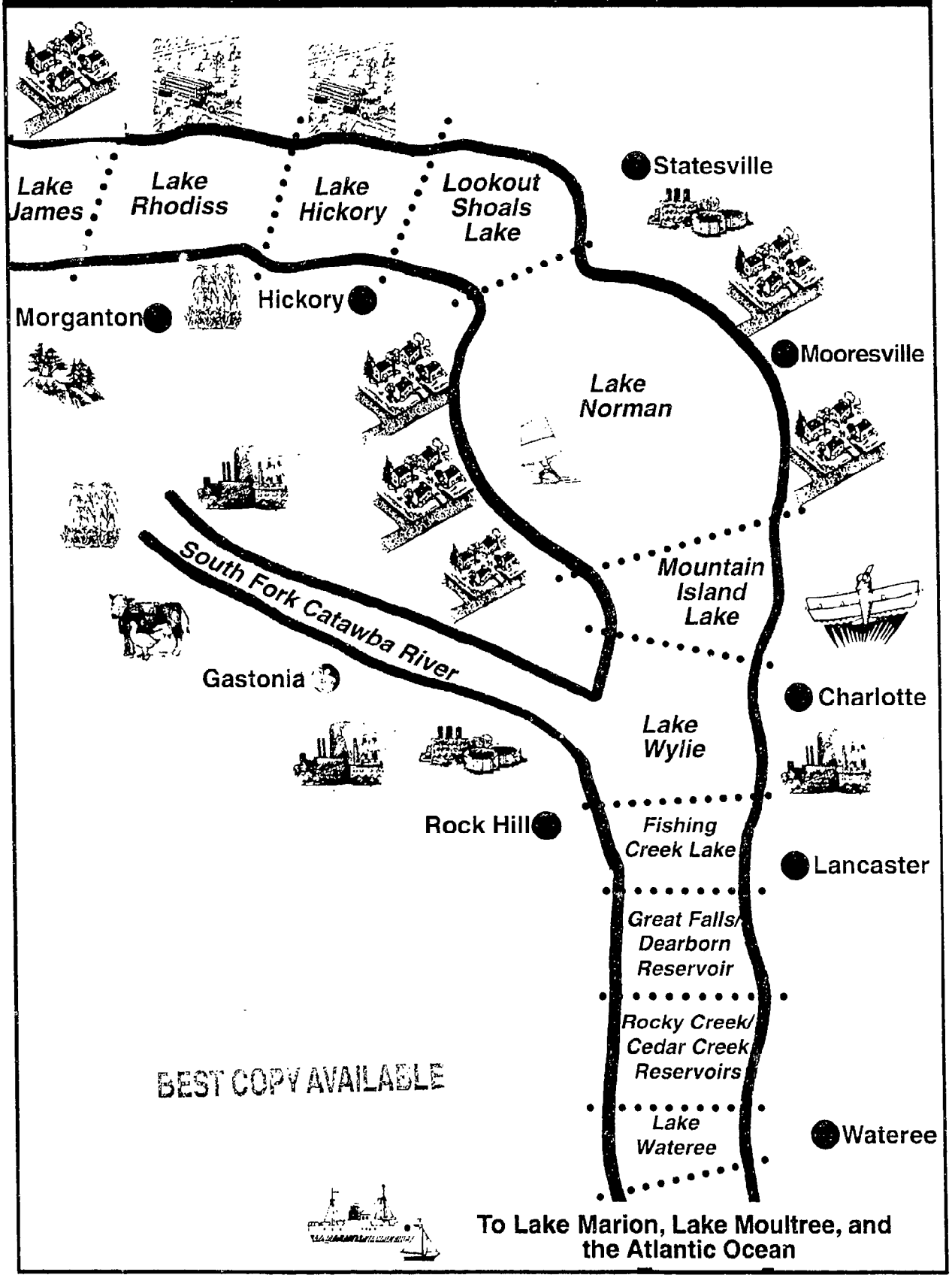
Industry is big on Lake Wylie. Some of the industries located in the watershed with wastewater treatment facilities discharging into the lake include a machinery company, hosiery mill, chemical company, trucking company, clothing industry, and chainsaw manufacturer. [Point Sources = chemicals (red powder), oil (soy sauce) and possibly air pollution (blue powder)]

From here the Catawba will flow into four more reservoirs in the Catawba River Basin: Fishing Creek Lake, Great Falls Dearborn Reservoir, Rocky Creek Cedar Creek Reservoir, and Lake Wateree.

Educator: At this point, have students guide their water drop down the Catawba. Have them make observations.

Below Lake Wateree's dam the Catawba River's name changes to Wateree River. From there it flows into Lake Marion and Lake Moultree, and eventually to the Atlantic Ocean near Charleston, South Carolina. As you can see, the water is not as clear and clean as it used to be. It has acquired many new pollutants on its journey downstream.

Catawba River to the Atlantic Ocean



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VOCABULARY

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.

Acid Rain - Rain, or other precipitation, with a pH of less than 5.6; results from atmospheric moisture mixing with sulphur and nitrogen oxides emitted from the burning of fossil fuels; may cause damage to buildings, car finishes, crops, forests, and aquatic life.

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.

Algae bloom - A heavy growth of algae in and on a body of water; usually results from high nitrate and phosphate concentrations entering water bodies from farm fertilizers and detergents; phosphates are also naturally occurring in rock formations.

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 then 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 has its eyes in front rather than on the side of its head, it is a member of the Order Strigiformes (the owls).

Community - A group of organisms living in a specific region under similar conditions, and interacting with each other through food webs and other relationships.

Delta - A usually triangular alluvial deposit at the mouth of a river.

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.

Divide - The ridge of land or point of higher ground that separates two adjacent watersheds.

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.

Estuary - The part of the wide lower course of a river where its current is met and influenced by the tides.

Eutrophication - Naturally occurring changes that take place after a water body receives inputs of nutrients, mostly nitrates and phosphates, from erosion and runoff of surrounding lands; this process can be accelerated by human activities.

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 complete metamorphosis.

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

Limiting factors - influences in the life history of any animal; when one of these exceeds the limit of tolerance of that animal, it becomes a limiting factor; it then drastically affects the well-being of that animal.

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.

Nitrogen oxide - A family of gases that are produced when fossil fuels are burned. Nitrogen oxides are major contributors to the formation of ground-level ozone and acid deposition.

Nonpoint source pollution - Pollution that cannot be traced to a specific point, because it comes from many individual places or a widespread area (e.g., urban and agricultural runoff).

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.

Point source pollution - Pollution that can be traced to a single point source, such as a pipe or culvert (e.g., industrial and wastewater treatment plant discharges).

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

Predator - An animal that captures, kills and feeds on another animal.

Quality - A degree of excellence which a thing possesses.

Riffle - An area of choppy water caused by a rock, sandbar or other object lying just below the surface of a moving body of water.

Ridge line - A point of higher ground that separates two adjacent watersheds; also know as divide.

Riparian areas - The areas on or along the banks of rivers and streams and around springs, bogs, wetlands, lakes, and ponds; the land areas directly influenced by the presence of water.

River basin - The watershed of an entire river. It encompasses the many smaller watersheds of the river's tributaries or branches.

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.

Sewage - Liquid and solid waste mixed with water.

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

Siltation - The build up of silt in a body of water.

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.

Splash dam - A dam constructed across a stream to retain a head of water for driving logs downstream.

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

Stocked - periodically replenished with a population of fish.

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.

Turbidity - The amount of sediment or foreign particles suspended in water. Very muddy or dark water has high turbidity.

Wastewater Treatment Plant - Facility where water from households, businesses and industries is treated with chemicals, or processed to remove harmful bacteria and chemicals.

Water - A transparent, odorless, tasteless liquid compound of hydrogen and oxygen (H_2O) 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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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: South Mountains State Park
3001 South Mountains Park Ave.
Connelly Springs, NC 28612

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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 **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 _____

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. Grade level/age level _____
8. 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
3001 South Mountains Park Ave.
Connelly Springs, NC 28612