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AUTHOR	Bradley, Jack L., Jr.; Beazley, Lea J.; Cook, Carrie
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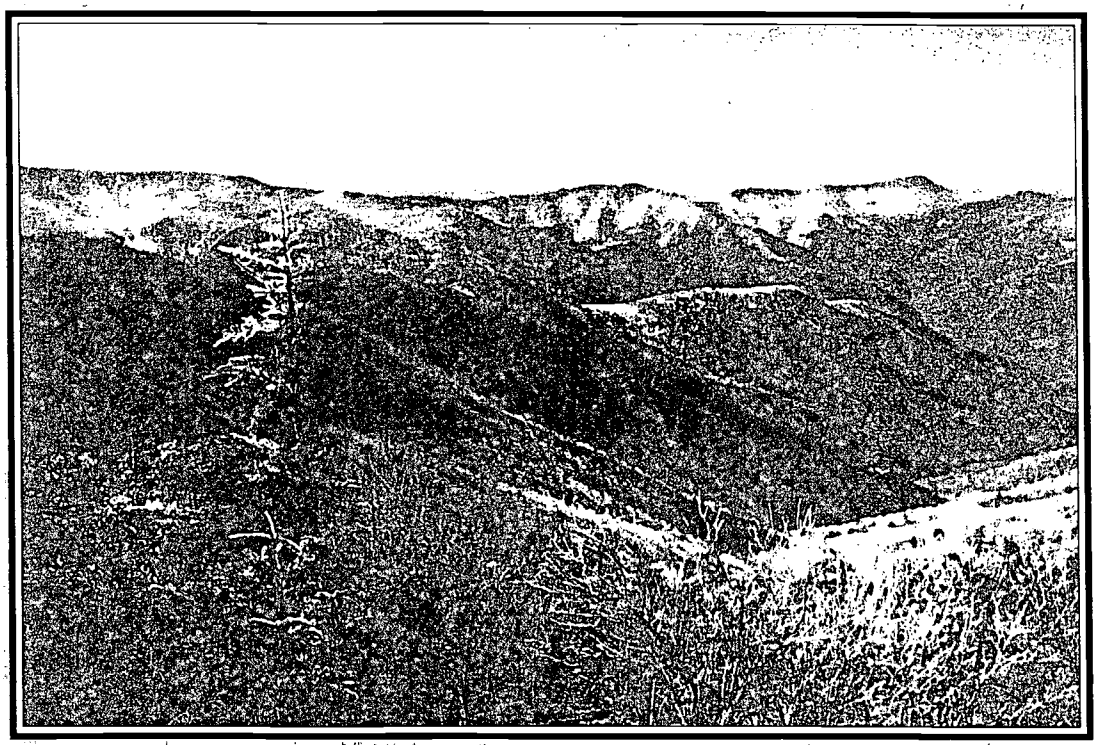
ABSTRACT

This curriculum packet was developed to provide environmental education through a series of hands-on activities for the classroom and the outdoor setting of Mount Mitchell State Park, North Carolina. Designed for grades 3 through 6, the packet meets established curriculum objectives of the North Carolina Department of Public Instruction's Standard Course of Study. Students are exposed to major concepts such as spruce-fir forest ecosystems, tree anatomy and physiology, limiting factors and spruce-fir forest decline, decomposition, interdependence of plants and animals, preservation of natural areas, and stewardship of natural resources. The packet is divided into eight sections: (1) introduction to the North Carolina State Parks system, Mount Mitchell 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 4-6. 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)

ALPINE

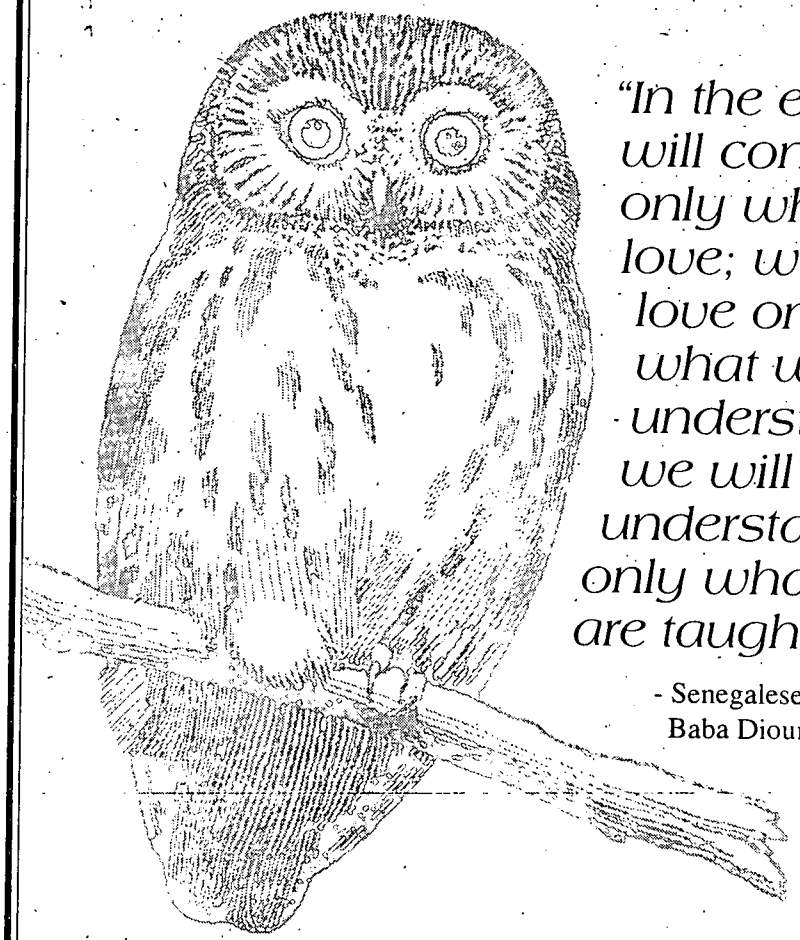


FOREST

Mount Mitchell State Park

An Environmental Education Learning Experience

Designed for Grades 4-6



"In the end, we will conserve only what we love; we will love only what we understand; we will understand only what we are taught."

- Senegalese conservationist
Baba Dioum

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This Environmental Education Learning Experience
was developed by

Jack L. Bradley, Jr.
Lead Interpretation and Education Ranger,
Mount Mitchell State Park
Lea J. Beazley
Interpretation and Education Specialist
North Carolina State Parks
and Ms. Carrie Cook
Intern, East Carolina University

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

James B. Hunt, Jr.
Governor

Wayne McDevitt
Secretary

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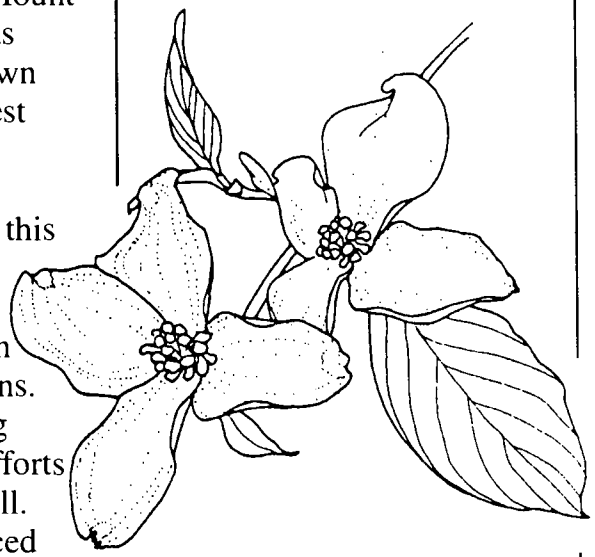
Table of Contents

Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark — the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park of North Carolina. That was in 1915.

The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks,



recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.

As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 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 that cultivates responsible stewardship of the earth.

For more information contact:

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

Introduction to Mount Mitchell State Park

In the crest of the billion year old Black Mountain range lies the summit of Mount Mitchell, the highest point east of the Mississippi. This lofty peak is the focal point of the 1,677 acre Mount Mitchell State Park.

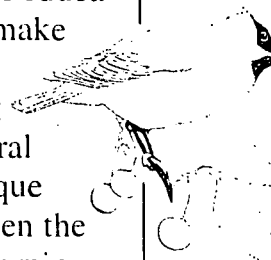
Mount Mitchell State Park is the oldest state park in the southeastern United States. It was established in 1915 by the North Carolina General Assembly for the preservation and protection of the unique spruce-fir forests located there. The two highest peaks of the eastern United States are located within the boundaries of the park: Mount Mitchell at 6,684 feet and Mount Craig at 6,647 feet.

Mount Mitchell is located in Yancey County, 34 miles northeast of Asheville off the Blue Ridge Parkway on North Carolina Highway 128.

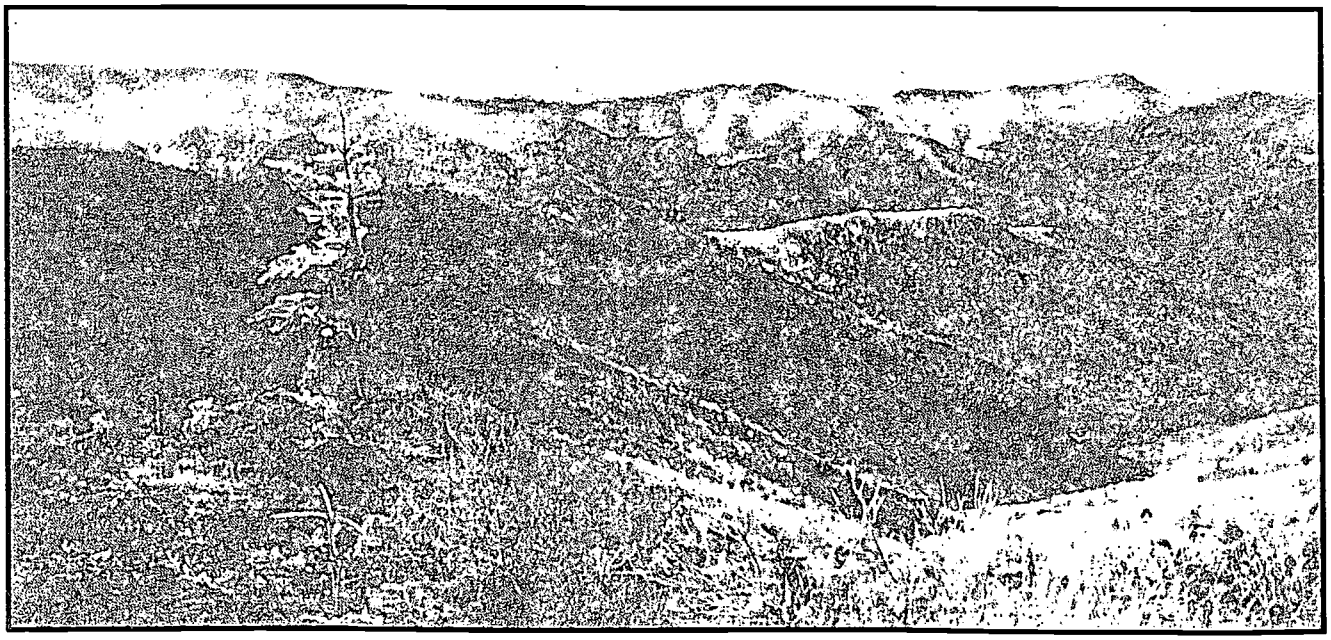
The Park as an Outdoor Classroom

Numerous recreation facilities and a variety of educational opportunities make a visit to Mount Mitchell a rewarding adventure. The natural resources of this unique mountainous area open the door to a world of learning and discovery. One of the most outstanding natural features of the park is its high elevation. Because temperature decreases as altitude increases, the climate of Mount Mitchell is similar to that of southern Canada.

Mount Mitchell State Park has a unique natural history and is an excellent place to study geology, ecology, biology and environmental issues. The park is also rich in cultural resources and provides a wonderful outdoor classroom for learning about history, literature and recreation. Students can study and learn about these and other subjects on a hands-on basis.



Groups are encouraged to visit the park during the warmer months 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 Learning Experience packet. A park ranger will be happy to meet with your group upon arrival to answer any questions the students may have, or to welcome the group and present a short talk. Park staff will make every effort to accommodate persons with disabilities.



Park Facilities:

Restrooms: Restrooms are available at the park office, the restaurant, and concession stand.

Picnic Area: A picnic area is located at the north end of the summit parking lot. It contains 40 picnic tables, several stone grills, drinking water and two picnic shelters which can accommodate 16 people each. All are available on a first-come basis although shelters may be reserved. Use of the shelters is free of charge unless you reserve them.

Family Camping: Family camping is available from May 1 to October 31 on a first-come basis. Each of the nine campsites has a grill, picnic table and a gravel pad for tents. The campsites are located a short distance from the campground parking lot. A centrally located washhouse provides drinking water and toilet facilities. This washhouse is closed during the winter. Electric and water hookups are not available.

Scheduling a Trip:

1. Please contact the park at least two weeks in advance to make a reservation.

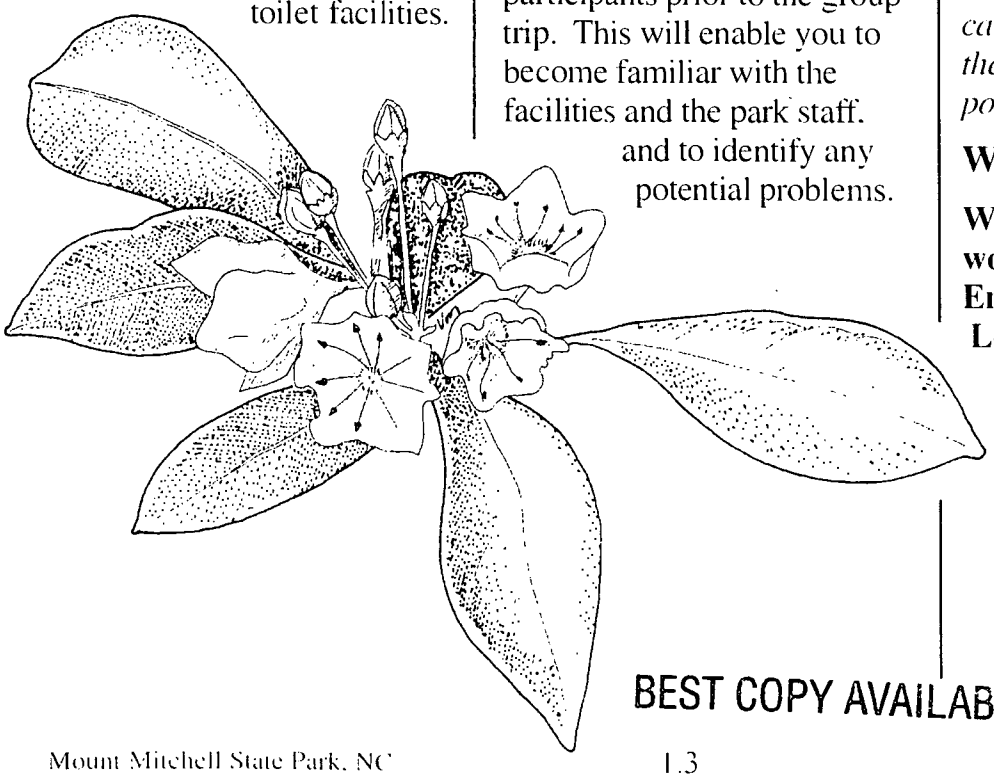
2. Complete the Scheduling Worksheet located on page 8.1, and return it to the park as soon as possible.

3. Research Activity Permits may be required for sampling activities. If your group plans to collect any plant, animal or mineral within the park, please contact the park office at least 30 days in advance to obtain a permit application.

Before the Trip:

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

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



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

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

5. Activities that take place outdoors may expose participants to insects and seasonal weather conditions. The high altitude makes the climate of Mount Mitchell quite cold even in summer. Be prepared by dressing accordingly and wearing sunscreen and/or insect repellent, if necessary. Comfortable walking shoes should also be worn.

6. *The group leader is responsible for obtaining a parental permission form from each participant, including a list of any health considerations and medical needs.* An example of this form is on page 8.2.

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

While at the Park:

Whether your class is working on an Environmental Education Learning Experience or taking a nature hike, please obey the following rules:

1. To help you get the most out of the experience and increase the chance of observing wildlife, be as quiet as possible while in the park.

2. On hikes, walk behind the leader at all times. Running is not permitted.

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

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

5. *In case of accident or emergency, contact park staff immediately.*

Following the Trip:

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

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

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

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

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

Park Information:

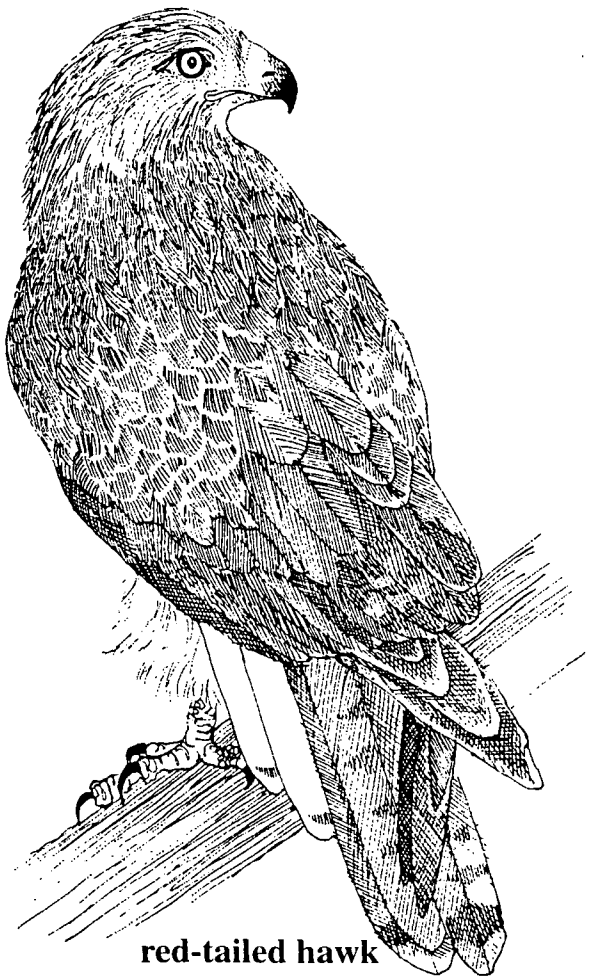
Mount Mitchell State Park
Route 5, Box 700
Burnsville, NC 28714
Tel: (828) 675-4611
Fax: (828) 675-9655
E-mail:
momi@yancey.main.nc.us

Office Hours:

8:00 a.m.- 5:00 p.m.
Monday - Friday

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.



red-tailed hawk

Introduction to the Activity Packet for Mount Mitchell State Park

The Environmental Education Learning Experience, *Alpine Forest,* provides a series of hands-on activities for the classroom and the outdoor setting of Mount Mitchell State Park. This activity packet, designed for grades 3 through 6, meets established curriculum objectives of the North Carolina Department of Public Instruction's Standard Course of Study. Three types of activities are included:

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. Pre-visit activities should be introduced prior to the park visit so that students will have the necessary background and vocabulary for the on-site activities. We encourage you to use the post-visit activities to reinforce concepts, skills and vocabulary learned in the pre-visit and on-site activities. These activities may be performed independently; however, they have been designed as a series to build upon the students' newly gained knowledge and experiences.

The Environmental Education Learning Experience, *Alpine Forest,* will expose the students to the following major concepts:

- **Spruce-Fir Forest Ecosystems**
- **Tree Anatomy and Physiology**
- **Limiting Factors and Spruce-Fir Forest Decline**
- **Decomposition**
- **Interdependence of Plants and Animals**
- **Preservation of Natural Areas**
- **Stewardship of Natural Resources**

The first occurrence of vocabulary words used in these activities is indicated in **bold type**. Their 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:
The on-site activities will be outdoors and could expose the students to cold conditions, ticks and insects. Accessibility to some areas may be difficult for persons with special needs. When conducting the on-site activities, please remember that collecting specimens of any kind in the park is prohibited.

striped skunk

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 Canada Down South (page 3.1.1)

In this activity, students will play a card game to learn about the changes in natural communities at different elevations in the Southern Appalachians.

Major Concepts:

- Natural communities
- Community diversity with change of elevation
- Identifying plants and animals

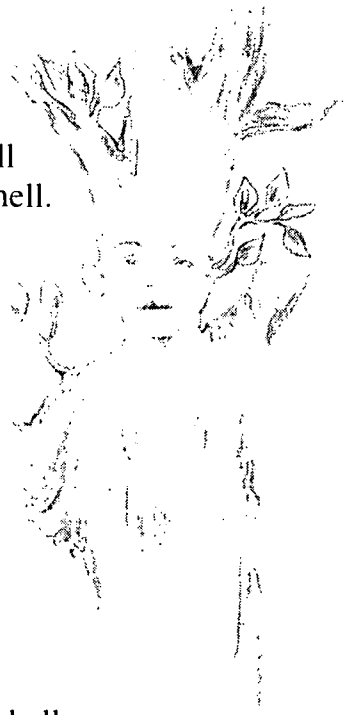
Learning Skills:

- Observing, classifying and communicating
- Organizing and analyzing information

Objectives:

- Describe five different natural communities you would encounter as you ascend Mount Mitchell.
- Name four plants and four animals from each of these natural communities.
- List two environmental factors which bring about changes in natural communities between 0 and 6000 feet above sea level in North Carolina.

#2 The Human Tree (page 3.2.1)



Students will participate in a simulation to learn, or review, basic tree anatomy and physiology. During a second simulation, students will be introduced to the limiting factors that impact Fraser firs at Mt. Mitchell.

Major Concepts:

- Tree anatomy and physiology
- Air pollution
- Insect pests
- Limiting factors

Learning Skills:

- Observing, classifying, communicating and predicting
- Participating in creative interpretations
- Applying concepts and ideas

Objectives:

- List three or more parts of a tree and describe their functions.
- List three limiting factors that impact the Fraser firs at Mt. Mitchell, and describe how each factor affects the physiology of the tree.

#3 Acid from the Skies (page 3.3.1)

Students will simulate the effects of acid rain on a variety of objects by experimenting with household acids and uncooked eggs, pennies, and plants. They will then relate their experiences with acids in the classroom to acid rain in the environment outside the classroom by completing a worksheet that illustrates where the acid in our atmosphere comes from and how it may affect the environment. Also, in an activity involving balloons, they will portray acid rain producers and things affected by acid rain.

Major Concepts:
- Acidity and pH
- Acid rain formation
- Effects of acid deposition on plants

Learning Skills:
- Observing, communicating, experimenting and predicting
- Measuring, averaging and graphing
- Applying and expanding information

Objectives:
- Predict and observe the effects of household acids on nonliving objects and plants inside the classroom.
- Using experimental results, predict how acid rain might affect living and nonliving things in the environment outside the classroom.
- Draw or list two sources of acid rain.
- Given a list of terms, correctly label a diagram depicting acid rain formation and its possible effects.

II. On-Site Activities

#1 Meet A Tree (page 4.1.1)

The students will collect data from several small plots along the Balsam Trail at Mount Mitchell State Park. They will identify each tree species within the plot and estimate each tree's diameter. Students will also measure the pH of the soil in their plot.

Major Concepts:
- Ecology of the spruce-fir forests of the Southern Appalachians
- Plot sampling methods
- Soil pH

Learning Skills:
- Observing, classifying and communicating
- Interpreting data and making inferences
- Measuring

Objectives:
- Identify the four most common trees on Mount Mitchell.
- Determine the number of trees in a plot.
- Measure each tree's diameter at 4 1/2 feet above the ground.
- Determine the soil pH.

#2 Mt. Mitchell — A Sense of Place (page 4.2.1)

Educators will lead the students in a guided story that allows them to use their imaginations to experience life as a Fraser fir at Mount Mitchell. Students will also participate in a silent hike along the Balsam Trail.

Major Concepts:

- Life cycle of a tree
- Spruce-fir forest
- Interdependence of plants and animals

Learning Skills:

- Communicating and observing
- Responding personally and creatively to a story/experience

Objectives:

- Observe and describe three different plants and three different animals inhabiting the spruce-fir forest on Mt. Mitchell.
- Describe the condition of the trees on Mt. Mitchell and list two possible causes of tree mortality.
- Complete a journal entry with observations, sketches, poetry, or other written response after participating in a guided imagery activity on Mt. Mitchell.

#3 Planting for Tomorrow (page 4.3.1)

By planting trees at Mt. Mitchell State Park, students participate in a stewardship activity and express their appreciation of trees.

Major Concepts:

- Benefits of trees
- Planting trees
- Spruce-fir forest decline

Learning Skills:

- Observing, measuring, inferring, predicting
- Participating in a stewardship activity
- Graphing and interpreting data

Objectives:

- Observe and describe the condition of Fraser firs on Mt. Mitchell.
- List two limiting factors that stress Fraser firs on Mt. Mitchell.
- List at least three ways that trees benefit people.
- Successfully plant Fraser fir seedlings on Mt. Mitchell, or observe and measure trees that were planted by other groups.

III. Post-Visit Activities

#1 Forest Game (page 5.1.1)

Through a game, students will experience some of the factors limiting tree growth.

Major Concepts:
- Environmental factors affecting forest growth

Learning Skills:
- Communicating and observing
- Participating in creative interpretations
- Applying concepts and ideas

Objectives:
- List five elements that can adversely affect natural communities.
- List three ways to help protect the spruce-fir forest.

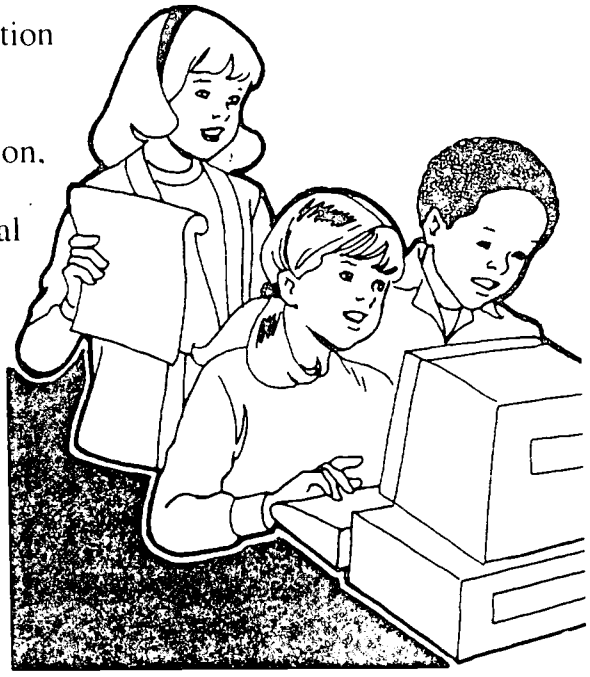
#2 Forest Stewardship (page 5.2.1)

Students write forest stewardship plans outlining responsible actions they can take to improve the health of trees and forests.

Major Concepts:
- Conservation of natural resources
- Stewardship
- Responsible environmental action

Learning Skills:
- Writing a stewardship plan
- Carefully considering consequences of actions

Objectives:
- List at least two stewardship actions individuals can take to improve the health of trees and forests.
- Explain the positive consequences of each action listed above.
- Define at least two of the four types of responsible action: ecomanagement, persuasion, consumerism, and political action.
- Choose one type of responsible environmental action and write a forest stewardship plan, outlining the steps in taking action.



#3 Recycle a Forest — Leave a Log Alone (page 5.3.1)

Students will listen to a story to learn why rotting logs are important to the health of the forest community. They will participate in a simulation to learn how a variety of decomposers work together to break down dead trees.

Major Concepts:

- Decomposers and decomposition
- Forest resource management

Learning Skills:

- Participating in creative interpretations; listening
- Applying concepts and ideas
- Observing, classifying, communicating and predicting

Objectives:

- List three decomposers and describe their role in returning dead trees to the soil.
- Explain why park managers often choose to leave dead trees and logs alone.
- List pros and cons of not disturbing dead trees or logs on school property or in students' neighborhoods.

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: Canada Down South, p. 3.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	2.1, 2.2, 2.4, 2.6, 4.1, 5.1, 5.3	1.1, 2.1, 2.2	8.3 Skill Goal I	
4	2.1, 2.2, 2.4, 2.6, 4.1, 5.2	1.1, 2.1, 2.2	3.2, 4.2 Skill Goal I	5.1, 5.2, 5.3, 5.5, 5.6
5	2.1, 2.2, 2.4, 2.6, 4.1, 5.1, 5.3	1.1, 2.1, 2.2	4.2 Skill Goal I	5.1, 5.2, 5.3, 5.5, 5.6
6	2.1, 2.2, 2.4, 4.1, 6.1	1.1, 2.1, 2.2		7.1, 7.2

Pre-Visit Activity #2: The Human Tree, p. 3.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	2.1, 2.2, 2.4, 2.7, 3.1, 4.2, 4.3, 5.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3	4.2 Skill Goals I & II	
4	2.1, 2.2, 2.4, 2.7, 3.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.3		
5	2.1, 2.2, 2.4, 2.7, 3.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.3		
6	2.1, 2.2, 2.4, 2.7, 3.1, 4.2, 5.1, 6.1	1.1, 1.2, 1.3, 2.1, 2.2. 2.3, 4.1, 4.3		

Correlation Chart

Pre-Visit Activity #3: Acid from the Skies, p. 3.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	1.1, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 2.10, 2.11, 2.12, 2.13, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 5.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1	6.2, 6.3, 8.3, 9.3 Skill Goals I & II	4.1, 4.3, 4.13, 6.1, 6.2, 6.7
4	1.1, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 2.10, 2.11, 2.12, 2.13, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1	2.3, 5.3, 9.4, 11.2, 11.3 Skill Goals I & II	4.1, 4.3, 6.1, 6.2
5	1.1, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 2.10, 2.11, 2.12, 2.13, 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 5.1, 5.3, 5.6	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1	2.3, 5.2, 5.3 Skill Goals I & II	6.1, 6.2
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On-Site Activity #1: Meet a Tree, p. 4.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 2.9, 3.1, 3.3, 4.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1, 4.3, 4.6, 4.11, 4.12, 4.13, 6.1, 6.2
4	2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 2.9, 3.1, 3.3, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1, 4.10, 5.1, 6.1, 6.2
5	2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 2.9, 3.1, 3.3, 4.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		2.4, 4.1, 4.6, 6.2, 6.4
6	2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 2.9, 3.1, 3.3, 4.1, 4.2, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		6.1, 6.2

Correlation Chart

On-Site Activity #2: Mt. Mitchell — A Sense of Place, p. 4.2.1				
Grade	**Science**	**English Lang. Arts**	**Soc. Studies**	**Mathematics**
3	2.1, 2.4, 3.1, 3.5, 4.1, 4.2, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1, 4.2, 4.3		
4	2.1, 2.4, 3.1, 3.5, 4.1, 4.2, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 4.1, 4.2, 4.3		
5	2.1, 2.4, 3.1, 3.5, 4.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 4.1, 4.2, 4.3		
6	2.1, 2.4, 3.1, 3.5, 4.1, 4.2, 6.2, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 4.1, 4.2, 4.3		

On-Site Activity #3: Planting for Tomorrow, p. 4.3.1				
Grade	**Science**	**English Lang. Arts**	**Soc. Studies**	**Mathematics**
3	1.1, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	1.2, 6.1, 6.3, 9.3, 11.2, 11.4 Skill Goals I, III & IV	2.6, 4.1, 4.7, 4.13, 6.1, 6.2, 6.3
4	1.1, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	2.3, 5.2, 5.3, 7.5, 8.2, 9.4, 11.3 Skill Goals I, III & IV	2.6, 4.1, 4.6, 4.11, 6.1, 6.2, 6.3, 6.4
5	1.1, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 5.1, 5.3, 5.4	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	2.3, 5.2, 5.3, 9.2 Skill Goals I, III & IV	4.5, 4.6, 6.1, 6.2, 6.4
6	1.1, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 5.1, 5.2, 6.2, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2		4.1, 4.2, 6.1, 6.2, 6.5, 6.6

Correlation Chart

Post-Visit Activity #1: Forest Game, p. 5.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	2.1, 2.4, 3.1, 4.1, 4.2, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	1.2, 4.2, 6.2, 6.3, 9.3, 11.4 Skill Goals I, III & IV	
4	2.1, 2.4, 3.1, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	2.3, 5.2, 5.3, 7.5, 8.2, 9.4 Skill Goals I, III & IV	
5	2.1, 2.4, 3.1, 4.1, 4.2, 5.1, 5.3, 5.4	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2	2.3, 5.2, 5.3 Skill Goals I, III & IV	
6	2.1, 2.4, 3.1, 4.1, 4.2, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2		

Post-Visit Activity #2: Forest Stewardship, p. 5.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 3.1, 4.2, 4.4, 5.3, 6.3, 9.3, 11.2, 11.4 -- Skill Goals I, II, III & IV	
4	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3	2.3, 5.2, 5.3, 7.5, 8.2, 8.3, 9.1, 9.2, 9.4, 11.3 -- Skill Goals I, II, III & IV	
5	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 5.3, 5.4	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3	2.3, 5.3, 7.3, 8.2, 11.3 -- Skill Goals I, II, III & IV	
6	1.1, 2.1, 2.2, 2.4, 2.6, 2.7, 4.1, 4.2, 4.3, 5.1, 5.2, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3		

Correlation Chart

Post-Visit Activity #3: Recycle a Forest — Leave a Tree Alone, p. 5.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
3	2.1, 2.2, 2.4, 2.7, 3.1, 3.5, 4.1, 4.2, 5.1, 5.2, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1	1.1, 4.4, 9.3, 11.4 Skill Goals I & II	
4	2.1, 2.2, 2.4, 2.7, 3.1, 3.5, 4.1, 4.2, 5.1, 5.2, 5.4	1.1, 1.2, 1.3, 2.1, 2.2, 4.1	2.3, 5.2, 5.3, 8.2, 9.4 Skill Goals I & II	
5	2.1, 2.2, 2.4, 2.7, 3.1, 3.5, 4.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 4.1	5.2, 5.3 Skill Goals I & II	
6	2.1, 2.2, 2.4, 2.7, 3.1, 3.5, 4.1, 4.2, 6.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 4.1		

Pre-Visit Activity #1 Canada Down South

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

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources, competency for interacting with others
- Science: living things—plants, earth science, environment
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: competency and skill for interacting with others,
- Healthful Living: environmental health,
- Science: ecology
- Social Studies: gather, organize and analyze information, draw conclusions

Location: Classroom

Group Size:
30 students, class size

Estimated Time: 20 minutes

Appropriate Season: Any

Materials:
Provided by the Educator:
Per group: "Mountain Community Fact Sheet", one deck of "Mountain Community Cards"

Major Concepts:
- Natural communities
- Community diversity with change of elevation
- Identifying plants and animals

Objectives:
- Describe five different natural communities you would encounter as you ascend Mount Mitchell.
- Name four plants and four animals from each of these natural communities.
- List two environmental factors which bring about changes in natural communities between 0 and 6000 feet above sea level in North Carolina.

Educator's Information:

In this card game, students will learn about the plants and animals that make up five different **natural communities** in the **piedmont** and mountain regions of the southeastern United States. They will learn which plants and animals are common to several natural communities and which are found only in one community.

Instructions:

1. Divide the class into groups of four. Copy the "Mountain Community Cards" to make one set of 60 cards for each group. Cut the cards apart as indicated and laminate them for durability. Have the students read the Student's Information sheet, then hand out a copy of the Mountain Community Fact Sheet to each student.

2. Explain to the students that the object of the game is for each player to make as many natural community "books" as possible out of the cards in his or her hand. The students will need to refer to their Mountain Community Fact Sheet to determine which cards will make a book. A book consists of four cards that all come from the same community type. The four cards must be different plants or animals from the same community type. Books are laid down on the table face up.

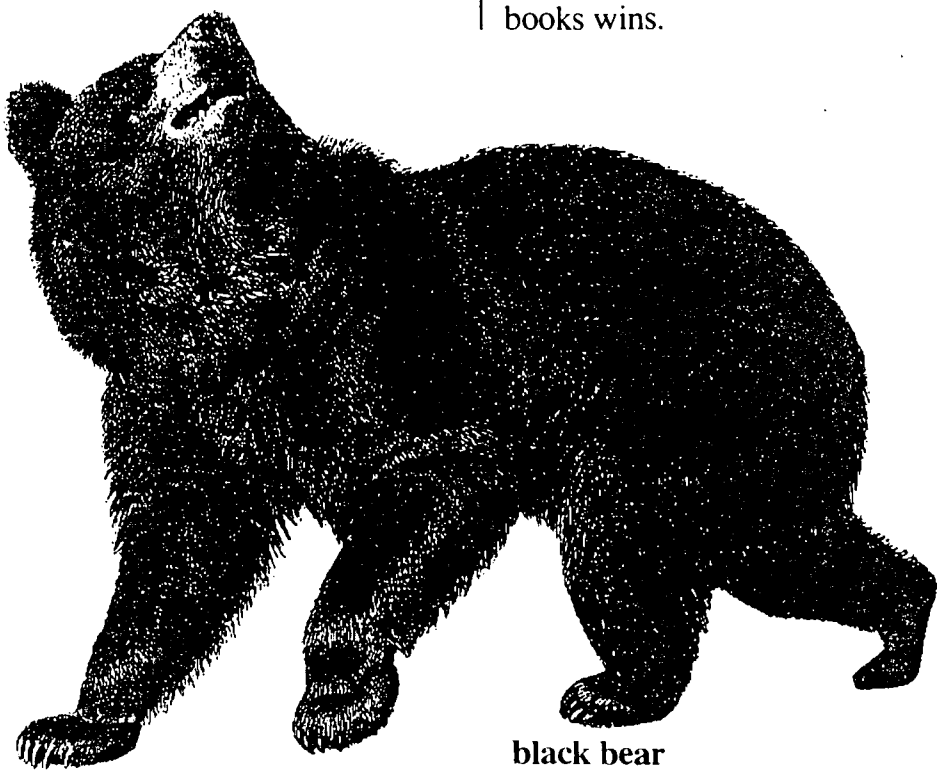
3. To play the game, the dealer deals eight cards to each player, starting with the player on the dealer's left. Have the dealer place the leftover cards in a stack face down in the center of the table, with the top card turned over and placed beside the stack as the start of the discard pile.

The player to the right of the dealer starts the game. He or she will draw a card from the stack or pick a card from the discard pile. If the player can use the new card, he or she does so, laying down any natural community books held. When laying down a book, the player must name aloud the natural community it represents. He or she will then discard one card into the discard pile, face up. If a card drawn from the stack cannot be used, it can be discarded. Play continues in this manner.

4. If a player has two or three cards from one natural community, and another card from that same natural community is placed on the discard pile by the player whose turn was immediately before him or her, the player may pick up the entire discard pile, after showing the two or three cards as proof. The player must then put the whole discard pile in his or her hand, using as many cards as possible to make books. The player then discards one card.

5. When the stack has been used up, the discard pile is shuffled, then turned over and used as the stack. Play continues until there is no longer a stack or discard pile or when only one player is left holding cards.

6. The player with the greatest number of natural community books wins.



black bear

Student's Information

Would you believe that you can travel to a place very much like southern Canada and still be in North Carolina? You can, and here's why:

During the past two million years, erosion and other forces have changed the mountains of North Carolina. During the last Ice Age, glaciers (wide, thick rivers of ice) covered much of what is now the northern United States. As these glaciers slowly moved south from the polar regions to present day Illinois and Indiana, they brought colder weather into the southern United States.

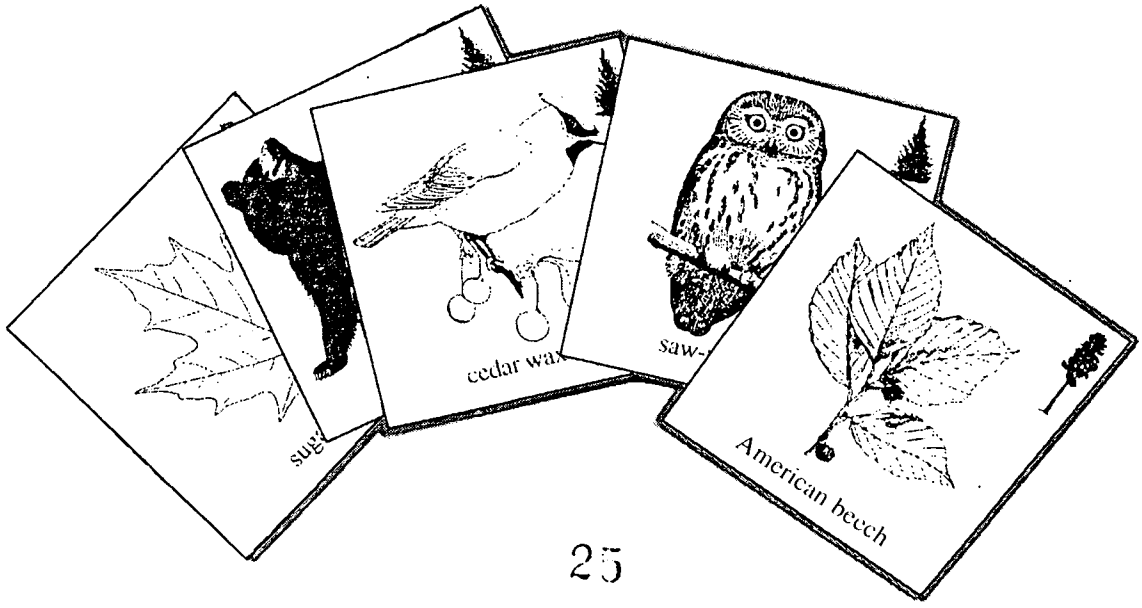
Some animals and plants that lived in the north spread south ahead of the glaciers, since the weather was warmer in that direction. Although the climate in the South was colder during the Ice Age than it had been previously, it was not as cold as the climate in northern places that were covered by the glaciers. Animals and plants from the North were able to live in areas that had been too warm for them before the Ice Age.

Thousands of years passed, and the earth gradually warmed up. The glaciers shrank as they melted back to the far North, and the climate in the South warmed up again. Some cold-weather plants and animals followed the melting glaciers north. Others could now live only in the coldest places in the South — mountain tops above 5500 feet, such as those of the Black Mountains.

Today, we still find plants and animals in North Carolina which are **adapted** to cold weather similar to that in the northernmost United States and southern Canada. They live on the peaks of the Southern Appalachian mountains. Some of these plants and animals have changed over time into distinct species and live nowhere else in the world.

The plants and animals that live at the top of these mountains are adapted to the cold, whereas the plants and animals that live in the valleys are adapted to a warmer climate. Between these valley and mountain communities is a **gradient** in weather conditions from warm to cold, with a wide variety of plants and animals living along this gradient.

If you were to travel from North Carolina to Canada by car, you would notice that the plants growing by the roadside and in fields and forests begin to look different as you traveled farther north. That's because the average temperature drops around 3 degrees **Fahrenheit** for every 300 miles that you travel north. The farther north, the cooler the climate. Plants that grow well in the lower elevations of North Carolina generally do



not do well in southern Canada. On the other hand, cold-loving plants that thrive in southern Canada would find North Carolina's climate in the piedmont or coastal plain too hot. But traveling north is not the only way to find a cooler climate. Here's how you can take a quick trip to a forest like that of southern Canada without ever leaving North Carolina. If you were to climb 1,000 feet up the side of a mountain, you would find the climate approximately 3 degrees Fahrenheit cooler than it was where you started. If you began your trip at sea level and kept going until you reached the top of a 6,000 foot mountain, how much cooler would it be at the top than it was at the beach where you started (0 feet altitude)?

Solution

Step 1: 6000 ft ÷ 1000 ft = 6

Step 2: 6 x 3° = 18°

Answer: *The temperature would be 18° F cooler at the top of the mountain.)*

Suppose you were to hike the Mount Michell Trail which starts at the Black Mountain Campground near Busick (2800 feet above sea level) and ends at the summit (6684 feet above sea level). You would pass through the same types of forests and climate changes as you would if you drove north to southern Canada! There is about 12 degrees Fahrenheit difference in temperature from the base of Mount Mitchell to its summit.

Here's how to calculate the temperature drop on the trail:

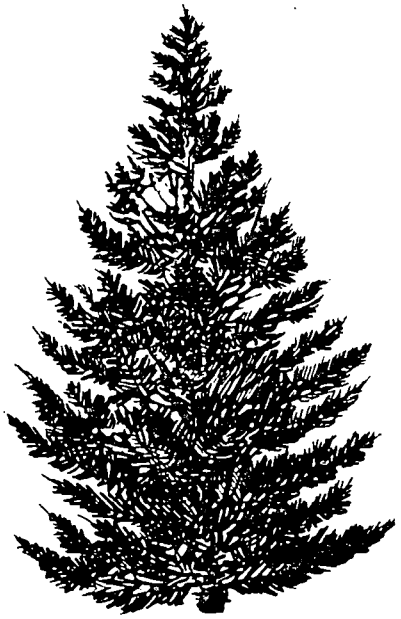
Step 1: Find the difference in elevation between the summit and the Black Mountain Campground at the base of the trail: 6,684 - 2,800 = 3,884

Step 2: 3,884 ft. ÷ 1000 ft = 3.9

Step 3: 3.9 x 3° = 11.7°F

The "**Mountain Community**" fact sheet lists some of the plants and animals which live in the natural communities found on the slopes of the Black Mountain Range. Some of these plants and animals are found in only one type of natural community. For example, Fraser fir trees are found only in the **spruce-fir forest** community. In the Southern Appalachians, spruce-fir forests generally occur above 5500 feet. Some animals, such as the white-tailed deer, are so adaptable they can be found from the coast to the cool mountain tops, living in all the natural communities.

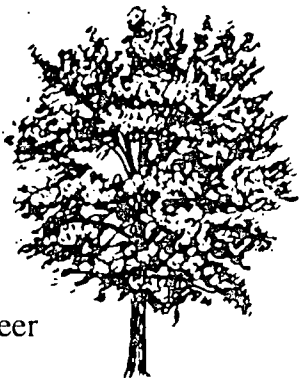
You will be playing a game where you match up four cards representing four members of the same natural community. Five different natural communities found on the slopes of the Black Mountain Range are represented in this game: **oak-hickory forests**, **cove hardwood forests**, **northern hardwood forests**, mountain **balds**, and spruce-fir forests. There are more than five natural communities found in the Black Mountains, but only five are used in this game.



Mountain Community Fact Sheet

Here are five natural communities found at different elevations on the slopes of the Black Mountains:

Oak-Hickory Forest



At lower elevations (below 3,500 feet), we find oak-hickory forests. These forests occur over the southern- and eastern-facing outer slopes of the Blue Ridge Mountains below 3,500 feet and in the interior mountain basins. The most common trees are white, red and chestnut oaks, but black and scarlet oaks are plentiful as well. In the oak-hickory forests we find:

- white oak
- black bear
- pignut hickory
- striped skunk
- gray squirrel
- red maple
- wild turkey
- raccoon
- red oak
- white-tailed deer
- white pine
- box turtle

Cove Hardwood Forest

In especially damp areas at lower elevations, we find cove hardwood forests. These forests occur in the Southern Appalachians in sheltered mountain valleys on north- and east-facing slopes from 1,500 to 4,500 feet. Cove forests are among the richest, most magnificent deciduous forest found anywhere on earth. This forest includes:

- American beech
- gray squirrel
- sugar maple
- white-tailed deer
- yellow poplar
- black bear
- red oak
- box turtle

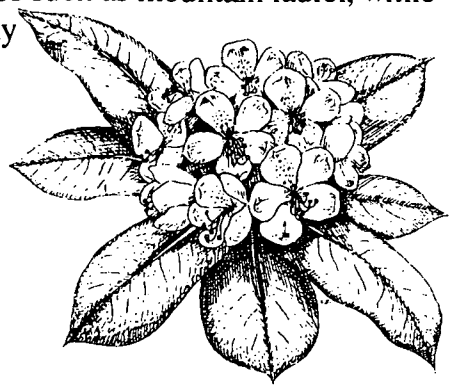
Northern Hardwood Forest

At higher elevations, between 3,500 and 5,500 feet, we find northern hardwood forests. These forests are like those found in the New England states. In them we find:

- American beech
- spotted salamander
- eastern hemlock
- New England cottontail rabbit
- box turtle
- yellow birch
- red squirrel
- gray squirrel
- sugar maple
- black bear
- white-tailed deer
- raccoon

Mountain Balds

At these same elevations (3,500 - 5,500 ft.) we find some mountain tops that have few or no trees at all. These are called balds. There are two very different types of balds: heath balds and grassy balds. Heath balds are mainly composed of woody shrubs such as mountain laurel, while grassy balds are composed of grass, mosses and other nonwoody plants. Plants and animals found on balds include:



- grasses
- wild turkey
- mountain laurel
- saw-whet owl
- rhododendron
- meadow jumping mouse
- white-tailed deer
- sedges
- red-tailed hawk
- eastern cottontail rabbit
- screech owl
- peregrine falcon

Spruce-Fir Forest

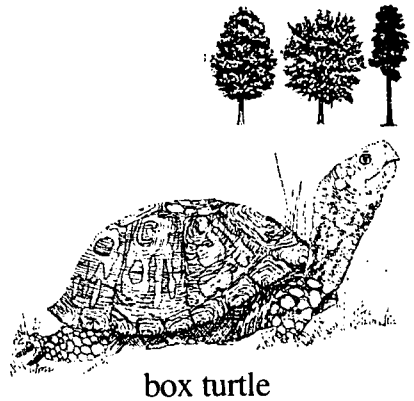
At the highest elevations of the Southern Appalachians, over 5,500 feet, we find spruce-fir forests. These are like the forests in southern Canada and the northern United States. In these forests we find:

- red spruce
- junco
- yellow birch
- yellow coneflower
- saw-whet owl
- Fraser fir
- cedar waxwing
- mountain laurel
- northern flying squirrel
- mountain ash
- rhododendron
- long-tailed weasel
- black bear
- white-tailed deer
- New England cottontail rabbit
- red squirrel

Mountain Community Cards

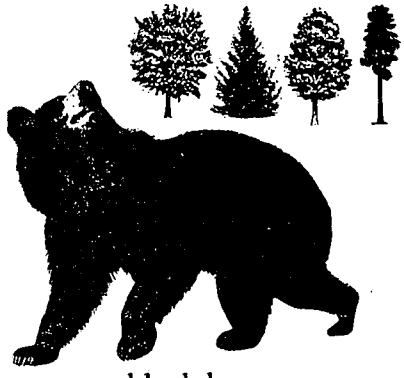
American beech

black bear



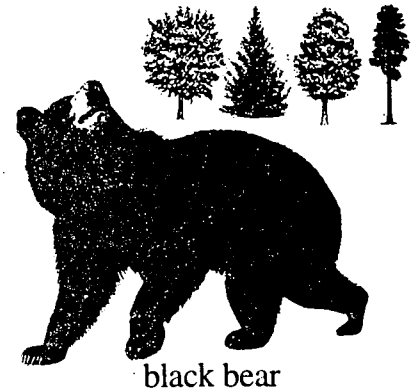
box turtle

American beech

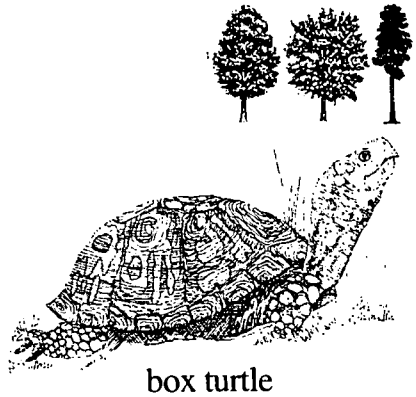


black bear

cedar waxwing

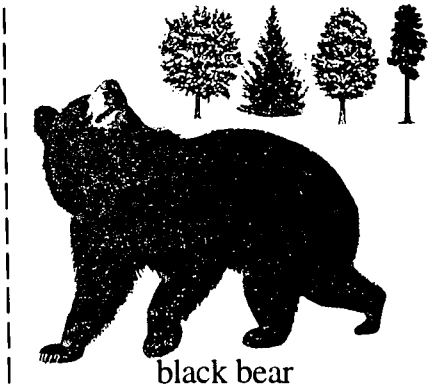


black bear

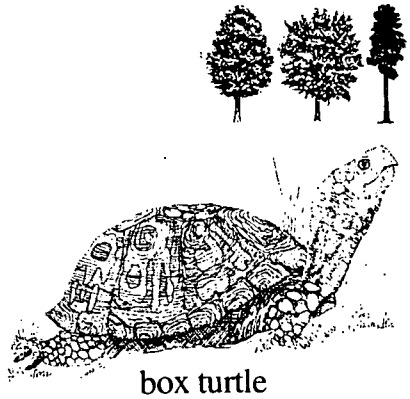


box turtle

eastern cottontail rabbit



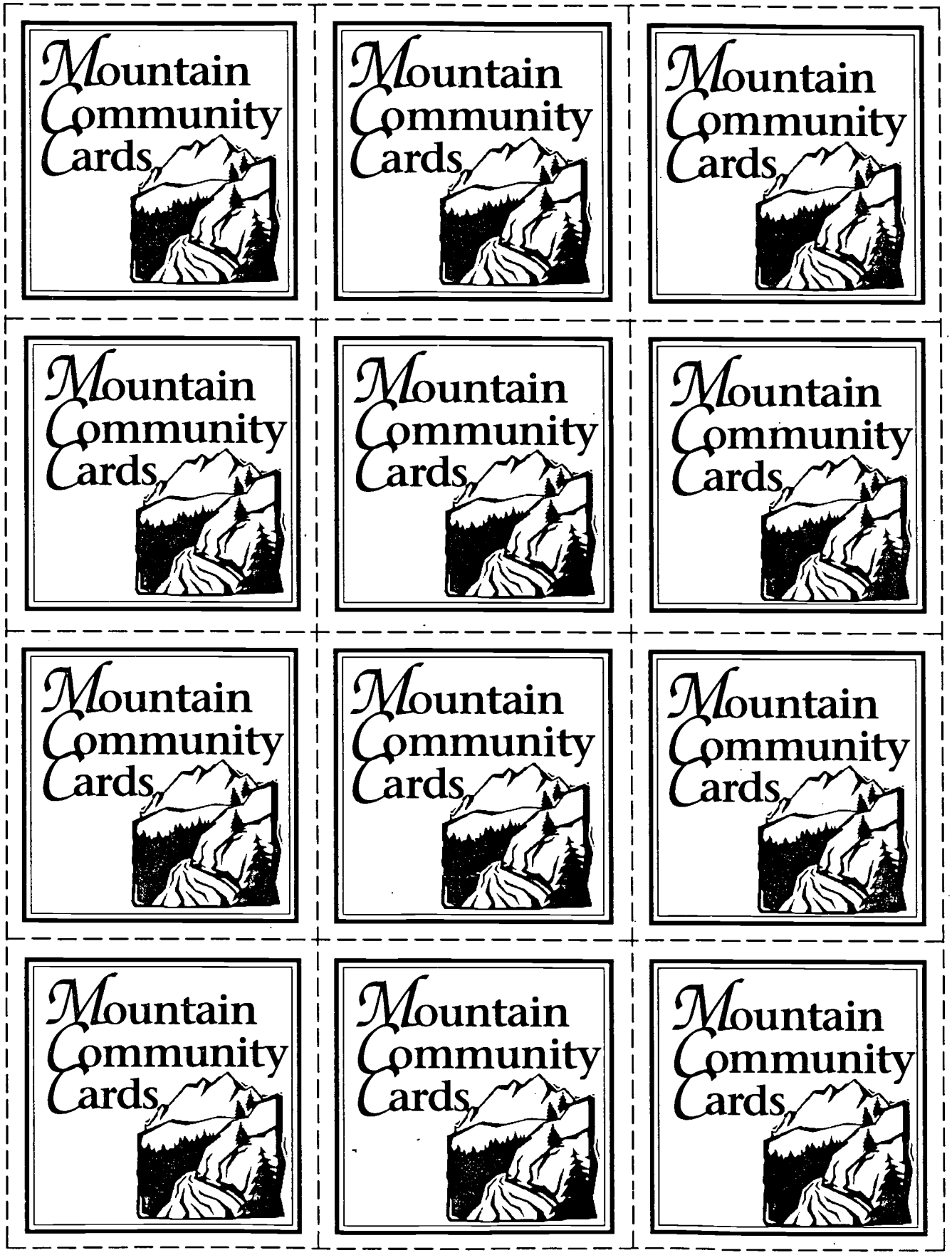
black bear



box turtle

eastern hemlock

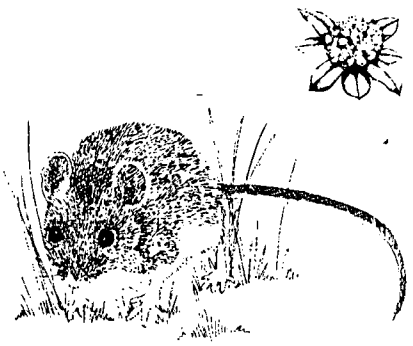
Mountain Community Cards - Backing Sheet



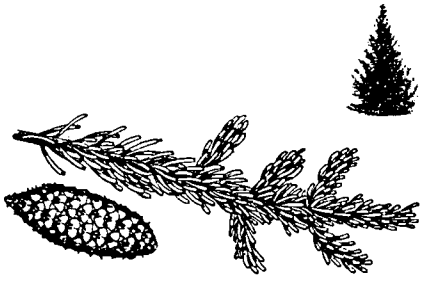
Mountain Community Cards

striped skunk

gray squirrel



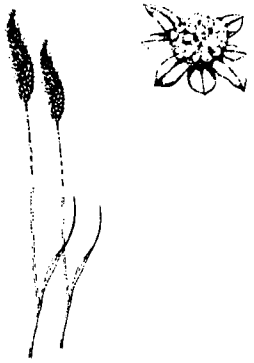
meadow jumping mouse



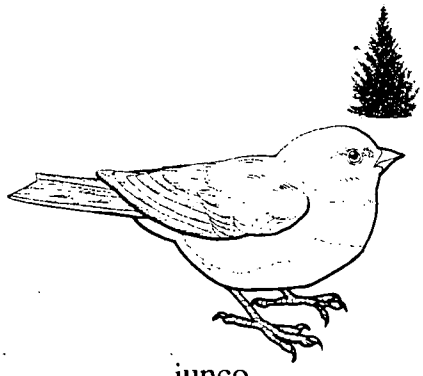
Fraser fir

gray squirrel

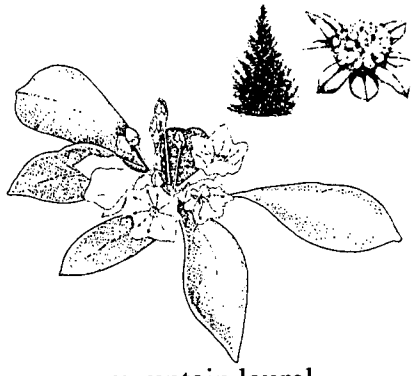
mountain ash



grasses

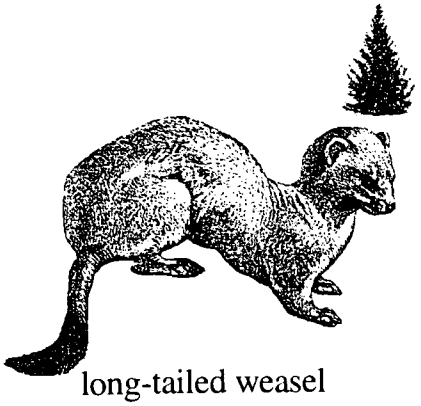


junco

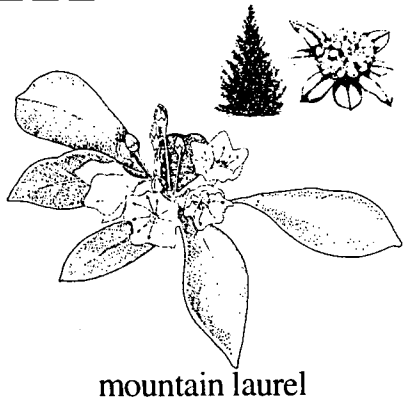


mountain laurel

gray squirrel

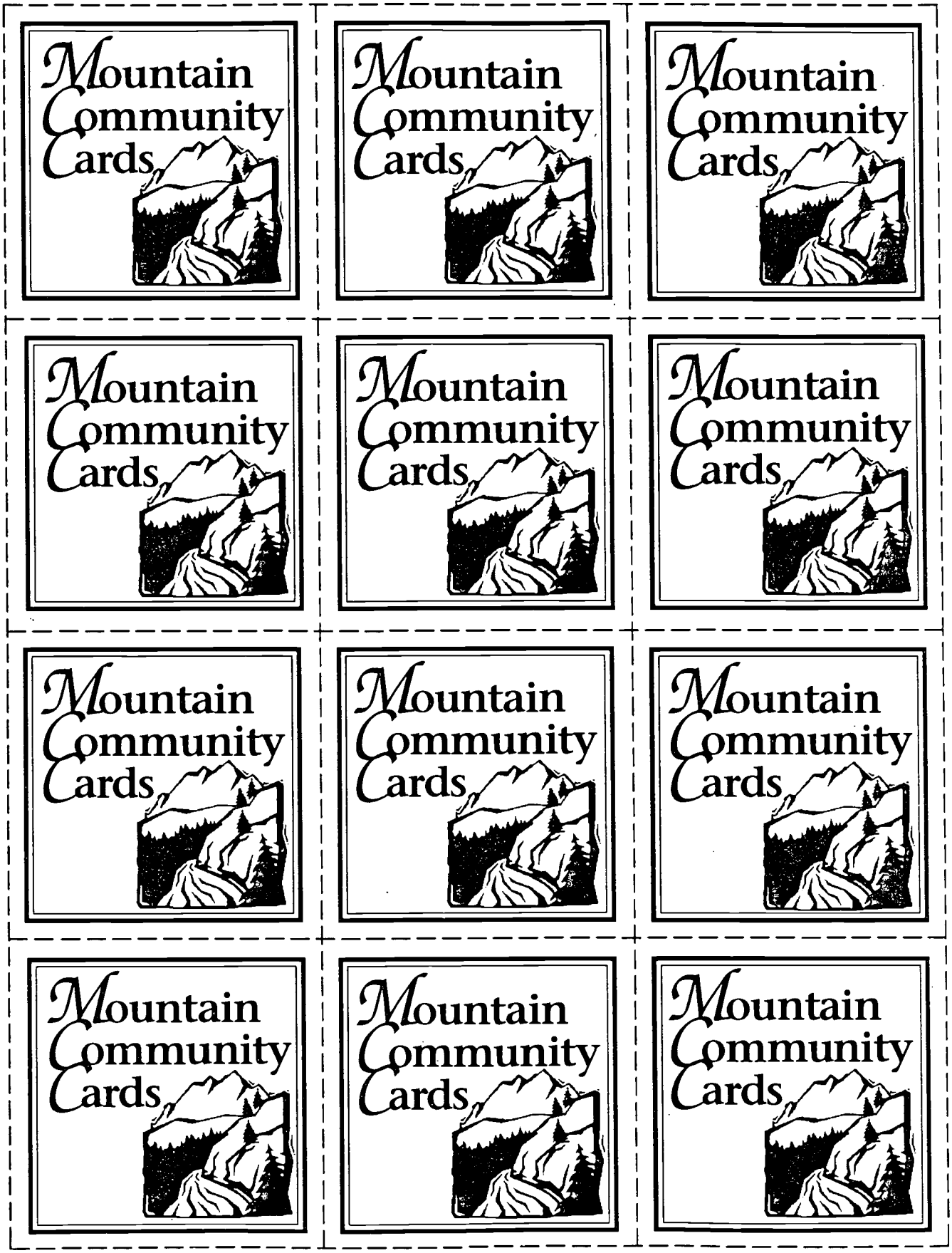


long-tailed weasel

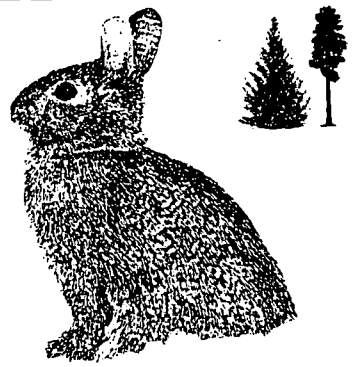


mountain laurel

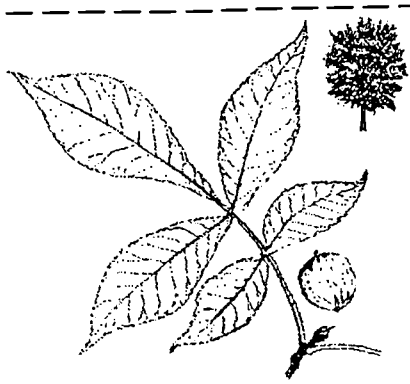
Mountain Community Cards - Backing Sheet



Mountain Community Cards



New England cottontail rabbit

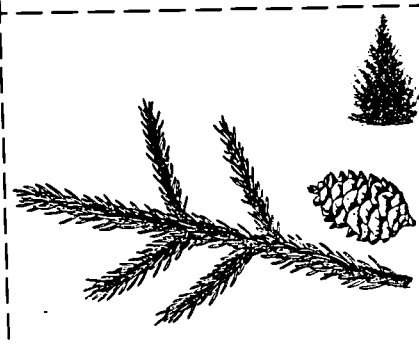


pignut hickory

red maple

New England cottontail rabbit

raccoon



red spruce

northern flying squirrel

raccoon

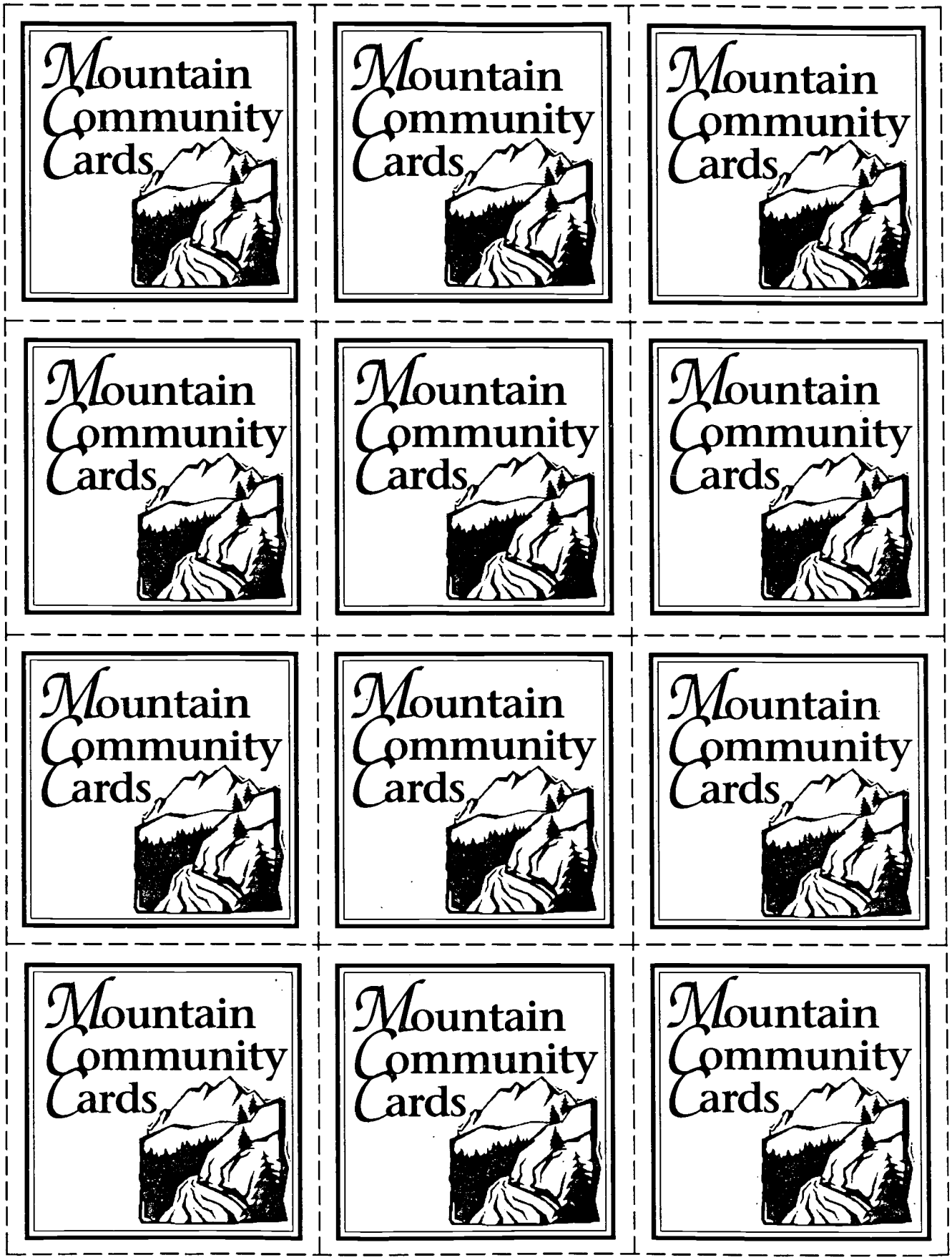
red squirrel

peregrine falcon

white pine

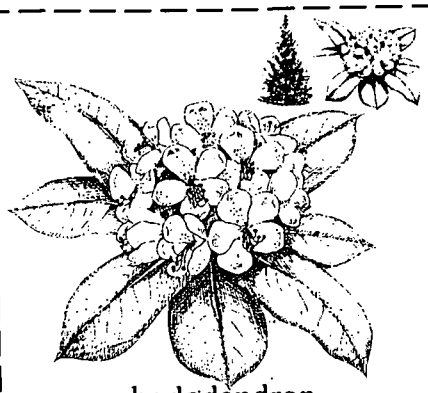
red squirrel

Mountain Community Cards - Backing Sheet

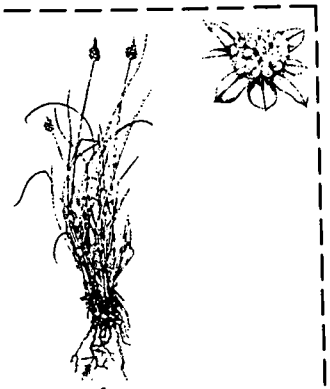


Mountain Community Cards

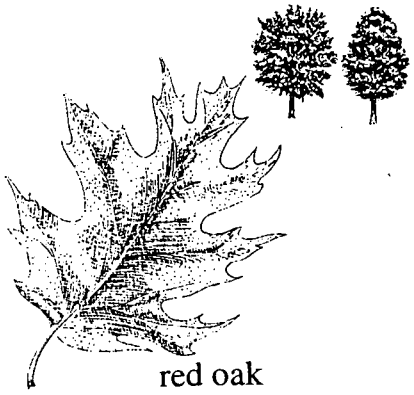
red-tailed hawk



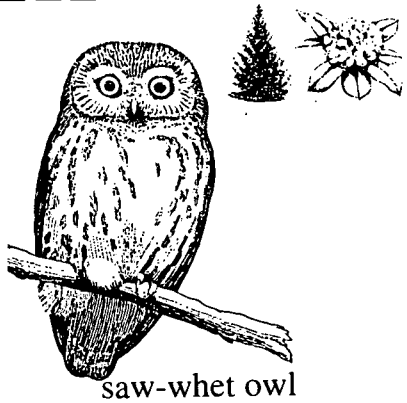
rhododendron



sedges

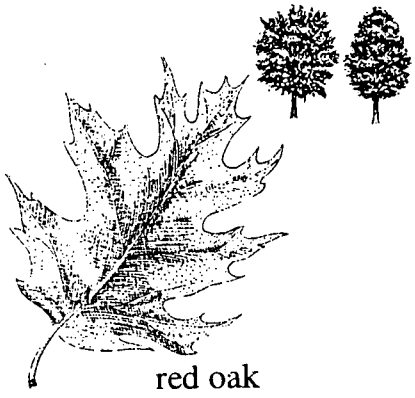


red oak

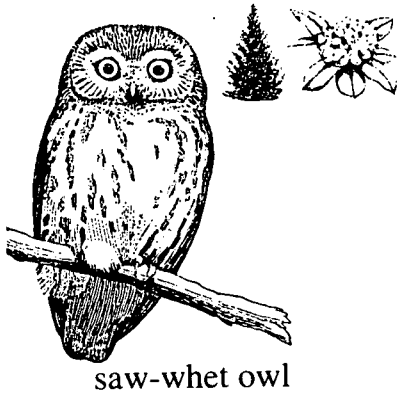


saw-whet owl

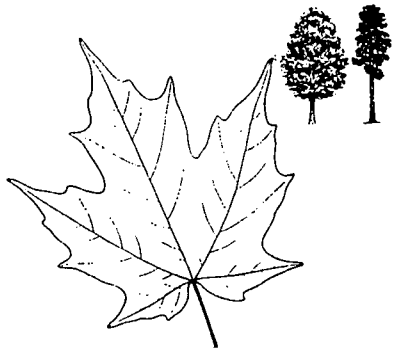
spotted salamander



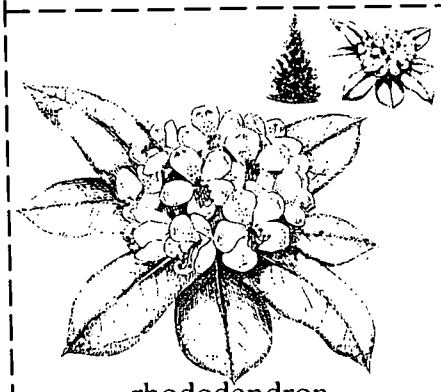
red oak



saw-whet owl



sugar maple

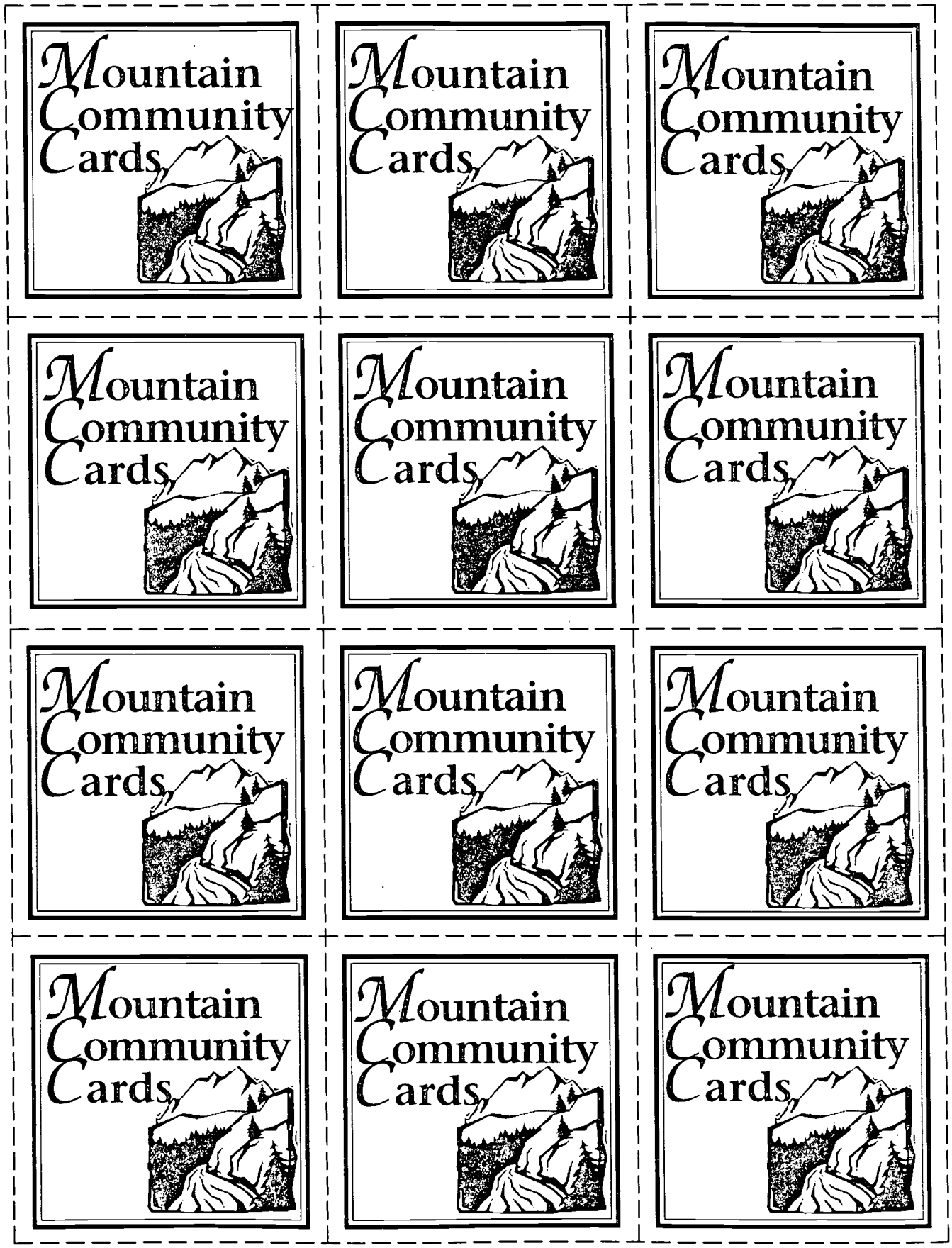


rhododendron

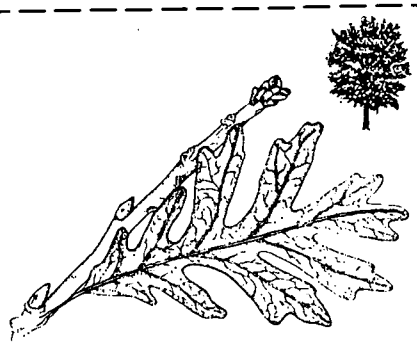
screech owl

sugar maple

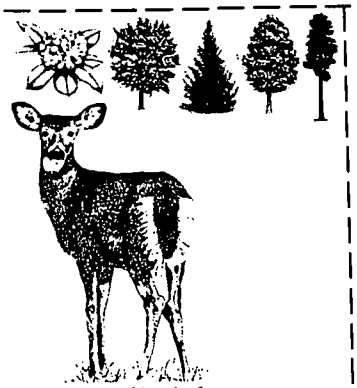
Mountain Community Cards - Backing Sheet



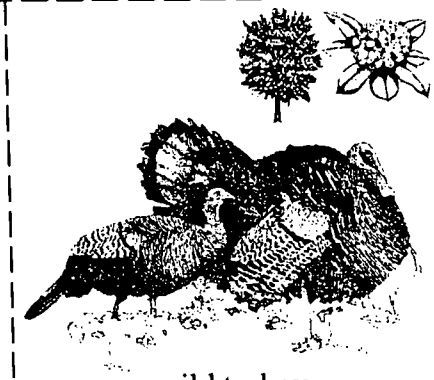
Mountain Community Cards



white oak



white-tailed deer

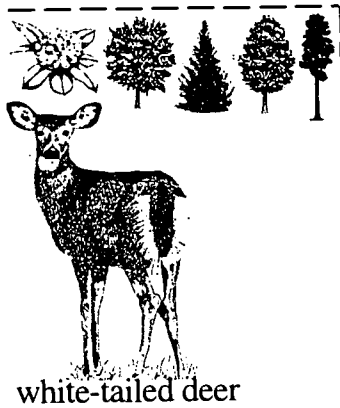


wild turkey

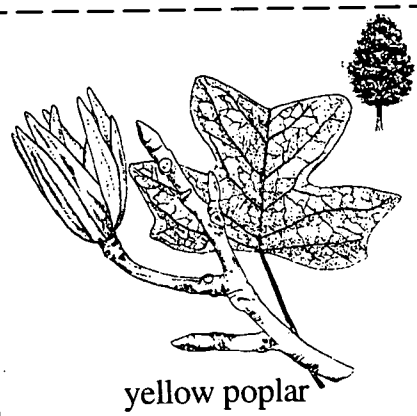
white-tailed deer

white-tailed deer

yellow birch

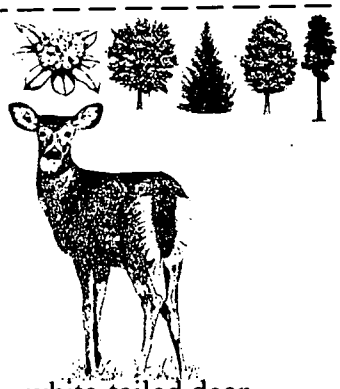


white-tailed deer



yellow poplar

yellow birch

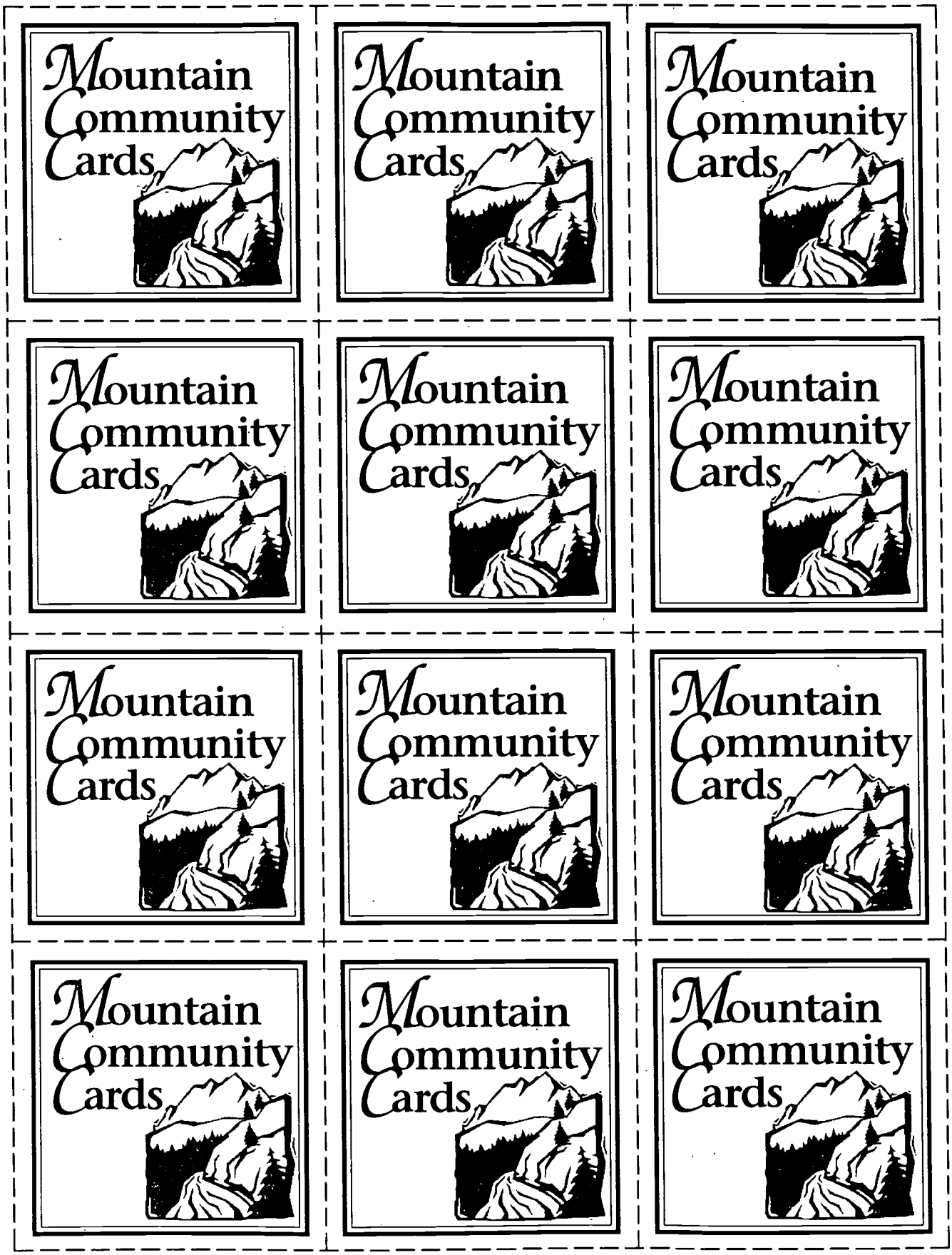


white-tailed deer

wild turkey

yellow coneflower

Mountain Community Cards - Backing Sheet



Pre-Visit Activity #2 The Human Tree

Major concepts:
- Tree anatomy and physiology
- Air pollution
- Insect pests
- Limiting factors

Learning Skills:
- Observing, classifying, communicating and predicting
- Participating in creative interpretations
- Applying concepts and ideas

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

Location: A large indoor play space or outside area is recommended

Group Size: 27 to 30 students

Estimated Time: 1 hour

Appropriate Season: Any

Materials:
Provided by the educator:
Per class: Slips of paper with names of tree parts, paper bag, ball of yarn or string
Per student: One copy of Student's Information

Credits: Adapted from *Project Learning Tree: Environmental Education Activity Guide* (Pre K-8), Activity #63, "Tree Factory," pp. 223-227.

Objectives:

- List three or more parts of a tree and describe their function.
- List three limiting factors that impact the Fraser firs at Mt. Mitchell and describe how each factor affects the physiology of the tree.

Educator's Information:

This pre-visit activity gives teachers a kinesthetic strategy for introducing important vocabulary words used in the on-site activities. Students will participate in a simulation to learn, or review, basic tree anatomy and physiology. During a second simulation, students will be introduced to the **limiting factors** that impact the Fraser firs at Mt. Mitchell. A basic understanding of how trees become sick will help the students make sense of what they observe during their visit to Mt. Mitchell State Park, or similar areas with **spruce-fir forests**.

Important Note: The information given in the second simulation presents theories that scientists have advanced to explain the recent changes in the spruce-fir forest. Forest ecologists, like medical doctors, do not always agree on the diagnoses and treatment of their patients. This is especially

true in trying to determine the effects of **acid rain**, a relatively new phenomenon. Laboratory studies demonstrate a variety of pathologies when trees and food crops are exposed to acid rain and/or **ozone**. However, scientists are still investigating what is actually happening to red spruce and Fraser firs in the environment of Mt. Mitchell. Many factors such as pests, severe weather, logging and air pollution could be interacting in very complicated ways. Because our current knowledge is limited, it is difficult to give an accurate prognosis for the Mt. Mitchell spruce-fir forest. Will the trees become sicker, as some scientists predict, or will the forest recover? In this activity, we have attempted to provide the teacher with simple explanations of complicated theories. We hope that our simulation will not frighten the children, or put undue emphasis on one limiting factor over the others.

Instructions:

1. Study the Student's Information; photocopy for your students if desired. Prepare a slip of paper for each student by writing the name of a tree part on each slip. Use the following formula if you have 27-30 students in your class: **Heartwood** (1), **Sapwood** (2), **Taproot** (1), **Lateral roots** (2), **Cambium** (3), **Phloem** (5), **Bark** (7), **Leaves** or needles (4), **Limiting factors** (3-5). If you have fewer that 27 students, adjust the numbers as necessary. Finally, make four "branches" for your tree by cutting yarn or string into four, six-foot (1.8 m) lengths.

2. Ask your students to compare a tree with a human. Make a chart on the chalkboard or overhead. For example:

Human	**Tree** (Suggested Student Response)
Torso	(Trunk)
Arms	(Branches)
Legs	(Roots)
Hair/skin	(Bark)
Blood	(Sap)
Arteries/veins	(Tree's pipes - sapwood & phloem)
Bones (skeleton)	(Heartwood)
Stomach & Intestines	(Leaves)
Lungs	(Stomata or holes in leaves)

The teacher should write human parts on the left side of the chart and solicit responses from the students for the right side. If students have difficulties with this exercise, ask them to read the Student's Information to learn more about the parts of a tree and try again.

3. Continue the comparison by asking students to list health problems or diseases that people can experience and relate these to problems that can affect trees. For example:

People's Health Problems	**Tree's Health Problems**
Broken bones	Broken branches
Tooth decay	Heart rot or other wood rot
Cancer	Burl (looks like a wart on a tree)
Cut/wound	Bark removed & sap dripping out
Parasites (fleas, ticks, tapeworms, etc.)	Termites, beetles, aphids, etc.
Cold/infection/virus attack	Trees are attacked by bacteria, infection and viruses too

4. Tell the students that they are going to create a human tree by acting out the tree parts discussed in the Student's Information. First they will role-play a healthy tree and then they will role-play a sick Fraser fir tree on top of Mt. Mitchell. Ask each student to pick a slip of paper (prepared earlier) from the bag to find out what role they will play. Those students who have a piece of paper that says "limiting factor" will help the teacher build the human tree in the first

simulation and role-play a limiting factor that attacks the Fraser fir in the second simulation. (Or, the teacher could also ask the "limiting factor" students to join the students who are role-playing bark for the first simulation only.)

Simulation #1 — The Healthy Tree:

1. Take your students to the large play space or outside area. Ask them what tree part supports the tree or acts like a skeleton for the tree (heartwood). The student role-playing heartwood should stand center stage, show off his/her muscles, and chant in a loud and powerful voice, "I support; I support."

2. Ask students what tree part transports water to all parts of the tree (sapwood). Have the sapwood students join hands to form a small circle around the heartwood. These students chant, "Gurgle, slurp. Gurgle, slurp. Transport water," as they raise their joined hands up and down. Ask students where the water in the sapwood comes from (absorbed by the roots). Ask the student role-playing the taproot to sit down with his/her back against the sapwood. Next, ask the lateral roots to lie down on the ground with their feet toward the sapwood and their arms and fingers spread out to represent rootlets and root hairs. Have the roots make loud sucking noises (the more disgusting the better).

NOTE — Be sure to warn other students not to step on the roots!

3. At this point you may want the tree parts to practice their roles simultaneously: Heartwood - "I support, I support." Sapwood - "Gurgle, slurp. Gurgle, slurp. Transport water." Roots - "Shhlluuuck! Shhlluuuck!"

4. Ask students where the water in the sapwood travels (to the leaves). Have the heartwood student hold the ends of the four "branches" (pieces of yarn or string that you cut earlier). Give the other end of each branch to a student who represents leaves. Ask the leaves what they do for the tree (make food through **photosynthesis**). Have the leaves flutter their hands and chant in high-pitched, high-energy voices, "We make food; we make food."

5. Ask the leaves what happens to all the food they make using sunlight, air, and water (it gets transported to the rest of the tree). Ask everyone what part of the tree transports the food from the leaves to the rest of the tree (phloem). Have the "phloem" students join hands and form a large circle around the sapwood. Then have them simulate the role of the phloem by reaching above their heads and grabbing (for food), and then squatting and opening their hands (releasing the food) while chanting, "Food to the tree! Food to the tree!"

6. Now, have the five groups (heartwood, roots, sapwood, phloem and leaves) chant their roles one at a time.

7. Ask students if they've left out an important part of the tree. What layer produces new sapwood and phloem to keep the tree growing and healthy? (cambium) Have the "cambium" students form a circle between the phloem and the sapwood. Tell them to sway from side to side and chant, "New phloem, new sapwood, and cam-bee-um; new phloem, new sapwood, and cam-bee-um."

8. Ask students what final component of their tree is missing — it's something that protects the tree (bark). Have the "bark" students lock arms and form a circle that faces out from the center of the tree. Ask them to look tough. Have them march in place chanting, "We are bark, please keep out." Note: If the students are unable to lock arms, have them fold their arms across their chests and swing the upper part of their bodies from side to side, as if they are guarding the inside of the tree. Again, their feet should remain in one place to prevent injury to the students role-playing the lateral roots!

9. When the tree is completely assembled, have all students act out and chant their parts, one group at a time, and then simultaneously.

Simulation #2 — Fraser Fir Under Attack:

1. Once the students understand how the tree parts work together in a healthy tree, they will role-play a tree under attack! For this second simulation, the students will be creating a Fraser fir tree, one of the major forest trees above 5,500 feet on Mt. Mitchell. Tell the students to stay where they are and continue playing their assigned roles but to also listen and react to your directions. (The leaves will actually become needles in this skit.) The teacher should ask the lateral roots to reposition themselves by sitting against the sapwood students (in a similar pose to the taproot) in order to avoid an accident. The "limiting factor" students will role-play the various outside agents that are attacking the Fraser fir tree. They should listen to the teacher's directions and work as a group to role-play one limiting factor at a time. The goal is to make the action look realistic, but like real actors on TV or in the movies, the students should not actually hit or hurt another actor.

The teacher's script follows in regular type. Additional directions to the teacher are given in italics and brackets.

2. When we visit Mt. Mitchell State Park, we will see many dying or dead trees. The Fraser fir trees on Mt. Mitchell — and on other southern Appalachian peaks higher than 5,500 feet (1675 meters) above sea level — are under attack from high winds, ice storms, drought, insects, and air pollution. The first limiting factor to affect the tree will be the wind.

Winds, get in there and blow the needles around and make all the parts of the tree shiver from the cold. Make a noise that sounds like high winds blowing. It is winter time and the bitter winds are blowing at speeds of more than 100 miles per hour near the top of Mt. Mitchell. Bark, rub your arms and legs and jog in place to try and stay warm! OK, everyone playing a tree part, do your role-play, but give your chants in a very cold, shivery-sounding voice. One-two-three-ACTION! *[Allow the students to role-play for 30 to 60 seconds.]*

3. CUT! Everybody, stop action! The winds blew so hard this winter that a branch on the west side of the tree broke off. *[Remove one of the branches/needles. Ask the student role-playing this branch/needle to join the other students role-playing limiting factors.]* Now it is summer time and lots of insects are flying around the tree. One insect in particular is a real pest. Its name is the **balsam woolly adelgid**. It was introduced to North America from Europe in the early 1900s. Students playing limiting factors — you will now become the balsam woolly adelgids. Hold your hands in front of you, palms together, with your arms straight to represent your beak or mouthpart. Try to stick your beak between the "bark" students in order to feed on the phloem and cambium. While feeding, you are also injecting your saliva into the tree. Make high-pitched sucking and spitting noises as you feed on the tree! (Please don't

actually spit!) Bark, try to guard the tree, but remember, you can't move your feet or slap the insects. Instead, use your upper body to block their attack. The balsam woolly adelgids can fly around the tree to find a weak place in the bark. They might work together to attack one particular spot. Be tough bark, hang in there! OK, balsam woolly adelgids attack and everybody do your chants. One-two-three-ACTION! *[Allow students 30 - 60 seconds to role-play this phase of the simulation.]*

4. Cut! Stop action. Finally, fall has arrived. The balsam woolly adelgids are **dormant**. Fortunately these insect pests did not do much harm. The tree was healthy; the bark was tough.

Years go by. The Fraser fir survives wind storms, snow storms, and drought, but now a mysterious enemy is coming — air pollution. Scientists think there are two types of air pollution that can attack trees on Mt. Mitchell — **ozone** and **acid rain**. Both types of air pollution may harm the needles which make food for the tree. Acid rain may also affect the soil so that tree roots can not absorb minerals needed by the tree. Without enough food and minerals, the tree becomes weak or stressed. Students playing acid rain and ozone, pretend to attack the needles and the roots. Other students, show me how stressed you are by slowing down your motions and whispering your chants. One-two-three-ACTION! *[Allow the students 30 - 60 seconds to roleplay this new situation.]*

5. CUT! It is summer again and THEY'RE BAACCKK! (The balsam woolly adelgids, I mean.) Adelgids, wake up and feed on the tree like you did before. This time the Fraser fir is very weak due to exposure to air pollution and a serious drought this year. The saliva that the adelgids have injected into the cambium is causing it to produce a dark, dense brittle type of wood. This wood acts like a plug and prevents the tree from moving sap and water through the phloem and sapwood. Needles, you are drying up and dying because you can't get water. When I say, ACTION, I want the adelgids to attack, the needles to fall off, the cambium to shrivel up and play dead. Sapwood and phloem, you will be silent to represent the fact that you aren't working. Roots, slow down and make quieter sucking noises. Bark, be very weak. OK, one-two-three-ACTION! *[Allow the students 30 - 60 seconds to role-play this final phase of the simulation.]*

Now, TREE COLLAPSE!

Assessment:

Discuss what happened to the tree. Students can tell in their own words what they experienced.

- What was responsible for the death of the tree? (Really, it was a combination of factors, rather than one limiting factor working alone.)
- Which limiting factors are caused by people? (Air pollution, and possibly, the balsam woolly adelgids since they were brought to this country from Europe by people.)
- What was realistic about this simulation and what was not? (Trees do not talk; the limiting factors often attack the tree simultaneously, not one at a time.)
- Ask students to predict how the following limiting factors might affect the various parts of a tree and their functions: fire, gypsy moth caterpillars, ice storm, lack of sunlight, poor soil. Then have the students act out their predictions to one of these situations with another human tree simulation.

Extensions:

1. Develop a play drama about trees to perform for another class.

2. Make an art project, the centerpiece being the tree.

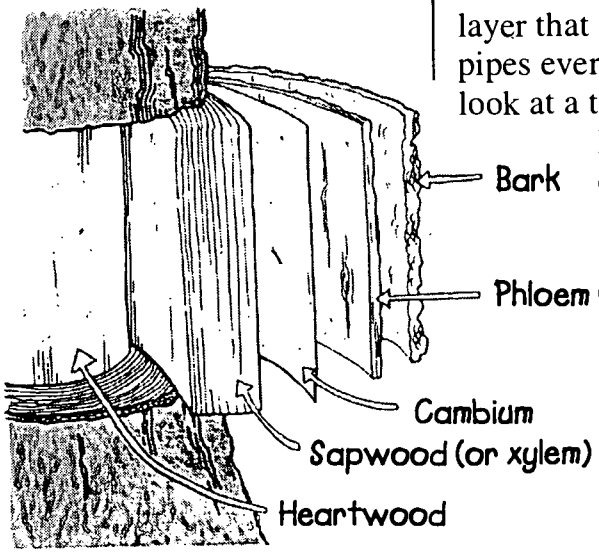
3. Read stories about trees such as *The Lorax* by Dr. Suess or *The Giving Tree* by Shel Silverstein. Write stories of your own.

Student's Information:

A tree has many parts to its body just like you do. When all the parts are working well together, the tree is healthy. Sometimes things don't work the way they should. Then the tree becomes sick and may die. It's important that you know about healthy trees and how their parts work, before you come to Mt. Mitchell and see some trees in trouble.

Leaves or Needles

Leaves or needles (modified leaves) are the food factories of a tree. Leaves contain a green-colored pigment called **chlorophyll** which helps them capture light energy from the sun. Using this sun energy, the leaves change **carbon dioxide** (the gas you exhale) and water into sugar (food for the tree) and oxygen (the gas you breathe). This process is called **photosynthesis**.



Roots

The roots anchor the tree in the ground and absorb water and minerals from the soil. Trees have **lateral roots** that spread out from the tree and cover a broad area. Some trees also have a **taproot** that grows straight into the ground. The taproot and lateral roots branch into smaller and smaller roots called rootlets. The rootlets themselves are covered by very small root hairs. Ninety-five percent of the water and minerals for the tree are absorbed by the root hairs!

Trunk and Branches

The trunk and branches contain the tree's "pipes" that transport water and food throughout the tree. The tree's pipes are similar to the arteries and veins in your body. If they are cut, broken or clogged, the tree will die. The trunk and branches also contain a special growing layer that adds new tree pipes every year. Here's a look at a tree trunk (diagram left) and a description of what each layer does:

- **Heartwood** forms the central core of the tree, is made up of dense dead wood, and provides strength for the tree. It supports the tree like the bones in your skeleton support your body.
- **Sapwood**, also called the xylem (ZEYE-luhm), represents the tree pipes that bring water and minerals up from the roots to the leaves. Older xylem cells become part of the heartwood.
- **Cambium** (KAM-bee-uhm) is a very thin layer of growing tissue that makes new sapwood, phloem, and cambium every year.
- **Phloem** (FLOW-uhm), also called the inner bark, represents the pipes that carry sap (sugar and nutrients dissolved in water) from the leaves to the rest of the tree. At certain times of the year, phloem may also transport sugars from the roots up to the rest of the tree. For example, in springtime, the sap of sugar maples rises from the roots and is tapped by people to make maple syrup.
- **Bark** protects the tree from injuries caused by insects and other animals, by other plants, by disease, and by fire. Bark is the tree's skin — if too much is removed or damaged, the tree will die. Bark can be thin, thick, spongy, rough, smooth, or covered with spines, depending on the type of tree.

Pre-Visit Activity #3 — Acid from the Skies

Major concepts:
- Acidity and pH
- Acid rain formation
- Effects of acid deposition on plants

Learning Skills:
- Observing, communicating, experimenting and predicting
- Measuring, averaging and graphing
- Applying and expanding information

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

Location: Classroom

Appropriate Season: Any

Group Size: 20 to 30 students

Estimated Time: First day — 30 minutes; second day — 60 minutes; third day — 30 minutes; the next two to three weeks — 10 to 15 minute spots every three or four days to water plants and make observations.

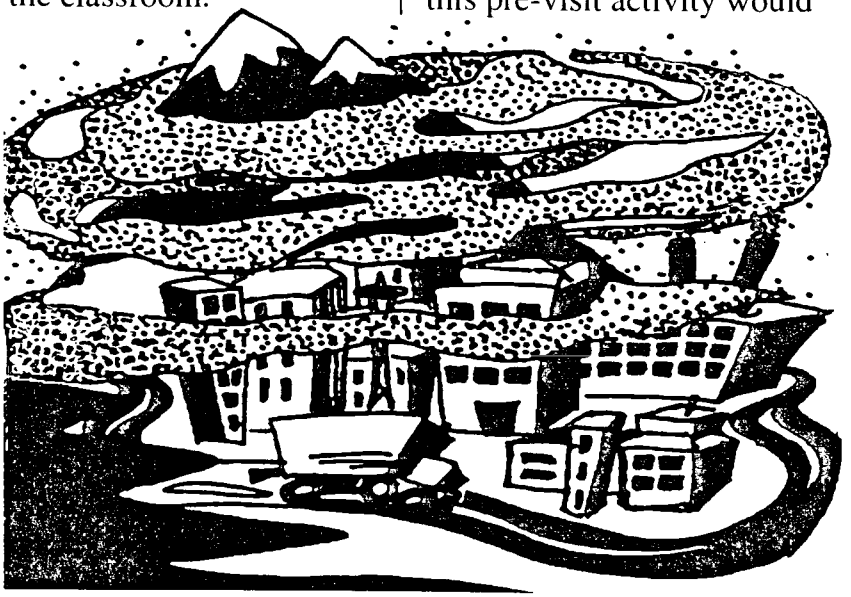
Materials:
Provided by the educator:
Per student: One copy of Student's Information and Acid Rain Tracking worksheet
Per class: Eight jars (6-10 ounce size), one-gallon bottle of vinegar, one pint of milk, 16 ounces of cola, ten or more pennies, five uncooked eggs, Acid Rain Tracking illustration, masking tape, drawing paper, crayons or markers, 10-20 balloons filled with colored glitter (or paper punches) and inflated, sharp pin, six (or more) healthy potted plants of the same type and age, three one-gallon containers with lids, tap water, three measuring cups.
Optional: litmus paper, graph paper, calculators, camera and film, or videocamera.

Credits: Adapted in part from *Project A.I.R.E. — Air Information Resources for Education*, "Acid Rain and Plants," pp. 127-129.

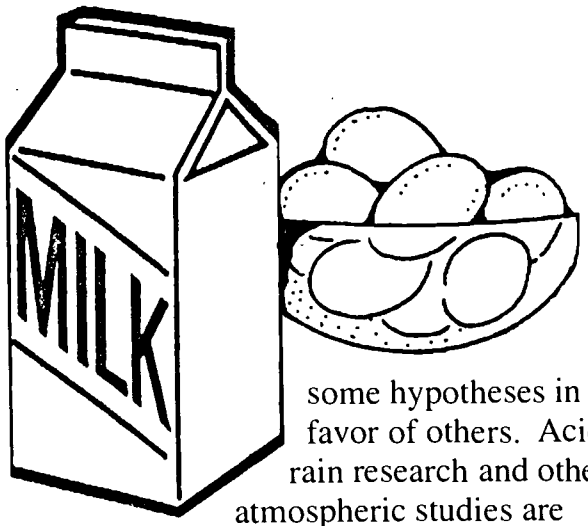
Objectives:
- Predict and observe the effects of household acids on nonliving objects and plants inside the classroom.
- Using experimental results, predict how acid rain might affect living and nonliving things in the environment outside the classroom.
- Draw or list two sources of acid rain.
- Given a list of terms, correctly label a diagram depicting acid rain formation and its possible effects.

Educator's Information:

In this activity, students will simulate the effects of **acid rain** on a variety of objects by experimenting with household acids and uncooked eggs, pennies, and plants. Information on **pH** was not included in the Student's Information so that teachers of younger students could use this activity as written. Teachers of older or high-ability students can add information about acidity and pH by photocopying and presenting the information from page 4.1.4 of this EELE. A discussion of pH as part of this pre-visit activity would



be especially helpful if the teacher plans to conduct On-site Activity #1— during which students will measure the pH of the soil at various sites on Mt. Mitchell. Additional suggestions are given for older students throughout the teacher instructions in this activity.



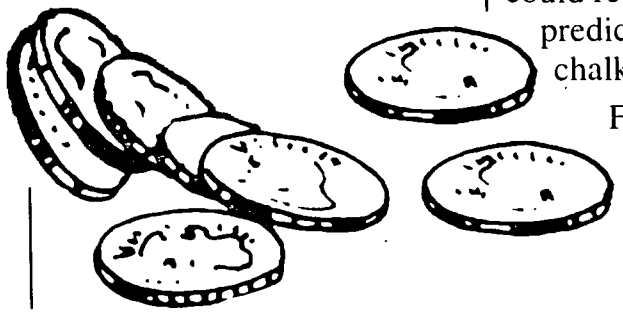
The plants used in the second experiment in this activity should be healthy and of the same age. Students could use plants that they have grown from seeds. This would be less expensive than purchasing full-grown plants, and more plants would be available for averaging results. This experiment presents a good opportunity for older students to practice skills of formulating a hypothesis, controlling variables, and interpreting data.

Important Note: In presenting information on acid rain and its possible effects on trees and forests, the teacher should stress the tentative nature of science. The information given in this activity highlights current theories on **acid deposition** that scientists are now testing. As new data is collected from Mt. Mitchell, and other places in the world, scientists may reject some hypotheses in favor of others. Acid rain research and other atmospheric studies are part of the exciting science frontier which illustrates well the principle that "scientific knowledge is shared, critiqued, and thrives on scrutiny by other scientists and the public." (DPI Science objective 1.1)

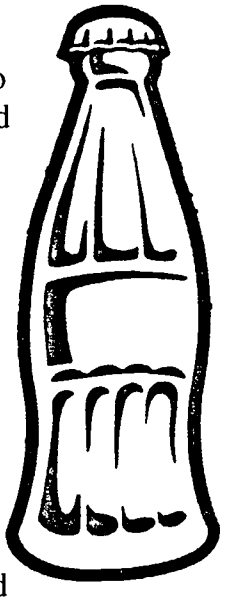
Instructions:

FIRST DAY

1. Tell the students that they will be doing activities over the next few weeks that will teach them about acid rain. In the first experiment, they will observe what acids can do to pennies and uncooked eggs. For younger students, the educator could define acid very simply by saying that an acid is a solution that reacts with things or changes them. In our experiment today, we will use common acids you have at home — vinegar, cola, and milk. For older students, the educator could discuss the information on pH and acidity (page 4.1.4 of this EELE). If **litmus paper** is available, the educator should have older students find the pH of each test solution before predicting results.



2. The educator should fill two jars with vinegar, two with cola, two with milk, and two with tap water. The educator should also label each jar according to the liquid it contains. Ask students to make observations of each liquid by looking, touching, and smelling. Show the students the five eggs and the pennies; allow them to observe these objects and discuss observations. Then ask the students to predict what they think will happen to each object if it is soaked overnight in each test solution. The educator could record the students' predictions on the chalkboard in chart form. For example:

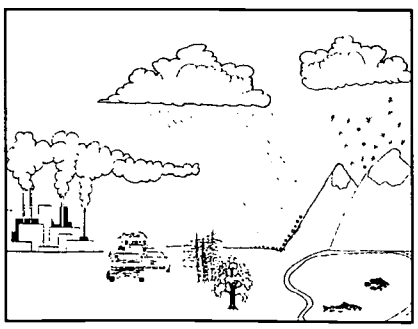


Test Solutions	Predictions for Egg	Predictions for Pennies
Vinegar		
Cola		
Milk		
Tap water		

3. Finally, the educator should place one egg in each test solution (four eggs in all). Also place several pennies in each of the four solutions (in the four remaining jars, separately from the eggs). The fifth egg and a few pennies should be left as "controls" so that students can compare them with the items soaked in the test solutions.

SECOND DAY

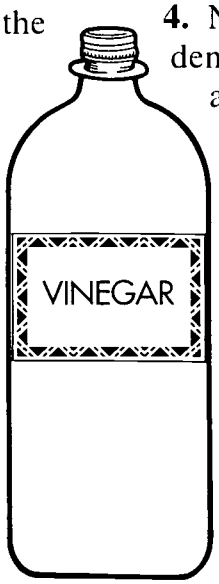
1. Prepare the Acid Rain Tracking illustration by making an overhead transparency or sketching it on the chalkboard before class begins. Photocopy the Student's Information in this activity as needed.



Acid Rain Tracking — Illustration

2. Ask students to carefully observe the objects soaked overnight in the test solutions and compare them to the objects that were not soaked. (In the vinegar jars, the egg's shell should have dissolved and the pennies should have turned black. The other solutions were weaker acids and less dramatic changes will be observed.) Compare the results with students' predictions written on the chalkboard. Were any of their predictions correct?

3. Ask students to make inferences to explain what happened. Where did the eggshell go? Why did the penny turn black? Here is a simple explanation for younger students: The solutions they used in the experiment were acids. Acid reacts with the calcium in the eggshell and dissolves it. Acid reacts with the copper in pennies and turns them black.

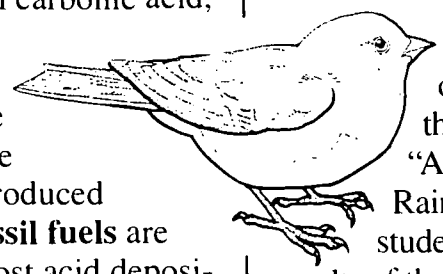


Ask the students which of the test solutions were the strongest acids (caused the greatest changes)? Which were the weakest acids (caused the smallest changes)? Note to the teacher: The pH of each solution is given on page 4.1.4. The lower the pH, the stronger the acid. Vinegar is the most **acidic** of the test solutions with a pH of around 2.25. Depending on your location, tap water may be close to neutral with a pH of 7, or it could be a very weak acid, similar to milk, with a pH between 6 and 7.

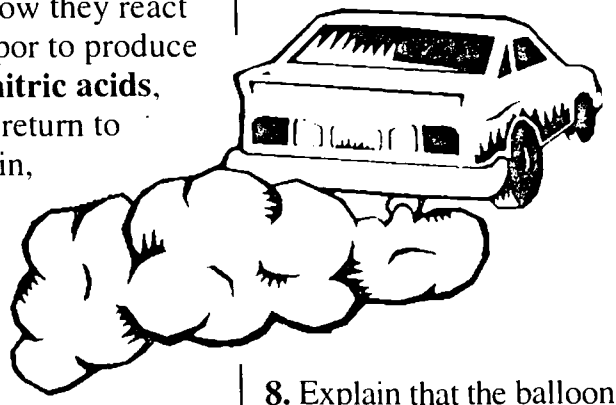
4. Now relate the students' experiences with acids in the classroom to acid rain in the environment outside the classroom. Use the Acid Rain Tracking illustration and the Student's Information in this activity to explain where the acid in our atmosphere comes from and how it may affect the environment. Be sure to

explain that scientists are still studying the effects of acid rain and other types of air pollution on trees, forests, animals and soils. The ideas presented in the chart represent some of the theories about acid rain that scientists are currently testing (tentative nature of science).

For older students: You may want to supplement the Student's Information with the following information on pH. Normal rain has a pH of about 5.4. This is about 50 to 100 times more acidic than distilled water with a pH of 7. The acidity in normal rain results from the reaction of atmospheric **carbon dioxide** with water vapor to form carbonic acid, a weak acid. (Carbon dioxide is the gas we exhale and is also produced whenever **fossil fuels** are burned.) Most acid deposition has a pH between 4.6 and 5.4, but scientists have measured pH values in acid rain in the eastern United States as low as 2.1. This is almost 100,000 times more acidic than distilled water!



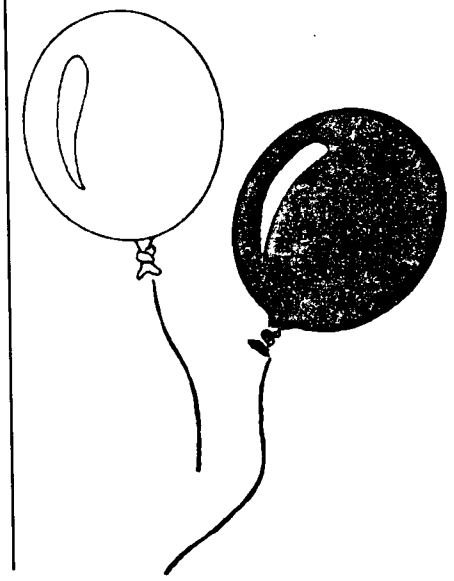
5. Ask the students to give you examples of things that burn fossil fuels to generate power or to produce products. List these on the chalkboard or overhead under the heading "Acid Rain Producers." (Examples: paper mills, factories, power plants, cars, fires, furnaces, wood stoves, lawn mowers, gasoline tools, boats, etc.) Using the illustration, discuss how the **sulfur dioxide** and **nitrogen oxides** get into the atmosphere, how they react with water vapor to produce **sulfuric** and **nitric acids**, and how they return to earth in the rain, snow, fog, or humidity.



6. Discuss things, both living and nonliving, that could be affected by acid rain. (Examples: lakes, trees, plants, mountains, rivers, fish, birds, statues, objects made of metal, soils, etc.) List these on the chalkboard or overhead under the heading "Affected by Acid Rain." Encourage students to apply the results of their classroom experiment to the larger environment.

7. Pass out drawing paper and crayons or markers. Half of the students should draw something from the "Acid Rain Producer" list and the other half should draw something from the "Affected by Acid Rain" list. Allow only five minutes for completion of these drawings; then help the students tape their pictures to their chests or backs. Spread the students around the classroom, interspersing the acid rain producers with things that are affected by acid rain. Announce that they will play the acid rain balloon game.

8. Explain that the balloons will represent clouds containing nitric and sulfuric acids. The object of the game is to keep the balloons in the air and away from you! Each student should call out what they represent whenever they bat an acid rain balloon away from themselves to another person. To start the game, give a glitter-filled balloon to each of the students portraying an acid rain producer. They should bat their



balloons towards a person portraying something affected by acid rain. When the teacher is ready to end the game, say "the clouds are about to release their acid deposition onto the land, lakes, trees, plants, and people." Pop the balloons one at a time with a sharp pin, allowing the glitter (or paper punches) to fall on the students.

DAY THREE (and for the next two to three weeks)

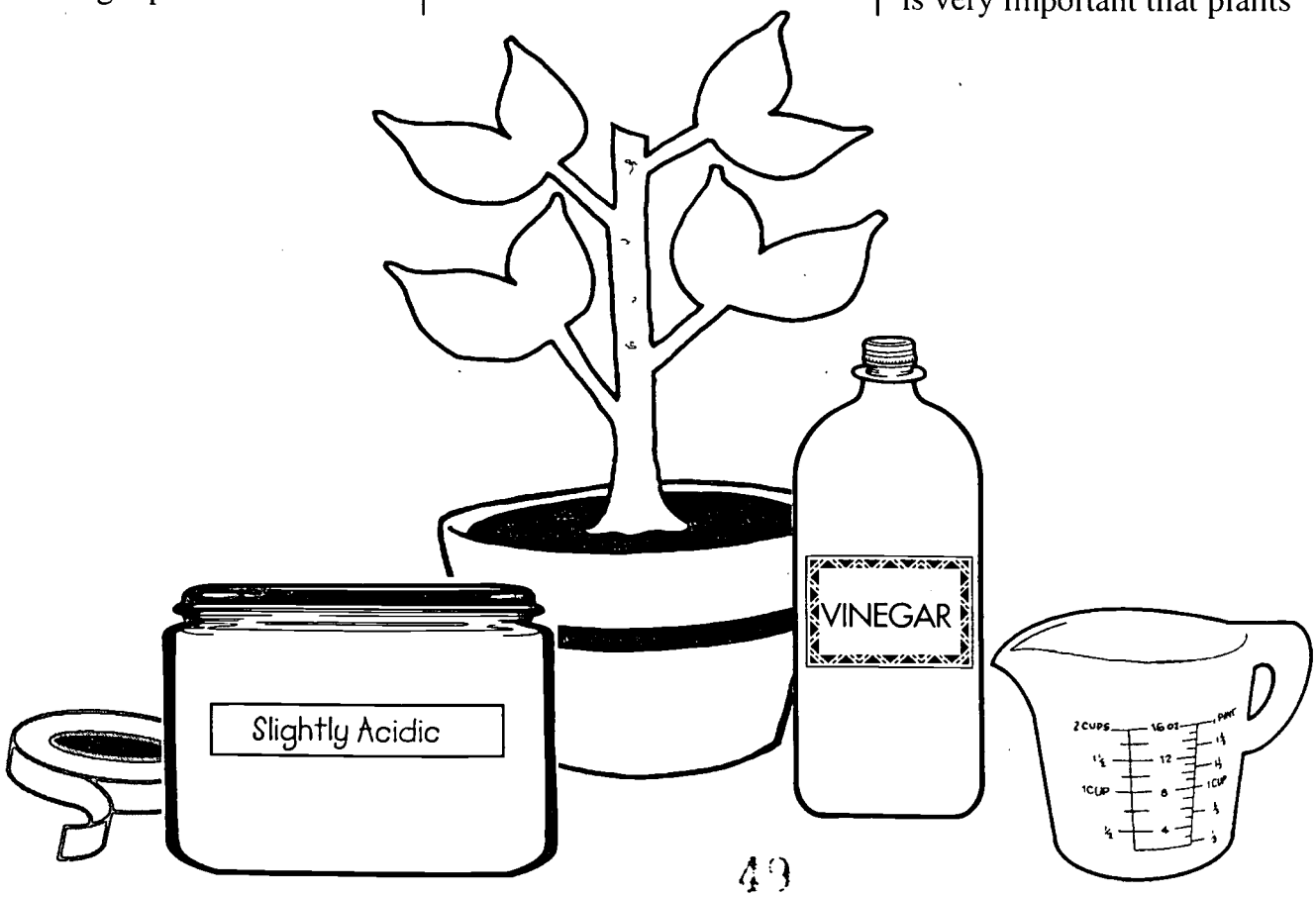
1. Divide the class into three teams. Give each team a one-gallon container with a lid and a measuring cup. Have one team fill their container with one gallon (3.8 liters) of tap water. They can use masking tape to label the container and their measuring cup, "tap water."

2. Have another team fill their container with one pint (0.5 liters) of vinegar and seven pints (3.3 liters) of tap water. Use masking tape to label the container and measuring cup, "slightly acidic." Older students could find the pH of this water and write it on the label.

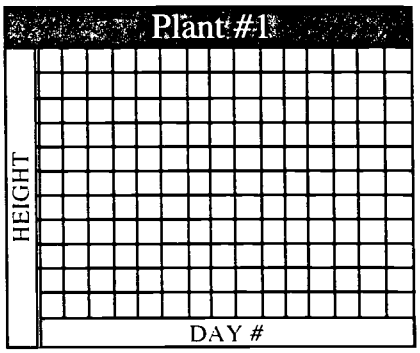
3. Have the third team fill their container with two pints (0.9 liters) of vinegar and six pints (2.8 liters) of tap water. Have them use masking tape to label the container and measuring cup, "very acidic." Again older students could find the pH and write it on the label.

4. Give each team two or more plants and have them label the plants the same as their container. Make each team responsible for watering their plants from the container with the matching label.

Older students should write a hypothesis in which they predict how varying amounts of acid will affect the plants. They should also discuss the importance of controlling variables such as light, heat, humidity, etc. For example, why should we place all the plants in the same area of the classroom? (To ensure that they get the same amount of light and heat.) Students should water the plants when they need it (every two to four days). It is very important that plants



in all three groups get the same amount of water in each watering cycle (use measuring cups). Have team members observe their plants every day and write these observations in a chart or journal — color, leaf condition, overall health, etc. For older students, consider quantitative measurements, too. For example, measure and record the height of each plant on the watering days.



It would also be helpful to have a photographic or video record of the plants over time. Another idea is to measure the pH of the soil at the start and end of the experiment to determine any cumulative effects of acid rain on soil.

5. Continue this activity for two to three weeks. Have students summarize their observations and write conclusions. (This may involve making inferences from their observations.) If they have recorded measurements, find an average for each experimental group on each measuring day. Graph the results (for example, height vs. time) for each group and compare. If they wrote a hypothesis before experimenting, should they accept or reject their original hypothesis based on their experimental data or observations? If they were going to try this experiment again, would they change any of their experimental methods? What do they think would happen if they used a different kind of plant? Would their results be the same?

6. Ask students to apply the results of their plant experiment to outdoor plants. Point out that although this activity gives an indication of how acid rain could affect plant life outside the classroom environment, outdoor plants might not react in the same ways as the indoor plants.

Discussion Questions:

- **How are conditions outside the classroom unlike the conditions in the classroom?**

Answer: Outdoor plants may be exposed to acid rain on their leaves or needles whereas the indoor plants may have been watered so that only the soil was in direct contact with the acidic water. Outdoor plants may be hit with acid rain infrequently, rather than every few days, like the indoor experimental plants. Outdoor plants may be attacked by insects, **bacteria**, and temperature extremes while the indoor plants were protected from these things.

- **Why is it difficult to determine exactly what acid rain is doing to plants and animals in the environment outside the classroom?**

Answer: Too many variables; it is hard to separate one factor from another. The various factors may interact with each other in ways that are difficult to study. For example, acid rain may weaken a plant's resistance to pests. The pests alone may not be able to kill the plant, but in the presence of acid rain, the plant may succumb to the pests. Without very careful study, it may look as if only the insects killed the plant, when in fact, both insects and acid rain were necessary.

- **How do the plants and the environment of Mt. Mitchell differ from those in your classroom experiment?**

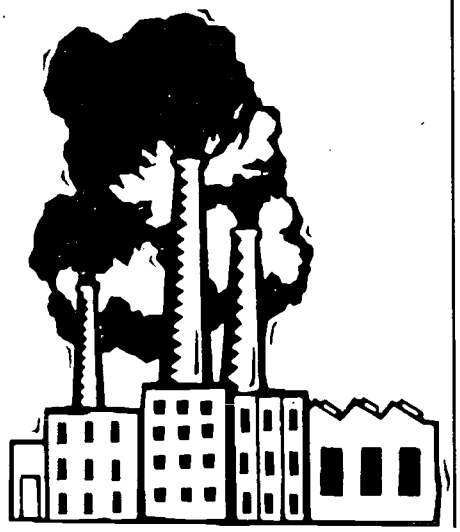
Answer: The climate on Mt. Mitchell is very cold and damp. The mountain is enveloped in clouds eight out of every ten days. Although the acidity of the

clouds is not always as great as the acidity of the solutions used to water your classroom plants, the trees on the mountain may be bathed in acid rain or fog much of their lives. If you performed the experiment again, you might consider spraying the plants with the solutions, in addition to watering them, to simulate acid fog. Also, trees on Mt. Mitchell are exposed to ice storms in the winter and insect pests such as the **balsam woolly adelgid**. Your classroom plants were not exposed to a harsh climate or insect pests. The soil on the mountain may be very different from the soil you used in your experiment. Of course, the kinds of plants on Mt. Mitchell are different from the plants you used in your experiment. You may have used a broad-leafed plant rather than a tree with needles. The plants on Mt. Mitchell might be more, or less sensitive to acid rain than your experimental plants.

7. Older students could research (magazine articles or Internet search) to find out about current scientific studies on acid deposition. Discuss difficulties scientists have when conducting field research and how scientists attempt to model natural systems in laboratories or greenhouses. Students will find that scientists have different opinions about acid rain and its role in forest decline. Why might this be? They use different methodologies and equipment in studying the problem. There may also be more than one logical interpretation for a given set of field data.

Why do we say that science is tentative? New research may reveal new things that necessitate changes in our working theories or hypotheses about acid rain and forest decline. We must always be ready to change our theories in the light of new discoveries. Being tentative means being willing to accept new and changing information.

8. Ask students to assess the possible impacts of acid rain on their community, state, nation, or another country. (This may involve some library research, interviews with local officials, and possibly their own inferences based on observations that they make of rain or outdoor plants in their community.)



Classify impacts as environmental, economic, social, or political. Predict future changes that are likely to occur if nothing is done to reduce the formation of acid deposition. List ways that individuals and governments could work together to reduce air pollution and the damage to human health and the environment.

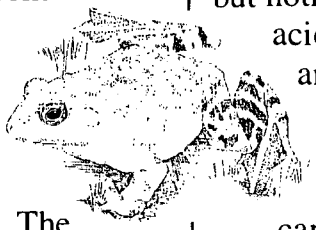
Assessment:

Use the "Acid Rain Tracking" worksheet (unlabelled version of the Acid Rain Tracking illustration) to check the students' understanding of theories regarding acid rain formation and effects. Provide the following terms on the chalkboard or overhead and ask the students to label the worksheet:

- acid rain
- acid snow
- aquatic animals affected
- changes in the soil
- trees' leaves and roots affected (hint: requires two lines on chart)
- nitrogen & sulfur oxides form nitric & sulfuric acids (hint: requires two lines on chart)
- prevailing wind
- spring runoff
- sulfur dioxide
- nitrogen oxides

Student's Information

You have just completed a simple experiment to learn about common acids and their effects on pennies and eggs. There are acids in the air and clouds above us, too. Scientists refer to the acids that fall from the skies as acid precipitation, or **acid deposition**. Acid deposition includes any rain, snow, sleet, fog, dust, or humidity with acidity levels similar to soft drinks (like cola) and vinegar. Normal rain is a much weaker acid, with an acidity level somewhere between milk and cola. Scientists are just beginning to study the effects of acid deposition and to test various theories about how it may affect the environment.



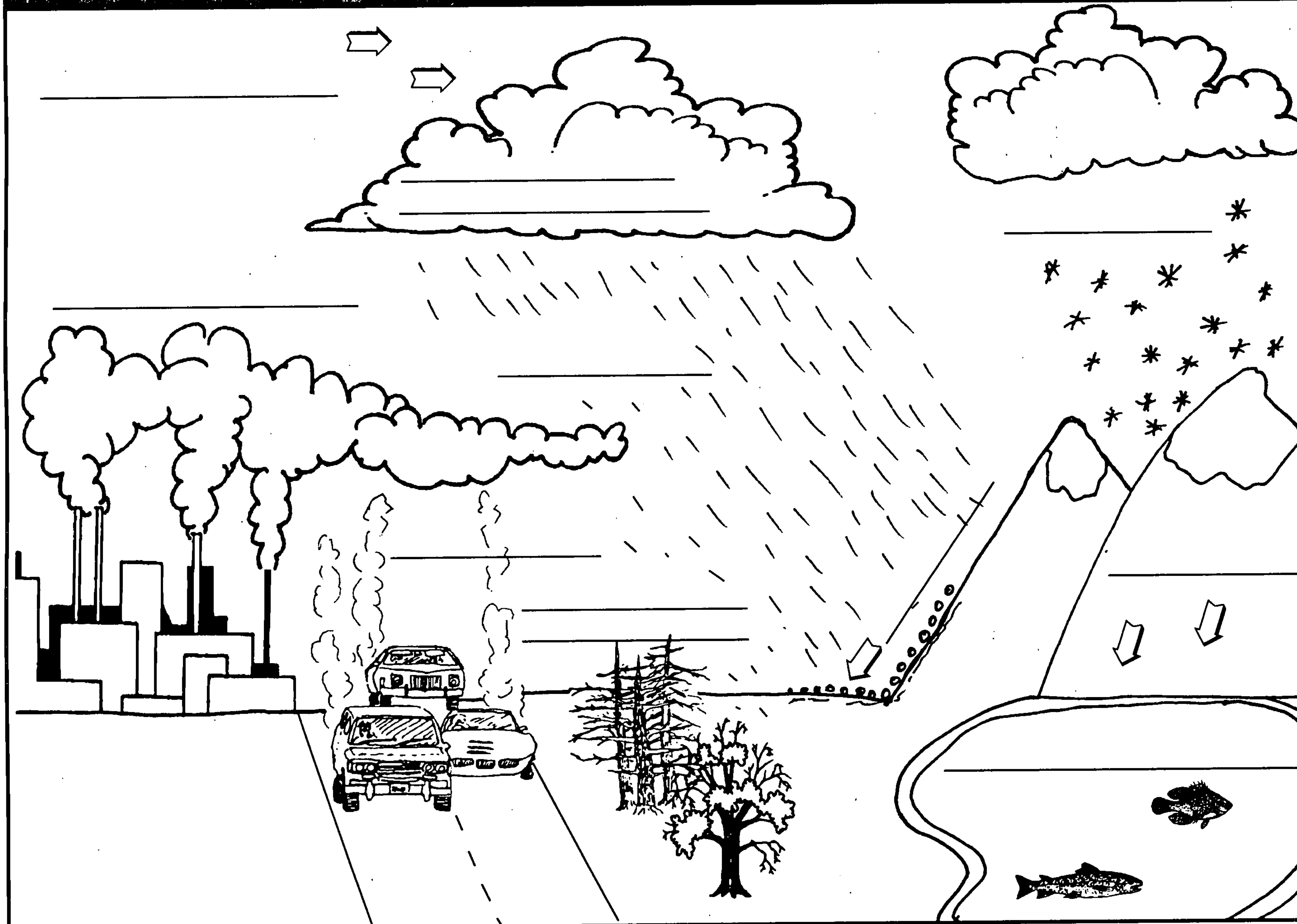
Nearly 95 percent of the acid deposition comes from two gases — **sulfur dioxide** and **nitrogen oxides**. The water vapor in the atmosphere reacts with these gases to make **sulfuric** and **nitric acids**. Sulfur dioxide is usually produced when coal, containing sulfur, is burned as a fuel in power plants that generate electricity. Nitrogen oxides are produced by cars, trucks, and buses. Like sulfur dioxide, nitrogen oxides can be transported by the wind for many miles, crossing regional and international boundaries, before falling to earth as **acid rain**. For example, scientists think that most of the acid deposition in the eastern United States and Canada comes from power plants in the Midwest that release large amounts of sulfur dioxide.

The effects of acid rain are not always easy to observe. At first glance, a lake may look clear and beautiful, but looks can be deceiving. Years of exposure to acid rain will increase the acidity levels of the lake, interrupting the normal **decomposition** process. Dead plants and animals settle to the bottom, making the water look crystal clear, but nothing is alive! If acidity levels of lakes and streams are increased even a small amount, some species of fish cannot reproduce. Spring runoff from acid snow could increase the acidity of lakes and streams at the very time that fish are trying to reproduce. Clams, snails, crayfish, bullfrogs and many insects are especially sensitive to higher acidity levels. If these smaller animals die, birds and mammals that depend on them for food are also affected. Over time, acid rain may weaken trees and other plants by harming their leaves and root systems. Some scientists think trees exposed to acid rain may be more easily attacked by pests and diseases. The harmful effects of acid rain on plants and animals may not always be directly caused by the acidity.

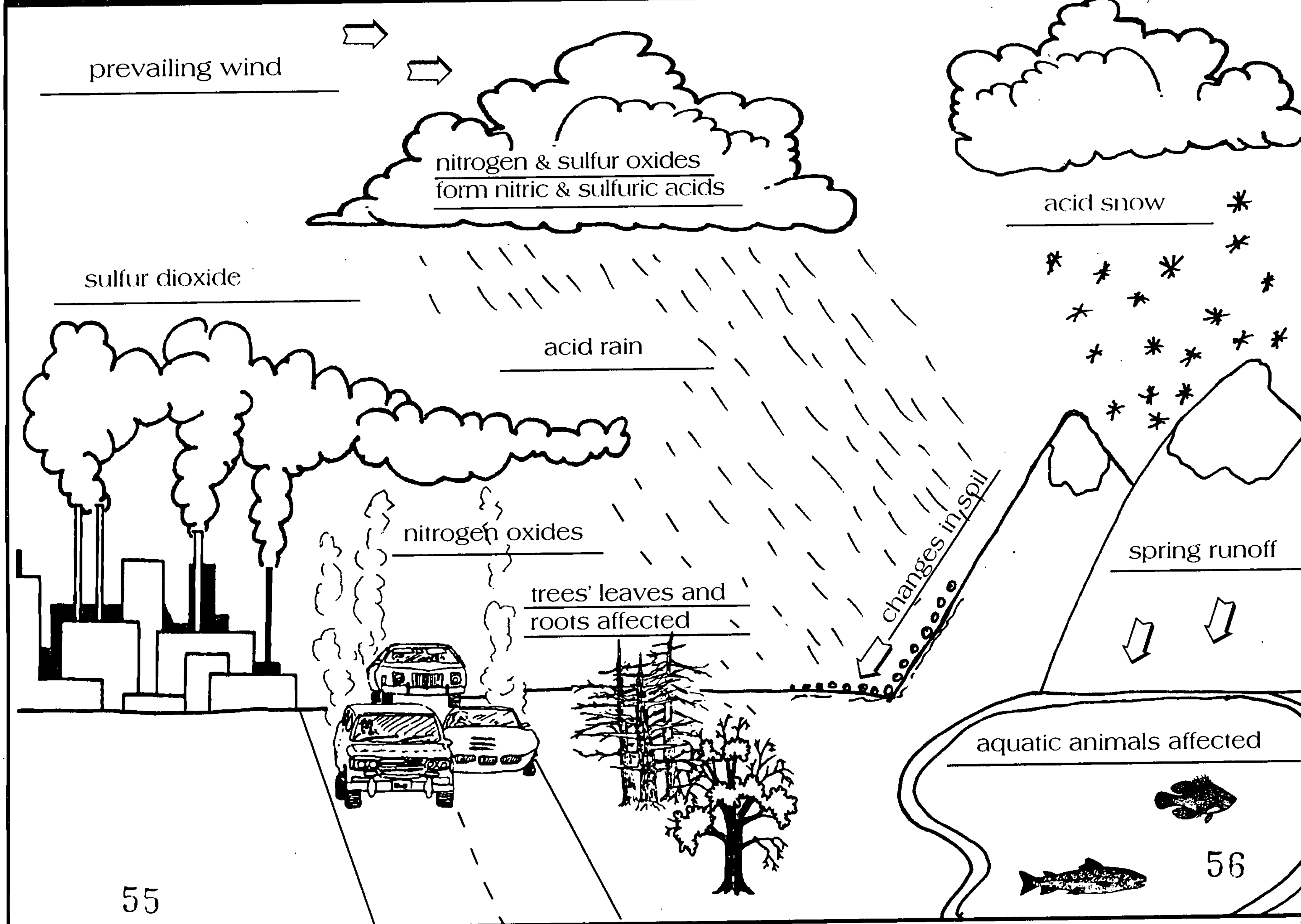
There may be indirect effects that scientists are just beginning to investigate. For example, acid rain may change the soil by releasing poisonous metals, such as **aluminum** and **mercury**, and by washing away valuable plant **nutrients**, such as **calcium**. The "released" aluminum may interfere with a plant's ability to absorb nutrients through its roots. The "released" mercury may be taken up by plants and then eaten by animals. Mercury, which is stored in the fatty tissues of animals, can be passed on through the **food chain** affecting many more animals.

There is much more for us to learn about acid deposition and its long-term effect on plants, animals, people, and soil. If you were a scientist, what kinds of experiments would you do to investigate acid rain? Would you do laboratory studies or field studies?

Acid Rain Tracking — Worksheet



Acid Rain Tracking — Illustration



On-Site Activity #1 — Meet A Tree

Curriculum Objectives:

Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency for interacting with others
- Healthful Living: recreational safety
- Mathematics: solve problems in measurement
- Science: adaptation to environment, weather and climate
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency for interacting with others
- Healthful Living: recreational safety
- Mathematics: solve problems in measurement
- Science: living things—plants, interdependence of plants and animals, Earth science, environment
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational safety
- Mathematics: solve problems in temperature and measurement
- Science: ecology
- Social Studies: gather, organize and analyze information, draw conclusions

Location:
Mount Mitchell State Park, Balsam Trail

Group Size:
30 or smaller, class size; students should be separated into groups of three

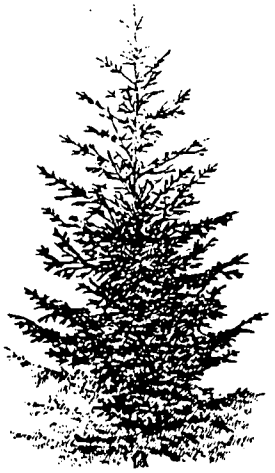
Estimated Time:
45-60 minutes

Appropriate Season:
Late spring to late fall

Materials:
Provided by the park:
Per group: string, litmus paper, litmus color chart, distilled water, paper cups, pencils, clipboards, ruler, map of the Balsam Trail
Provided by the educator:
Per group: "Alpine Forest Fact Sheet," "Alpine Forest Worksheet," calculator, pencils
Per class: poster-size "Alpine Forest Data Summary Table"

Major Concepts:
- Ecology of the spruce-fir forests of the Southern Appalachians
- Plot sampling methods
- Soil pH

Objectives:
- Identify the four most common trees on Mount Mitchell.
- Determine the number of trees in a plot.
- Measure each tree's diameter at 4 1/2 feet above the ground.
- Determine soil pH.



Educator's Information:

The students will record information about the plants and soil found within assigned **plots** along the **Balsam** Trail.

Using the "**Alpine** Forest Fact Sheet," each student team will identify the different plant species within their plot. They will also estimate the **diameter** of each live tree and determine the soil **pH** in their plot. The teams will share their data with the rest of the class. Together, they will summarize what they learned about Mt. Mitchell's alpine forest.

Special Considerations:
This activity requires a short hike along a trail. Students with physical disabilities should have no problem getting to the site, but may have difficulty with the activity as it occurs on the uneven ground along a trail. It is recommended that students wear sturdy shoes, a hat with a visor, old clothes and sunscreen. Be prepared for rainy, cool weather and dress accordingly.

Instructions:

1. Students should read the Student's Information, the "Alpine Forest Fact Sheet," and the instructions on the "Alpine Forest Worksheet" before arriving at the park. If possible, the students should practice measuring the diameter of different trees on the school grounds as explained in the worksheet instructions.

2. Make a poster-sized "Alpine Forest Data Summary Table." (See page 4.1.10.) Divide the class into groups or teams of three. The teacher may wish to assign specific roles to individual group members, such as data recorder (records data and does calculations), soil scientist (determines soil pH), and forester (identifies and measures trees). Although group members will work together as a team to accomplish the tasks described on the worksheet, individual members could take responsibility for organizing and conducting specific tasks. Give the groups time to read the worksheet instructions together and discuss how they will get their work done while at Mt. Mitchell. **Make sure students read the warning about dead trees and discuss how to work safely around them.**

3. Upon arriving at the summit parking area, a restroom break is suggested before beginning the on-site activity. After the break, ask the students to get into their groups. Work with the park ranger to distribute the necessary materials (see Materials section). **STUDENTS SHOULD BE CAUTIONED NOT TO TOUCH DEAD TREES DURING THEIR PLOT STUDY!**

4. Have each group complete the top portion of their "Alpine Forest Worksheet" and answer question #1 about the weather conditions. The weather gauges are located in the breezeway of the concession stand.

5. Assign each group a number. These numbers correspond to numbered posts along the Balsam Trail. The post will be the center of that group's plot.

6. Have the groups locate their pre-assigned numbered post on the Balsam Trail map. After the students locate their post on the map, the students must find their assigned post on the trail.

7. Each group of students should have a 15-foot section of string. With one student (data recorder) holding the end of the string on the post, another student will pull the string tight so that he or she is standing 15 feet from the post. After noting where he or she started, the student will make a circle around the post while holding onto the string. Every time the string touches a tree, the students will record what species of tree it is on the "Alpine Forest Worksheet."

8. When the string touches a tree, the students will also measure the diameter of the tree, by taking the ruler and holding it at eye level (approximately 4 1/2 feet from the ground) against the tree. They will record the estimated diameter on their worksheet.

9. After all the data is collected and worksheets are completed, gather the students together at the concession stand area to discuss each group's results. Show these results on the "Alpine Forest Data Summary Table" and answer the discussion questions.

Suggested Extensions:

At the park:

Visit the park's natural history museum and hike to the observation tower.

Back at the school:

1. Lay out plots in a forest near your school. Collect data like that on the "Alpine Forest Worksheet." Complete a large data summary table, similar to the "Alpine Forest Data Summary Table," and compare the forest near your school to the forest on Mount Mitchell.

2. Determine the total area of your plot.

Area = pi x radius squared

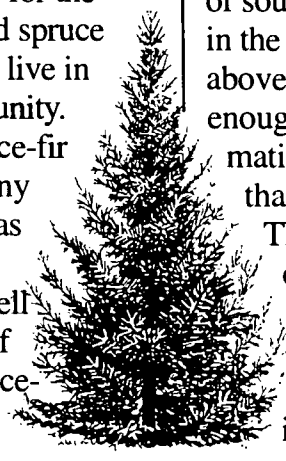
Answer: The string length (15 feet) is the radius of the circle. Fifteen squared (15 x 15) = 225. 225 x pi (3.14) = 706.5 sq. ft.

3. Complete the "Alpine Forest Worksheet" and "Alpine Forest Data Summary Table" a second time using the metric system.

Student's Information

Ecology is defined as the study of the relationships between **organisms** and their environments. The environment includes both living and nonliving things. For example, the environment of a tree includes the air that surrounds it, the weather that affects it, the animals that eat it or nest in it, the soil beneath it, and the other plants, that live nearby. The relationships of the tree to its environment are constantly changing. The tree itself changes as it grows older.

The tree belongs to a **natural community** just as you belong to a human community. A natural community includes all the plant and animal populations that interact with each other and share a common environment. Usually a natural community is named for the most abundant trees, or other plants, in that environment. The spruce-fir forest, for example, is named for the dominant trees (red spruce and Fraser fir) that live in this natural community. However, the spruce-fir forest contains many other plants, such as mountain ash and yellow birch, as well as an assortment of animals. The spruce-fir forest is the **alpine** (high elevation) forest in North Carolina.



The climate is one of the major environmental factors that affects the natural community on top of Mount Mitchell. Due to the high elevation, the climate on Mount Mitchell is very similar to that of southern Canada. Peaks in the Southern Appalachians above 5,500 feet are high enough that they have a dramatically different climate than the rest of the state. The air is thinner and colder, and the winters are cold and long. In fact, the coldest temperature ever recorded in North Carolina was on

Mount Mitchell in January of 1985, when the thermometer reached -34 degrees Fahrenheit.

Winds of 100 miles per hour are common in the winter. The winds on Mount Mitchell usually come out of the west. You can infer this from the shape of the trees. Instead of being cone-shaped like Christmas trees, the trees on Mount Mitchell have short branches on the west side and longer branches on the east side. Branches on the west side of the tree where the wind is strongest get broken, while those branches growing away from the prevailing wind are protected by the tree's trunk. These trees are called "flag" trees because their long branches point in the direction the wind is going, just like a real flag.

Most plants become **dormant** to survive the harsh winter conditions. They enter a resting stage in which some of their life processes are slowed down. They drop their leaves and thicken their sap so that it acts like antifreeze. These types of plants are called **deciduous**. **Evergreen** plants such as the red spruce, Fraser fir, mountain laurel and rhododendron have waxy leaves that help keep these plants from drying out in the cold, dry, windy winter air.

Another factor affecting plants is the **pH** of the soil they grow in and the precipitation that falls on them. Everything we eat or drink has a pH and so does the soil at your feet. Scientists use the pH scale to define degrees of acidity. The scale is represented by numbers from 1 to 14. A pH of 1 is extremely **acidic**, while a pH of 14 is extremely non-acidic, or **basic**. A pH of 7 is neutral, neither acidic nor basic. Pure water has a neutral pH of 7. Some examples of the pH of common things around you include:

Vinegar	pH of 2.25
Cola	pH of 4
Rain	pH of 5.4
Milk	pH of 6.5
Sea water	pH of 7.5

pH Scale

1----------7----------14

acidic neutral basic

Soils that have a pH close to neutral are considered "rich" because many minerals and nutrients are readily available. Acidic soils, on the other hand, are often called "poor" because the minerals tend to "leach" or wash out of them easily. Thus, the pH of soil is an important factor in determining which plants can thrive in a given environment.

The soil on Mount Mitchell is acidic. It is not acidic enough to hurt you, but it may be hurting the plants and animals that live on Mount Mitchell as the soil becomes more acidic due to **acid rain**.

As the example listed shows, rain water has a normal pH of 5.4, meaning it is slightly acidic. Unfortunately, the pH of rain water has changed dramatically in the past 20 years. Some of the rain falling on Mount Mitchell has had a pH as low as 3. This means that the rain water is very acidic which is why it is called acid rain. This type of rain also affects the pH of the soil, making it more acidic as well. Many scientists believe that as the soil becomes more acidic, the trees growing on Mount Mitchell, and in other alpine forests worldwide, will become sick and die.

What causes acid rain? Sometimes nature makes acid rain when a volcano belches out sulfur dioxide gas which mixes with rain water. But most acid rain is caused by people and the things we do. The gases that come from the tail pipes of our cars and from the smoke stacks of our factories, especially coal burning electrical plants, all contribute to acid rain.

Scientists use a variety of tools to measure pH. One simple tool is **litmus paper**. When litmus paper is dipped in water or a wet soil solution, it changes color. This color is compared to a spectrum of colors on a color gauge. Each color on the color gauge correlates to a known pH. When the matching color is found, the pH can be determined from the gauge. You and your group will use litmus paper to determine the pH of the soil on Mount Mitchell.

litmus paper

Alpine Forest Fact Sheet

There are many ways plants can be categorized. The following categories relate to question #3 on the "**Alpine** Forest Worksheet."

Shrubs: Woody plants that usually branch from the base with several main stems, not usually from a single trunk.

Trees: Usually tall, woody plants, distinguished from shrubs by comparatively greater height, and characteristically a single trunk rather than several stems.

Grasses: Plants with long slender leaves which are often rolled inward.

Ferns: Any flowerless, seedless plants, having fronds with divided leaflets, and reproducing by means of spores.

Herbaceous plants: Plants that have flowers and seeds. They have fleshy stems, as distinguished from the woody tissue of shrubs and trees. They generally die back at the end of each growing season.

Vines: Plants that have flexible stems and support themselves by climbing, twining, or creeping along a surface.

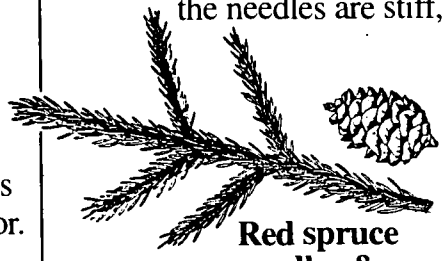
The plants and animals that live above 5,500 feet in the Southern Appalachians do so because they have **adapted** to the alpine environment of Mount Mitchell. Many of these same plants and animals are also found living in southern Canada where environmental factors are similar, especially rainfall and temperature patterns.

There are only four common tree species found within Mount Mitchell State Park's 1,600 acres. In a tropical rain forest of this size there could be as many as 500 species of trees. This shows that fewer species are able to adapt to harsher environments.

There are only two **evergreen** trees commonly found on Mount Mitchell: Fraser fir (*Abies fraseri*) and red spruce (*Picea rubens*). Both of these trees are **coniferous**.

The Fraser fir is the most abundant tree in the park. Fraser fir is also known as **balsam** because of its aromatic odor. On young Fraser fir tree trunks, resin blisters are more pronounced than on the trunks of red spruce. The needles of the Fraser fir are flat and rounded at the tips. Both the needles and the branches are also soft to the touch. Gray or whitish stripes are present on the underside of the needles, giving the underside of the branches a grayish or whitish appearance. The cones, when present, project upward from the branch.

Red spruce, when viewed from a distance, looks very similar to the balsam. Closer examination, however, will reveal that the needles are four-sided or nearly round in cross section as opposed to the flattened needles of the Fraser fir. Also, the needles are stiff,



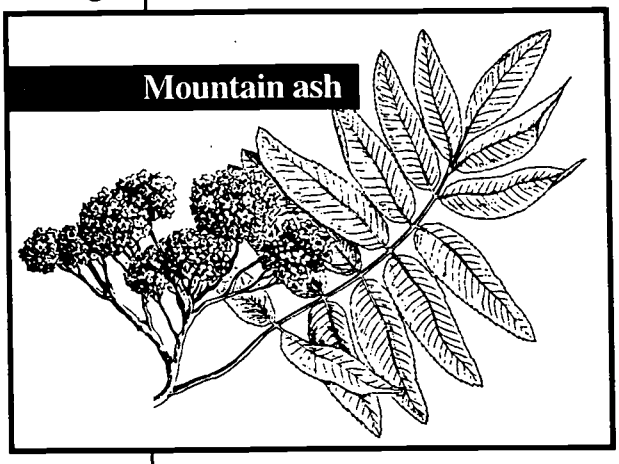
Red spruce needles & cone

pointed, and sharp to the touch. The cones, when present in the fall, project downward from the limb. The easiest way to distinguish these two trees is to remember that spruce trees have sharp needles.

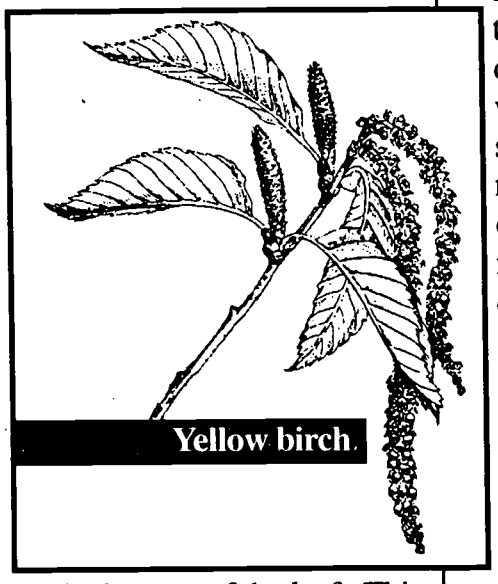
Fraser fir, needles & cone

There are only two common **deciduous** trees found along the Balsam Trail: the mountain ash (*Sorbus americana*) and the yellow birch (*Betula lutea*).

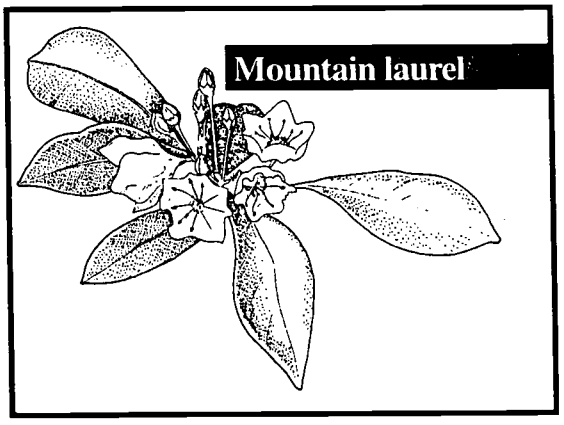
The mountain ash has bright red berries in the fall and winter which are a favorite food for bears and birds, especially grouse, grosbeaks and cedar waxwings. In the spring and summer, the tree is easily identified by its compound leaves.

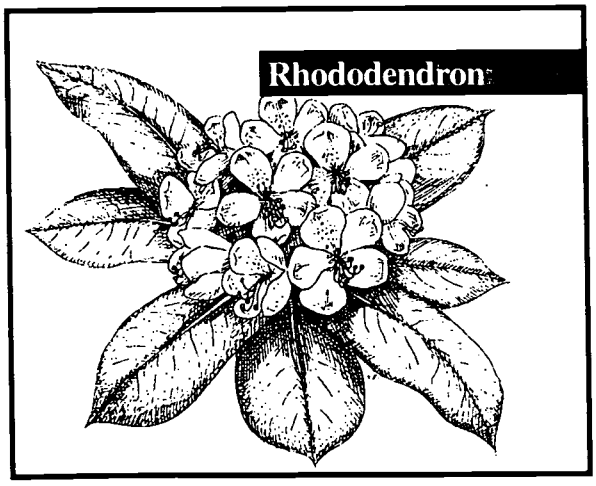


The yellow birch can be distinguished from the mountain ash by its simple, serrated leaves, with fuzzy veins on the bottom of the leaf. This tree does not have berries, but winged seeds. The leaves and twigs give off a wintergreen odor if crushed.



There are nine shrub species found on Mount Mitchell. Among these, mountain laurel (*Kalmia latifolia*) and purple rhododendron (*Rhododendron catawbiense*) are the two most common evergreen shrubs. Both have shiny, waxy leaves but the laurel's leaves are smaller than the rhododendron's. The easiest way to tell these two shrubs apart is to remember that the one with the longest name, rhododendron, has the longest leaves.





Alpine Forest Worksheet

Post #: _____ Date: _____

School: _____

Group members: _____

_____

_____

_____

As a group, supply the following information.

1. Weather description

Temperature, wind speed, and wind direction can be obtained from the weather information display. This is located in the breezeway between the two concession stand buildings near the summit parking area. Fill in the appropriate information below.

Temperature: _____ Wind Speed: _____ Wind Direction: _____

Circle today's weather conditions. You can circle more than one weather description or state today's weather in your own words in the space below.

rainy sunny cloudy foggy windy calm

_____

_____

2. Location

Which side of the mountain are you on? _____

Clue: The road that you traveled to get to the park runs in a northerly direction and the Balsam Trail is located to the right of that road.

3. Plot description

Circle the types of plants growing in your plot. You can circle more than one type of plant.

trees shrubs grass ferns vines herbaceous

Which one of these types of plants covers the biggest portion of your plot?

_____

In your plot, a low growing plant such as a tree seedling would receive how much sunlight? (circle your answer)

little sunlight a lot of sunlight

Why? Explain. _____

_____

Are there any animals or signs of animals in your plot? (Do you see tracks, hair, insects, spiders, etc.?) Circle your answer.

yes no If yes, write down what animals or animal signs you saw.

_____

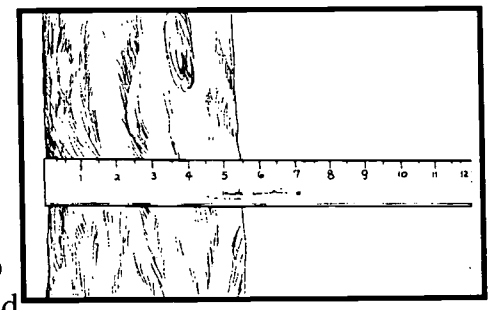
_____

4. Tree survey

To begin sampling the plot, one student should hold one end of the string on the top of the numbered post while another student holds the other end of the string, keeping the string straight and fairly tight. The second student will be 15 feet from the numbered post. This student should mark where he/she is standing by making a line on the ground, laying a stick down, or putting a stick in the ground as a marker. After marking the spot, the second student will walk in a circle around the numbered post. Every time the string touches a tree, the third person in the group should record that tree's data on this worksheet. The data from all the trees within the group's 15-foot circle must be obtained.

First, determine the tree's species using the "Alpine Forest Fact Sheet." Place its name (common and/or scientific) in the data table below. If there are standing dead trees in your plot, do not try to determine the species. Just count them.

CAUTION: A standing dead tree can be dangerous! Do not get too close, or touch the tree. The top could break off, fall and injure you. Do not try to measure the diameter of a dead tree.



Measure each live tree's diameter. Hold the ruler against the tree about four and one half feet above the ground. Close one eye, tilt your head to the left and line up the left side of the tree with the zero mark on the ruler. Hold the ruler steady. tilt your head to the right, still keeping one eye closed, and line up the right side of the tree with the ruler. The number on the ruler at the right edge of the tree is the tree's diameter in inches. Record this number below.

Record every tree and its diameter on this worksheet as you complete the circle by walking around the numbered post. Remember to use the illustrations and descriptions found in the "Alpine Forest Fact Sheet" to identify the plants. Under **Health,** write a few words describing the condition of each tree you measure. For example, if the tree has few, or no dead branches, describe it as "healthy." If the tree has some dead branches try to estimate how much of the tree is dead. Use a fraction such as 1/4, 1/3 or 1/2 "dead."

	Tree Species	Diameter	Health
Tree 1	_____	_____	_____
Tree 2	_____	_____	_____
Tree 3	_____	_____	_____
Tree 4	_____	_____	_____
Tree 5	_____	_____	_____

Tree 6			
Tree 7			
Tree 8			
Tree 9			
Tree 10			
Tree 11			
Tree 12			
Tree 13			
Tree 14			
Tree 15			
Tree 16			
Tree 17			
Tree 18			
Tree 19			
Tree 20			
Tree 21			
Tree 22			
Tree 23			
Tree 24			
Tree 25			

Total number of yellow birch _____ Total number of mountain ash _____

Total number of Fraser fir _____ Total number of red spruce _____

Total number of live trees _____ Total number of standing dead trees _____

Average of the diameters of yellow birch _____

Average of the diameters of mountain ash _____

Average of the diameters of Fraser fir _____

Average of the diameters of red spruce _____

Average of the diameters of all the trees _____

5. Soil pH

After collecting the tree data, measure the pH of the soil in your plot. You will do this by using the cup, the distilled water, and litmus paper given to you earlier. By hand, collect enough soil from your plot to fill one quarter of the cup. Put enough distilled water in the cup so that the soil and water together fill one half of the cup, then stir the soil and water using any small stick you find. (Remember, breaking of plants in a state park is prohibited— use a dead stick already on the ground.) Place a two-inch piece of litmus paper in the muddy water and compare the color change on the litmus paper with the litmus color chart.

Record your findings here. Soil pH _____

Circle which best describes your plot's soil: acidic neutral basic

How would you describe the soil in your plot in terms of moisture? Pick the soil up and squeeze it in your hand. Does it stick together and hold its form after you open your hand? If it does, that means the soil is moist. Does the soil fall apart after you squeeze it and then open your hand? If it does, that means the soil is dry.

Circle your answer. moist dry

What is the soil's color? _____

What is the soil's texture? Does the soil feel sandy, smooth, gritty or soft when you rub it between your fingers?

_____

6. After you complete this worksheet, return to the summit parking area.

7. Each group will present the data collected from their plots. The educator will record this information on the "Alpine Forest Data Summary Table." You will discuss what you learned about the spruce-fir forest on Mount Mitchell.

Alpine Forest Data Summary Table

Plot #	Soil pH	Yellow Birch	Mountain Ash	Red Spruce	Fraser Fir	Total # Live Trees	Total # Dead Trees
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Example: you could write down the average diameter or list all diameters as shown here.

Plot #	Yellow Birch	Mountain Ash	Red Spruce	Fraser Fir	Dead Trees
1	3 trees, 8",10",12"	2 trees, 6", 3"	2 trees, 12", 4"	2 trees, 6",12"	4 trees

Discussion Questions

Was the data from each of the plots the same?

(Answer: No two plots will be exactly alike. But, by taking the average of all the plots we get a better concept of the different kinds, numbers and sizes of trees that are growing in the spruce-fir forest.)

Of the four most common trees growing on Mt. Mitchell, which is the most abundant?

What is the second most abundant tree?

What is the third most abundant tree?

Which is the least abundant tree?

Which plot had the greatest number of trees?

Which plot had the least number of trees?

Which plot had the largest diameter tree and what was the species?

How many dead trees were found in the plots?

What was the health or condition of the live trees in each plot?

How might the data in each of the plots change over time? (Ask students to give their predictions.)

(Answer: We believe that the plots will change over time, but no one really knows how. The data the students collected can be compared to data collected by other classes and possibly by researchers. Data collected like this over time is a very valuable tool for researchers, for this is one of the best ways to find out how the spruce-fir forest is changing.)

What is different about the spruce-fir forest compared to the forests growing where you live?

On-Site Activity #2 Mt. Mitchell — A Sense of Place

Major Concepts:
- Life cycle of a tree
- Spruce-fir forest
- Interdependence of plants and animals

Learning Skills:
- Communicating and observing
- Responding personally and creatively to a story/ experience

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

Location:
Balsam Trail and grassy areas near the parking lot (See park ranger for other suggestions.)

Group Size: 15 or less

Estimated Time: 1 hour

Appropriate Season: Warm weather

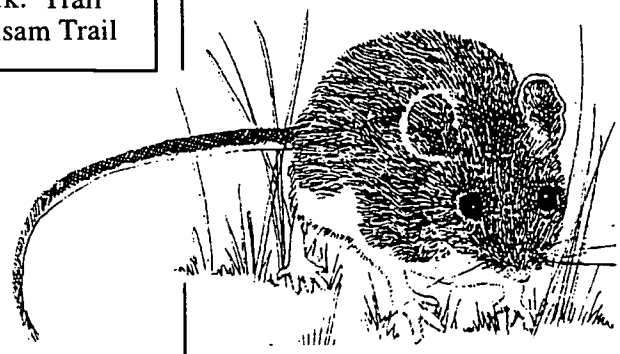
Materials:
Provided by the educator:
Per class: Song sheets ("My Roots Go Down") and copy of guided imagery script
Per student: Clipboard or notebook for journal activity, pencil
Provided by the park: Trail Guide for the Balsam Trail

Objectives:

- Observe and describe three plants and three animals inhabiting the spruce-fir forest on Mt. Mitchell.
- Describe the condition of the trees on Mt. Mitchell and list two possible causes of tree mortality.
- Complete a journal entry with observations, sketches, poetry, or other written response after participating in a guided imagery activity on Mt. Mitchell.

Educator's Information:

The teacher should be familiar with the guided imagery (story) in this activity and the Balsam Trail Guide for Mt. Mitchell. Students should have completed one of the pre-visit activities before coming to the park, so that they are familiar with the **spruce-fir forest** and the possible effects of **acid rain** on trees.



Instructions:

1. Check with the park ranger to choose an appropriate site for the guided imagery activity. If possible, divide the class into two smaller groups. One group could do the guided imagery activity while the other group is hiking the Balsam Trail. Then, switch places at a predetermined time.

2. Using the instructions in this activity, lead the students through the guided imagery (Fraser fir story, p. 4.2.3). Afterwards, have the students sit in a circle to share their experiences.

Possible questions:

- Were they successful at imagining what it would be like to be a Fraser fir on top of Mt. Mitchell?
- When did they feel the happiest?
- What did they like best about the spruce-fir forest? (favorite color, plant, animal, etc.)
- How did they feel when they were attacked by insects? Bathed in acid fog?
- If the mountain could talk, what would it say to the trees? To people?
- Did they like the guided imagery activity? Why? Why not?

3. Conduct a silent sensory awareness hike for half an hour on the Balsam Trail. The object of the hike is to observe as much of the forest as you can without leaving the trail. Review park rules with the students (pages 1.3 and 1.4 in this EELE). Stress the importance of using all of the senses, except taste. Before hiking, the educator should teach the students some signals to help them communicate without speaking. For example, if the teacher wants the students to look at something, she will form her hands into circles and put them up to her eyes (like binoculars), then point to the object. The signal for hearing might be to cup your hands behind your ears and, again, point in the direction of the sound. Older students could write their observations in notebooks or journals as they hike. This would help them to remain silent, as they write down comments and observations to share later with friends and the teacher. The educator should always stay in the lead and guide the students by pointing out objects to smell and feel, and also by stopping the group along the trail to listen to the wind, birds, and other animals. Give students time to examine the trees, but caution them against getting too close to a standing dead tree. The tree could fall over and hurt someone.

4. Discuss the silent sensory hike. What kinds of things did you see? Hear? Smell? Feel? Did you see any trees that you thought might be sick? What did they look like? Based on your observations, what do you think is hurting the trees? Did you see any signs of the **balsam woolly adelgids**, or bark injuries caused by the adelgids? Did you see any yellow needles that might indicate damage from air pollution? Describe the weather on Mt. Mitchell today. How does it feel to you? Normally, the mountain is enveloped in clouds eight out of every ten days. The cold, damp climate helps the fir and spruce trees to thrive, but may be a **limiting factor** for other plants and animals. What about you?

5. Conclude the activity with a 15-minute period for journal writing. Students could record their observations and feelings about Mt. Mitchell, or they could make sketches, write pieces of stories, poems or songs, etc. It is best if students do this activity alone, perhaps sitting in the same spot they used for the guided imagery. In case of inclement weather, check with the park ranger to see if the lounge in the Mt. Mitchell restaurant is available for this activity.

6. Sing the song, "My Roots Go Down" (p. 4.2.7). Ask individual students or volunteers to make up different verses using things they saw or imagined on Mt. Mitchell.

Examples:

"I am a hawk, flying o'er the trees ..."

"I am a fir, reaching toward the sky ..."

"I am acid rain, stressing out the trees ..."

"I am a cloud, raining on the mountain ..."

"I am a bug, feeding on fir trees..."

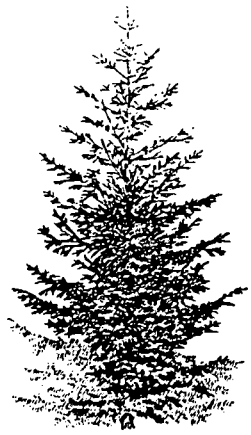
Assessment:

Back in the classroom, have students either draw a picture or write a short story about Mt. Mitchell including at least three plants, three animals, and two problems that affect the trees. Students could also write an ending to the guided imagery story they experienced on Mt. Mitchell. What happens next to the Fraser fir tree and its relatives? Will the spruce-fir forest continue to decline or will it make a come-back?

GUIDED IMAGERY SCRIPT — A STORY OF A FRASER FIR ON MT. MITCHELL

NOTE: The teacher should read the following story slowly and clearly, leaving a five-second break after each asterisk (*). Separate the students so that physical contact is not possible; however, students should be close enough to the teacher to hear the story.

SCRIPT — How many of you like to use your imagination? You're going to have a chance to do just that. I will read you a story about a Fraser fir tree on Mt. Mitchell and I would like you to try to imagine what I am telling you. First I'd like you to lie down on the ground, on your back, and close your eyes. You may need to wiggle around a bit to make yourself comfortable. Relax your arms and legs and remember to keep your eyes closed. Now take a deep breath and hold it in ... hold it ... hold it. Now exhale slowly and fully, feeling your body relax. Let's try that again. Take a deep breath ... feel the air filling your lungs with oxygen ... hold it ... hold it. Now exhale slowly and steadily, feeling your whole body relaxing on the earth beneath you. *



I want you to imagine that you're a tiny seed lying quietly inside the warm dark protection of a fir cone, a dark purple cone that points straight up into the air. You're 40 feet up in the branches of an 80-year-old Fraser fir tree here on top of Mt. Mitchell. Imagine what it's like up there as a late summer breeze rocks you back and forth ... back and forth.*

You sleep, warm and cozy, in your fir cone for two years, until one day ... POP! Suddenly, an explosion of blinding light shatters the darkness, as your cone bursts open and the wind carries you, whirling and twirling through the air. You look around and see other seeds, your brothers and sisters, twirling above and below you. What an exciting adventure! You are surfing on the air currents with your special wing. Imagine what it must feel like, whirling and twirling high above the treetops.*

Looking around you, you're amazed at how far the mountains reach out in all directions, the blueness of the sky and softness of the fluffy-white clouds floating above you. And look at what lies below, so many beautiful colors. The many shades of forest green are as glorious as anything you could possibly imagine. You also see patches of white and gold among all the green firs and spruce. You quickly sail over the gold patches to investigate. You see fast-growing, shiny, yellow birch trees growing in the openings of the **spruce-fir forest**. Cool! Now you visit the white patches. Zooming in

for a closer look you see the bleached bodies of dead trees. How creepy — like a cemetery! But, then you notice lots of baby trees growing underneath the dead trees. Maybe this is a nursery, and not a cemetery after all?

Hey, look over there. What's all that red? It's the bright-red berries of the mountain ash tree and the fire cherry. There's a big black bear eating the berries. You also see an unbelievable assortment of birds. Watch out! Don't let a bird eat you!*

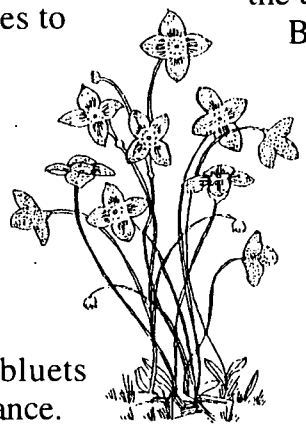
Now feel yourself slowly starting to descend ... down ... down ... down, past uncles, aunts and cousins — other firs that are part of your family, part of your heritage. You feel proud to be made up of the same fibers as these beautiful stately creatures of your **natural community**. You smile and wave as you continue on your journey down ... down ... down. You

pass a few red spruce trees, with their sharp, prickly needles and cones that point down toward the forest floor.

Down... down ... down you continue, past large outcroppings of metamorphic rock, millions of years old, speckled with shimmering flakes of mica and quartz. Some of the rocks are dotted with gray, green and orange lichens, a combination of algae and fungus which slowly break the rock into particles of soil. More texture and color take shape as the forest floor rises to meet you. There are purple turtlehead blossoms welcoming fat bumblebees, the sunny yellow flowers of St. John's Wort smelling like butterscotch, and patches of delicate bluets blooming in abundance. Take a few moments to enjoy the colors and smells around you.*

Finally, the warm breeze lays you gently down upon the forest floor. You look back up in amazement at where you've been. Everything looks so monstrous in size, towering above you. How does this make you feel? Are you alone? Or afraid? Well, you're not alone for long. Other seeds, pine needles, twigs and debris fall around you, making you feel welcome and comfortable. You're also beginning to feel a bit sleepy after your long journey, so you settle into your new home and fall into a long, deep sleep. Take a moment to dream about the tall, healthy fir tree you'll become. **

When you wake up, you feel very different. You've actually slept for a very long time — months, in fact. Once again you're in a warm, cozy, dark place. While you were sleeping, layers of colorful leaves and other debris covered you during the autumn months.



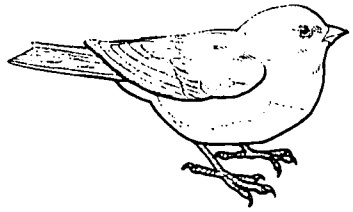
Blankets of snow fell during the winter, adding moisture and insulation to the leaf layer. If you listen carefully, you can hear the snow melting and dripping all around you.*

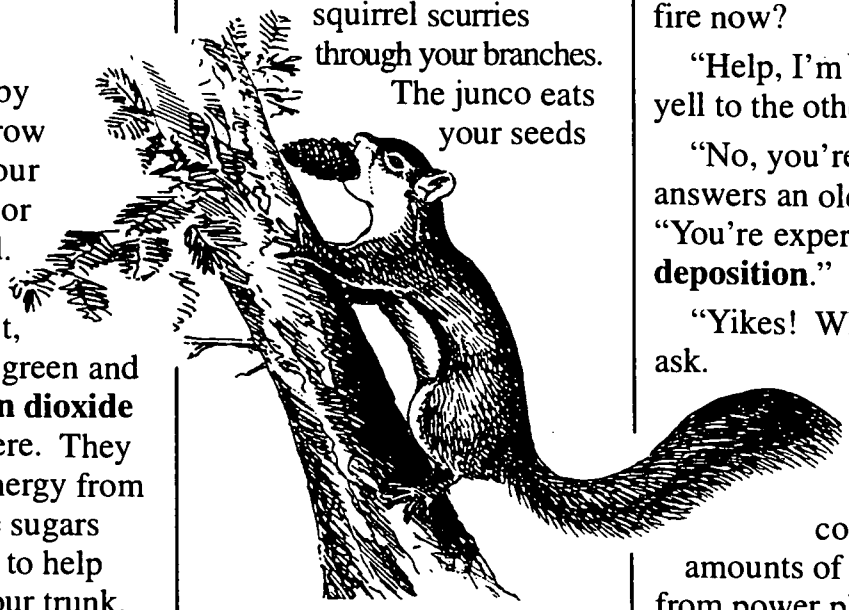
You begin to feel warmer as the springtime sun melts away the snow above you and reaches down through the leaves to touch your face. Suddenly, you feel yourself changing! First your tiny roots reach down and out, finding water and nutrients in the soil. Then you burst out of your seed covering, sprouting up ... up ... up through the leaf layer and toward the sun. You're so

hungry and thirsty from sleeping all winter. Take some time to enjoy these new experiences.*

The years pass by as you begin to grow tall and strong. Your heavy roots anchor you to the ground. Your branches reach up and out, their needles dark green and flat, absorb **carbon dioxide** from the atmosphere. They combine it with energy from the sun to produce sugars and starches, food to help you grow. Feel your trunk, your branches, your needles, working and growing to make you healthy and strong.*

You are a lucky tree. You've lived some 40 years now and are almost 20 feet tall. You are especially lucky that you landed on the east side of the mountain when you were just a little seed. Trees on the east side of Mt. Mitchell are protected from the prevailing winds that blow out of the west. Thanks to your protected spot, you've survived ice storms, heavy winds and even a few years of drought. You really like your neighborhood. The spruce-fir forest is a great place to live! The animals and plants in your natural community depend on you. The red squirrel scurries through your branches. The junco eats your seeds and nests on the ground below. The white-tailed deer, the bobcat, the cottontail rabbit, the weasel, the chipmunk and the deer mouse all enjoy your company and protection. All of the plants, animals, rocks and soil depend on each other for food, shelter and support. Take a few moments to thank your forest friends and to listen to all the life around you.*





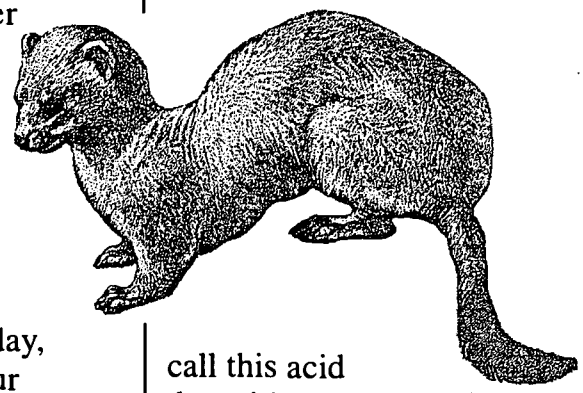
Early one spring day, you are enjoying your morning bath of cold, wet fog when ... ouch! You notice that the tips of your new needles are turning yellow. OUCH! It feels like your needles are burning. You remember the stories that old trees like to tell about the terrible fires that occurred after the logging on Mt. Mitchell, 80-90 years ago. You've never seen a forest fire. Could you be on fire now?

"Help, I'm on fire!" you yell to the other trees.

"No, you're not on fire," answers an older tree nearby. "You're experiencing **acid deposition**."

"Yikes! What's that?" you ask.

"The fog and clouds this morning contain large amounts of air pollution from power plants and automobiles," says the older tree. "Chemicals like **sulfur dioxide** and **nitrogen oxide** combine with water in the air to form acids. This acid is carried down to our branches and to the soil in the form of fog, rain, sleet and snow. People call this acid deposition or **acid rain**."

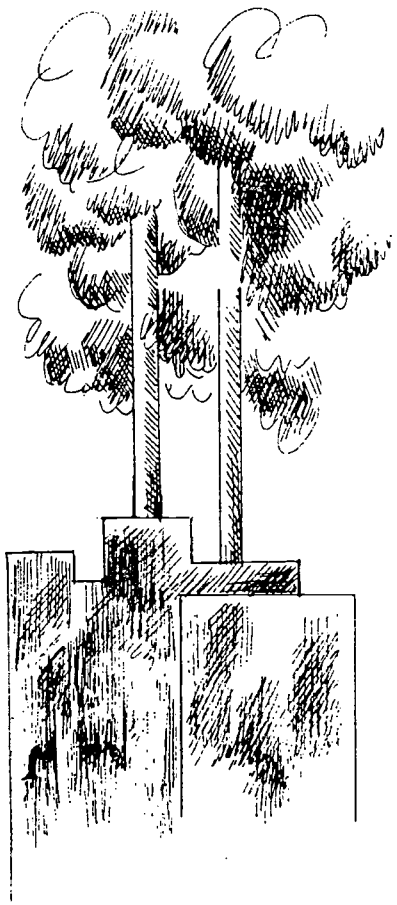


"Will it kill us?" you cry in alarm.

"Nobody seems to know that for sure," answers the older tree sadly. "But some scientists think that acid rain isn't good for trees — it stresses our needles and root systems."

"Oh, I hate stress!" you say. You are very glad when the acid cloud goes away later in the day. Whew! You hope you don't get another acid bath like that one anytime soon.*

A little later, you feel something stab you — OUCH! Several tiny, white-woolly bugs are sticking their mouthparts into your trunk. Oh no... it's the **balsam woolly adelgids**. You have heard all about these nasty critters. These tiny insects feed on fir trees, injecting a substance into your bark that changes the way your cells grow. Now less food and water will be able to reach your roots and branches. If enough of these bugs attack you, they could kill you in just a few years. Where's the fly swatter? You'd like these bugs to "bug off"!*

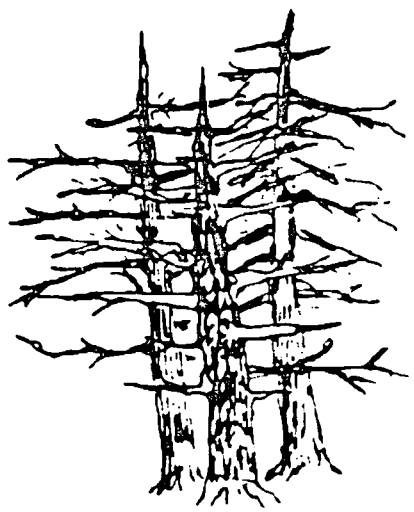


By now you are beginning to realize that it isn't easy being a Fraser fir tree on Mt. Mitchell. Even fir trees have bad days! Take a few moments to think about your life as a tree and what might happen to you in the weeks and months ahead.*

Before you open your eyes, I'd like you to clear your mind and take one last deep breath, holding it for a few seconds. Hold it ... hold it ...: now exhale bringing your hand up to cover your eyes as you slowly open them. Take some time to let yourself adjust, then sit up, or stand up, and stretch. We are going to make a circle and share some of our experiences as Fraser fir trees.

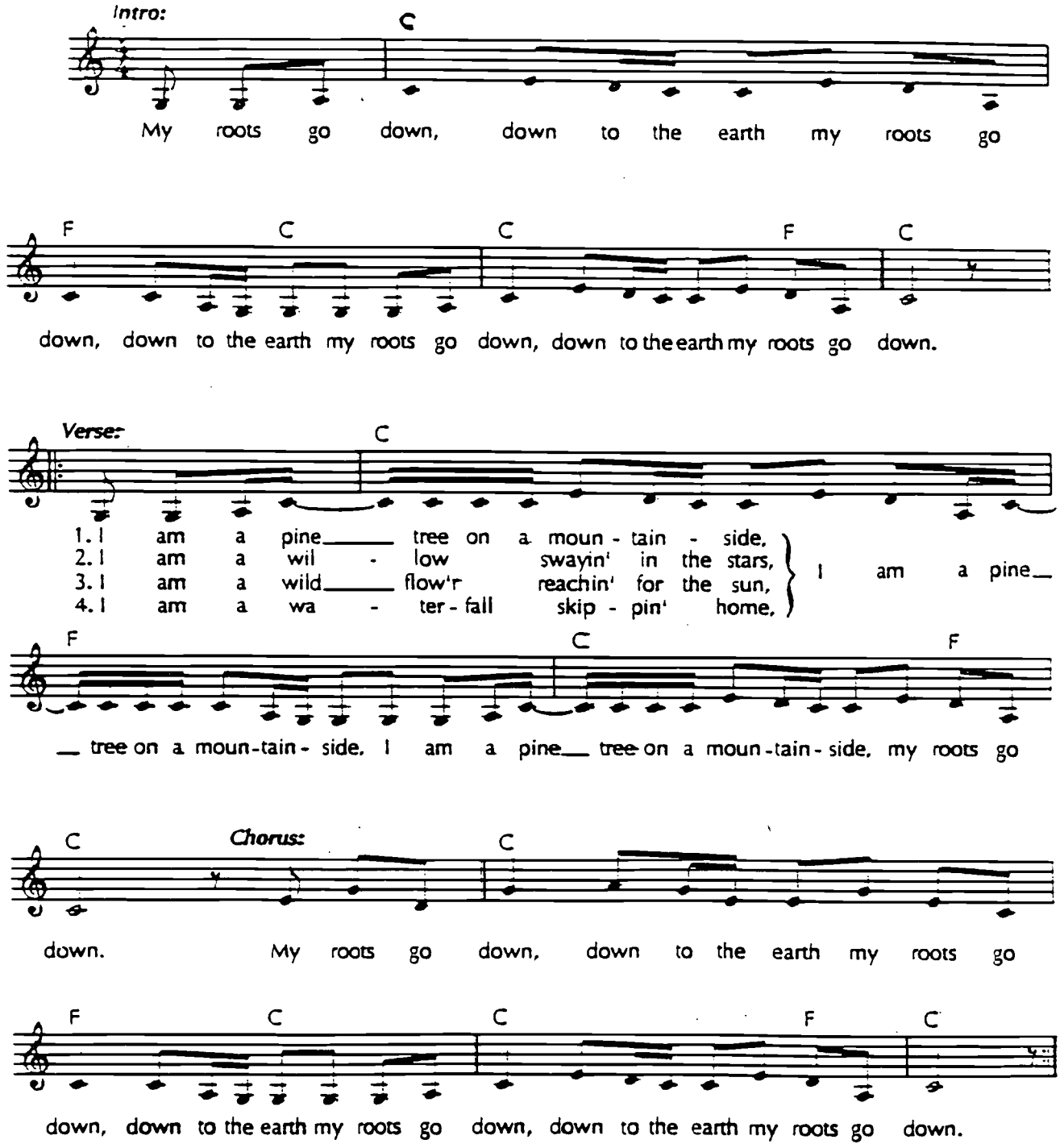
POSTSCRIPT TO TEACHERS:

The acid cloud incident described in this story is based on an actual event on Mt. Mitchell witnessed by Dr. Robert Bruck and other research scientists from N.C. State University in June 1987. The coincidence of new buds opening at the same time that a very acid cloud envelops the mountain will, hopefully, remain a rare event. However, there may be other, less obvious ways that acid rain affects trees over time. (See Pre-visit Activity #3 in this EELE.) The balsam woolly adelgids described in the guided imagery are still attacking and killing fir trees on Mt. Mitchell today. There are no environmentally-safe pesticides or other methods to combat these bugs. They were first discovered on Mt. Mitchell in the late 1950s and, a few years later, these exotic pests (originating from Europe) had killed over 275,000 Fraser fir trees in the Mt. Mitchell region.

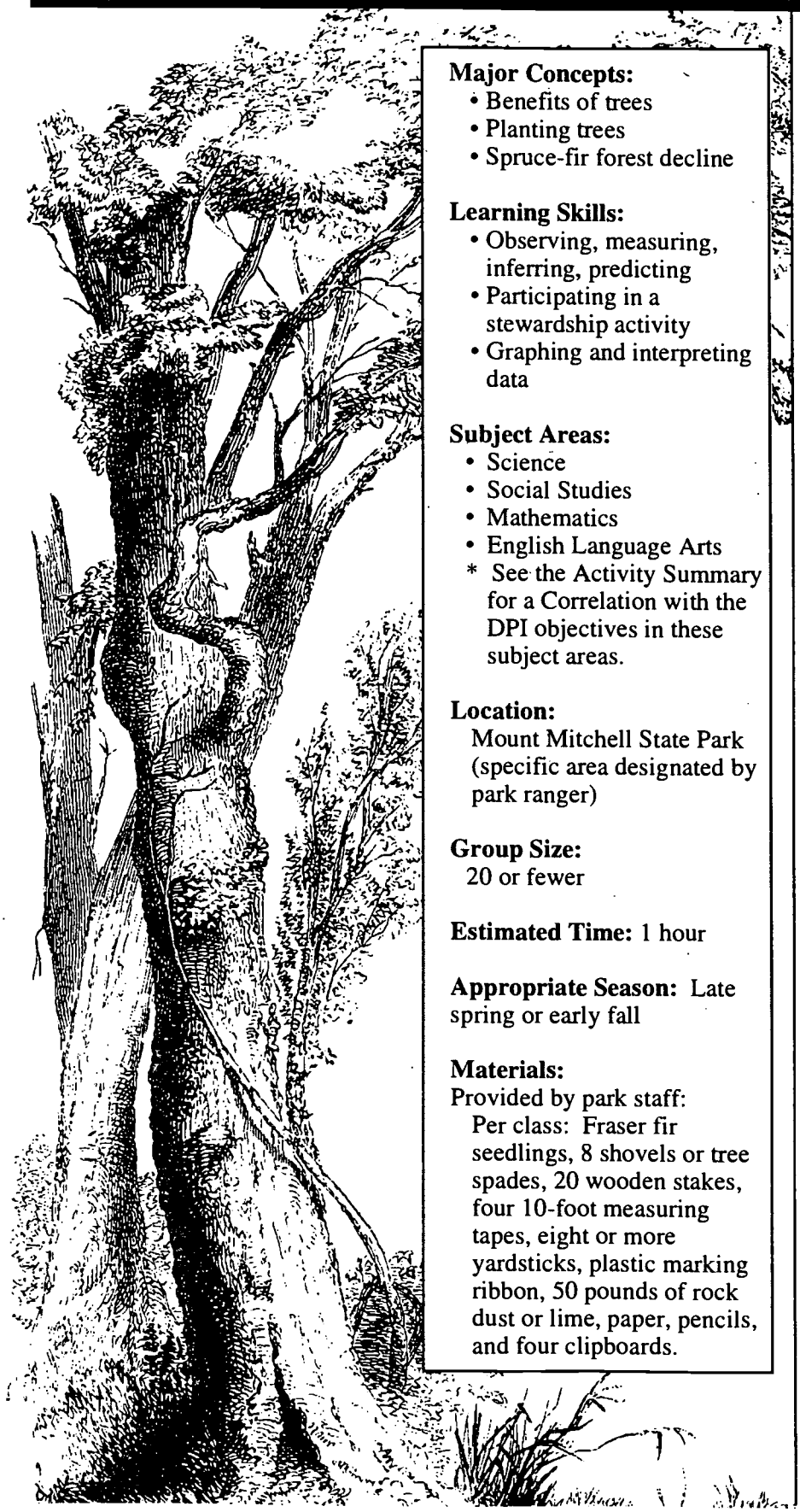


"My Roots Go Down"

Words and Music by Sarah Pirtle



On-Site Activity #3 Planting for Tomorrow



Major Concepts:
- Benefits of trees
- Planting trees
- Spruce-fir forest decline

Learning Skills:
- Observing, measuring, inferring, predicting
- Participating in a stewardship activity
- Graphing and interpreting data

Subject Areas:
- Science
- Social Studies
- Mathematics
- English Language Arts

* See the Activity Summary for a Correlation with the DPI objectives in these subject areas.

Location:
Mount Mitchell State Park (specific area designated by park ranger)

Group Size:
20 or fewer

Estimated Time: 1 hour

Appropriate Season: Late spring or early fall

Materials:
Provided by park staff:
Per class: Fraser fir seedlings, 8 shovels or tree spades, 20 wooden stakes, four 10-foot measuring tapes, eight or more yardsticks, plastic marking ribbon, 50 pounds of rock dust or lime, paper, pencils, and four clipboards.

Special Considerations:
Students will be using tools and following procedures that may require supervision or help. Extra adult supervision, other than the teacher and ranger, may be appropriate depending on group size and age of the students. Students should use safe procedures with all tools.

Objectives:

- Observe and describe the condition of Fraser firs on Mt. Mitchell.
- List two limiting factors that stress Fraser firs on Mt. Mitchell.
- List at least three ways that trees benefit people.
- Successfully plant Fraser fir seedlings on Mt. Mitchell, or observe and measure trees that were planted by other groups.

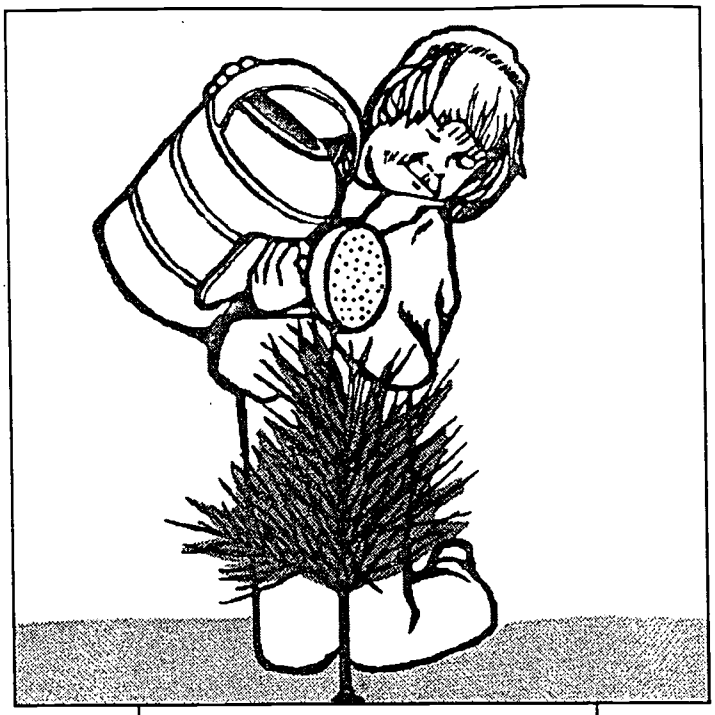
Educator's Information:

By planting trees at Mt. Mitchell State Park, students participate in a stewardship activity and express their appreciation of trees. This activity fits well with Science Objective 4.2 for all grade levels. Pre-visit activity #2 is recommended as a prerequisite to this activity.

Instructions:

1. Review the Student's Information with the class. This can be done verbally at the park or the material can be read by the students prior to their visit to Mt. Mitchell.

2. At the park, the ranger will discuss and demonstrate the safe use of shovels and lime, and the procedure for planting seedlings.



- The seedlings should be planted at least 20 inches apart.
- During planting, try not to handle the roots.
- Dig the holes a little deeper than the length of the roots of each seedling.
- Rock dust or lime should be added to the soil under and around the seedlings.
- The dirt should be packed firmly around the roots, but not too tightly.
- Soak the soil around the seedling to encourage deep rooting.

3. Divide the students into four groups. Have the groups lay out four 10'x10' plots using tape measures and wooden stakes to mark corners. Then, they should plant as many seedlings as possible in their plots, according to the ranger's instructions.

4. Have each group use a yardstick or tape measure to find the height of each seedling in their plot. Using the paper and clipboards provided by the ranger, the students should record the data for each seedling on a diagram of their plot. The ranger will give the teacher a copy of this data for future use.

5. Find the average height of seedlings in each plot. Did each plot have the same number of seedlings? If possible, visit the plot once a year. Record the height of remaining trees in each plot. Make observations on the conditions of trees in each plot. Calculate the mortality rate over the past year. Make graphs of tree height versus year for each plot, or number of surviving trees versus year for each plot. Compare the plots. If possible, make a videotape or photographic record of your plots each year.

Assessment:

Have students discuss or write their answers to the following questions. The educator might do this as a field activity on the school grounds.

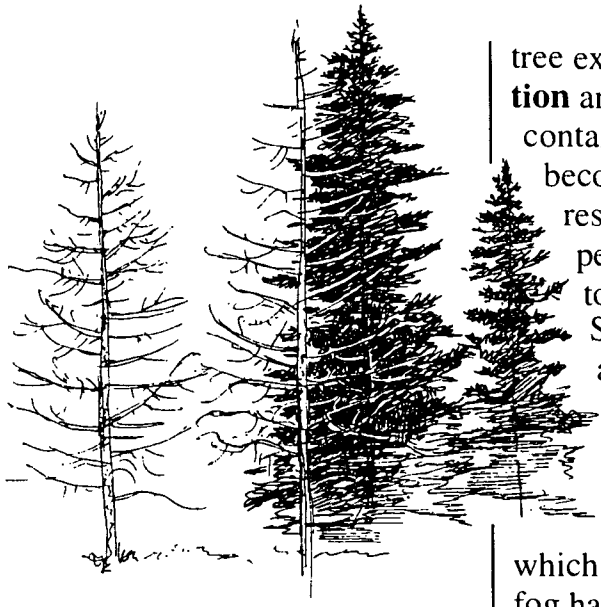
- Describe the condition of Fraser fir trees on Mt. Mitchell. Compare the Fraser fir trees with the trees around the school. Are the school trees healthier than the Fraser firs? What observations support your conclusion?
- List two **limiting factors** affecting Fraser firs on Mt. Mitchell. Do you think these same factors may be stressing trees growing near our school? Why or why not? What limiting factors may be stressing our school trees? (Use actual observations if possible.)
- Explain how trees help people. Give at least three benefits of trees. What benefits do we receive from the trees near our school or in our neighborhood?

Extensions:

1. Have future classes publish the growth of plots in a newsletter for the class or school.

2. Adapt this activity to an area around your school and plant trees there. The Morganton Forestry Center at 1-888-NCTREES sells native tree seedling packages.

Student's Information:

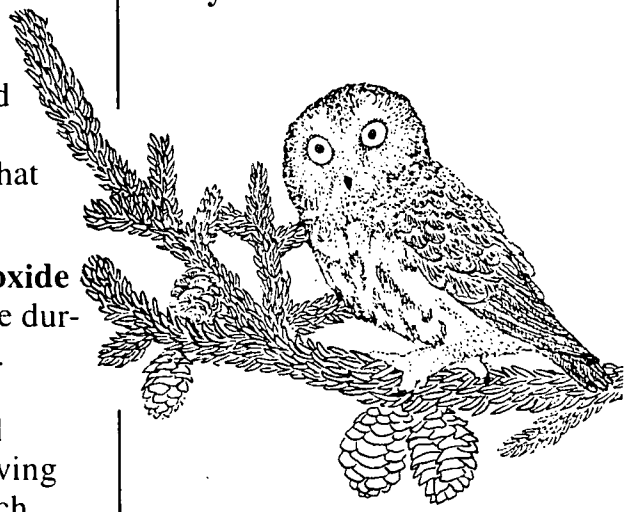


What is happening to the trees? Take a look around you. Many of the older Fraser fir trees are dying. There are many **limiting factors** that impact the health of the trees. Natural factors include ice storms, high winds, insect damage and drought. Some scientists think that natural factors alone can not explain the increased death rate of Fraser firs and red spruce on Mt. Mitchell. (The death rate has increased by 30 percent over the past 10 years.) Some scientists theorize that air pollution is a major contributor to tree mortality because, on eight out of ten days, Mt. Mitchell is covered in clouds and fog, sometimes as **acidic** as vinegar. In addition, the soil on Mt. Mitchell has a greater amount of heavy metals, such as **lead** and **aluminum**, than soil in urban environments. A healthy tree exposed to **acid deposition** and growing in contaminated soil may become weak and less resistant to disease and pests. As we plant trees today at Mt. Mitchell State Park, we will be adding rock dust or lime to the soil to make the soil more basic. We hope we can bring the soil, which the rain, snow and fog has made more acidic, back to a normal level for the fir trees. We hope that young healthy trees may have a better chance of survival, and that the trees you plant today will replace some of the trees being killed by the **balsam woolly adelgid**.

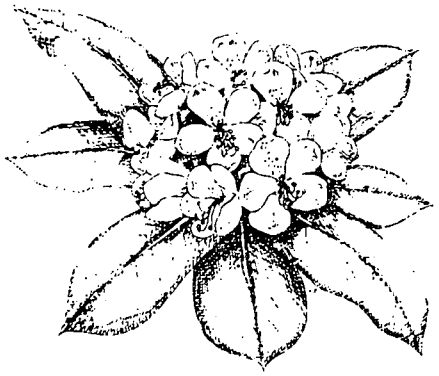
Why do we want to plant new trees? In addition to giving us an amazing array of paper and wood products, trees provide many other benefits. They:

- Help settle, trap, and hold small particles (dust, ash, smoke) that can damage lungs.
- Remove **carbon dioxide** from the atmosphere during **photosynthesis**.
- Help prevent **global warming** (by removing carbon dioxide which traps heat).
- Absorb sulfur dioxide and other pollutants.
- Replenish the atmosphere with oxygen.
- Hold soil with roots, preventing **erosion**.
- Provide homes and food for birds and other animals.
- Serve as a **windbreak**, keeping buildings warmer.
- Provide shade, keeping buildings cooler.
- Lower energy bills (by providing shade and serving as a windbreak).
- Muffle traffic noise.
- Provide beauty and enjoyment.
- Humidify or add moisture to the air.

Have you thanked a tree today?



Post-Visit Activity #1 — Forest Game



Curriculum Objectives:

Grade 4
- Arts Education: develop creative drama skills
- Communication Skills: listening, comprehension
- Guidance: competency for interacting with others
- Science: living things—animals, adaptation to environment, weather and climate
- Social Studies: participate effectively in groups

Grade 5
- Arts Education: participate in creative dramas
- Communication Skills: listening, comprehension
- Guidance: competency for interacting with others
- Science: living things—plants, earth science, environment
- Social Studies: participate effectively in groups

Grade 6
- Arts Education: participating effectively in creative drama activities, develop positive attitudes
- Communication Skills: listening, comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: environmental health, how people affect the environment
- Science: ecology

Location:
A field, or somewhere outside with plenty of space

Group Size: Any

Estimated Time: 40 minutes

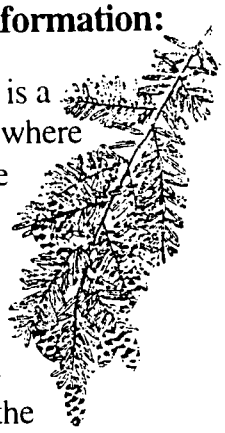
Appropriate Season: Any

Materials:
Provided by the Educator:
Per student: one copy of the Student's Information sheet
Per group: One pound of dried beans and two 1-gallon plastic buckets

Major Concepts:
- Environmental factors affecting forest growth

Objectives:
- List five elements that can adversely affect natural communities.
- List three ways to help protect the spruce-fir forest.

Educator's Information:



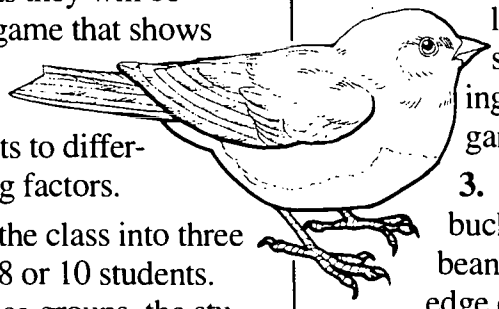
This activity is a simulation where the students role play various members of a **natural community** which are working together to keep the forest alive. The main objective of this forest simulation is reproduction and survival. The manner in which the alpine forest in this activity reproduces, and therefore survives, is by moving its seeds from the bucket containing beans to the empty bucket. A healthy forest will regenerate (create young trees) very quickly.

There will be no talking during the game. Natural community members must communicate with each other in ways other than using words. If the members of the natural community need to communicate, they should do so by quietly simulating their given parts, i.e. birds may chirp, trees can be blown by the wind, etc.

It is also important for the students to listen carefully. Forest creatures need to know what is going on around them. The educator will be telling a Forest Story, and students will be acting it out, but they won't be able to hear their part if they are not listening.

Instructions:

1. Discuss the Student's Information with the class. Introduce the new vocabulary words, **limiting factor** and **balsam woolly adelgid**. Tell the students they will be playing a game that shows how the spruce-fir forest reacts to different limiting factors.



2. Divide the class into three groups of 8 or 10 students. Within these groups, the students will count off by "3"s, as the students will be role playing three different natural community members. The "ones" will be Fraser firs, the "twos" will be red spruce trees, and the "threes" will be slate-colored juncos.

Explain the characteristics of each species and have the students role play their parts using the following descriptions, or roles they make up:

a. Red spruce trees are tall **evergreen** trees with short, sharp pointed needles and cones that hang down from the branches. All students playing red spruce trees should stand up as tall as they can, hanging their hands down to represent cones.

b. Fraser fir trees are tall evergreen trees with short needles, but they have cones that stand up on their branches. All students playing Fraser fir trees should stand tall with their hands pointed up to represent cones.

c. Slate-colored juncos are small birds that hop around on the ground and pick up small seeds to eat, thus dispersing seeds over a larger area. They make a loud chirping noise. All the students playing juncos should hop around and chirp loudly. Juncos should hop during the whole game.

3. Place the buckets containing beans in a line on one edge of the field, about three to four feet away from each other.

4. Place empty buckets directly across from the buckets containing beans, approximately 30 yards away. (Do not place the buckets too far apart because you will need to be heard clearly by everybody.)

5. Have the groups line up behind their bucket of beans.

6. When the educator says "go," each student is to take one bean from the bucket of beans for their group and start walking (or hopping) quietly over to their group's empty bucket. Everyone should put their bean into their group's empty bucket and walk or hop quietly back to get another bean. Continue this cycle until other directions are given. This is not a relay race - speed is not the object of this game. All the students can be coming and going at the same time, being careful not to knock over the buckets. (Remind the juncos to keep hopping.)

7. Let this process continue for awhile, to get everyone used to the cycle.

8. When the educator says "stop," every natural community member should stop where he or she is and listen to the instructions. Follow those instructions until new ones are given. If new instructions are not given for a particular species (fir, spruce, junco), that student will continue doing what he or she was doing before. If the student is given new instructions, he or she should act out this new role in addition to what he or she was doing before. Students should not begin role playing again until the educator says "go!"

Note:

This activity is especially fun when the directions are given dramatically. Also, the story presented here is only one version. We encourage you to make it more complicated, or to simplify it. See the Suggested Extensions.

Suggested Extensions:

1. To demonstrate that different natural communities have to contend with different factors (in terms of elevation, etc.), have the buckets at different distances for different groups.

2. Repeat the game using any of the following additional elements or any that you or your students create:

- Logging
- Destructive caterpillars
- Good soil due to decay
- People planting seedlings
- Flood
- Second home development

Forest Story:

Note: Leave appropriate pauses after each step in the story.

1. You are all parts of a healthy **spruce-fir forest**. You get rain and sunshine in just the right amounts. Go!

2. Then one year, there is a drought. Stop!

All the trees and birds in the forests have less water to drink, and this slows down their ability to reproduce. Everyone must go in slow motion. Go!

3. Because everything is so dry that summer, there is a fire. Stop!

The fire kills all of the trees. Trees - (this is where things get dramatic) act like you are dying. Now lay on the ground, dead. Birds - you escape to nearby forests and you are okay. Go!

4. Trees - You decompose until the next spring, enriching the soil as you do so. Stop!

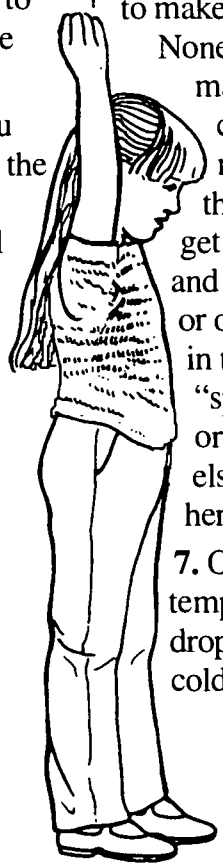
With the coming of spring rainfall, tree seedlings start to grow. Dead trees - you are now young trees of the same species that you were before. Go!

5. The next winter, there is a very heavy ice and snow storm. Stop!

The snow is so heavy that the fir trees can not hold the weight of the snow. Many of their branches break off. This means that they have fewer needles to make food in the spring. Fir trees must hop on one foot. Go!

6. That same winter, another storm comes, and winds hit the mountains at speeds up to 100 miles an hour. Stop!

All the spruce trees lose a lot of their branches, which means they have fewer needles to make food in the spring.



None of the spruce trees may use their hands to carry beans. They must have help from the juncos or fir trees to get a bean out of the can and put it in their pockets, or on top of their heads, or in their socks, etc. If a "spruce tree" loses his or her bean, someone else must help him or her get it back. Go!

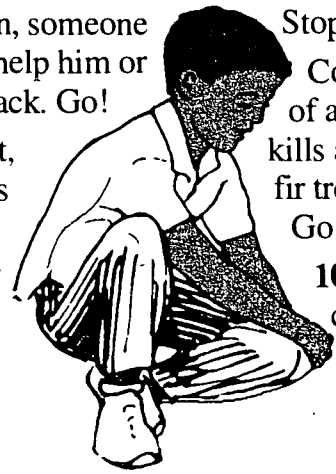
7. One night, temperatures drop to the coldest temperatures ever experienced in North Carolina. The temperature reaches -34 degrees **Fahrenheit**, which is really cold! Stop!

This affects all the plants and animals in the forest. In addition to what the trees were doing before, the juncos must now walk or hop while bobbing their heads up and down. Go!

8. Now it is spring! The trees are still trying to recover from the winter storms. A city, which is 60 miles away, is polluting by putting sulfur and nitrogen into the air. Stop!

The extra sulfur and nitrogen in the air is contributing to acid rain. The acid rain makes it even harder for the injured trees to make food. In addition to what they were doing before, each tree must now twirl in circles. Juncos have recovered from the winter cold and can now hop normally. Go!

9. Some **balsam woolly adelgids** come to the forest and start eating the fir trees. This insect injects a substance into the bark of the trees, which makes it hard for the fir trees to transport food and water. Stop!



Combined with the effect of acid rain, this eventually kills all the fir trees. All the fir trees - Lie down dead. Go!

10. The humans have discovered ways to reduce air pollution and to control the balsam woolly adelgids. Stop!

Scrubbers were put in the smokestacks of coal-burning electric power plants. Trees will no longer have to twirl around because acid rain has been reduced. Spruce trees have also recovered from the wind damage and can use their "hands" again to pick up beans. The fir trees begin to regenerate after the last attack of the adelgid and acid rain. Fir trees may reproduce again, but they must walk in slow motion. Go!

11. We will stop our simulation at this point, with our natural community recovering from the effects of several limiting factors. Stop!

Note: Students may want to count the number of beans their natural community was able to transport during the game.

12. After completing the game, collect all the beans and buckets.

Find a tree on the school's campus and have the class sit in its shade. Discuss the limiting factors that affect this tree's growth. Examine the tree for signs of stress. Think back to the class visit to Mount Mitchell. What are the differences and similarities regarding the limiting factors which affect this tree and those of the **spruce-fir forest** on Mount Mitchell?

How was this simulation game like a real natural community? (Answer: Different natural communities respond differently to environmental stresses depending on their health, their elevation, which side of a mountain they are growing on, etc. There are many limiting factors that affect a natural community. The interactions between the various members of a natural community change due to their response to these factors.)

How was this simulation game <u>not</u> like a real natural community? (Answer: Trees really can't move. Storms and winds affect all the trees instead of only one kind of tree, etc.)

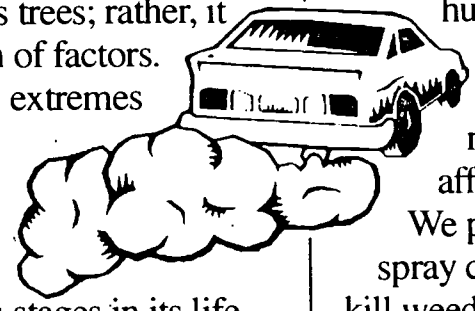
What did it feel like when you were not able to get the bean in the can as easily as you could at the beginning of the game? What limiting factor, or combination of limiting factors, made it the most difficult for you to survive and reproduce?

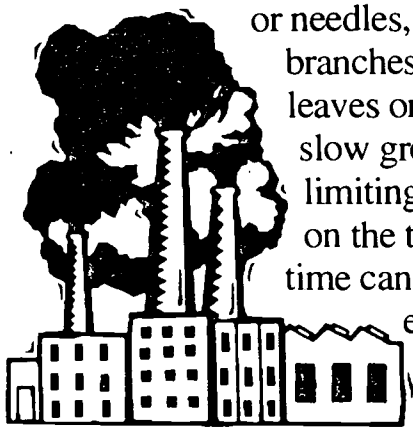
Is there anything we can do to help protect the sruce-fir forest like the one we simulated? (Answer: There are many things we can do. For example, learn more about the forest and how it functions so that we can appreciate it and use it more wisely; use less paper and recycle paper so fewer forest communities are cut down; work in your local community to reduce the amount of pollution by doing such things as riding a bicycle, walking instead of driving, and using less electricity so the power plants do not need to produce as much; write letters to the city council and to state and federal legislators expressing your concern about protecting natural communities such as the spruce-fir forest on Mt. Mitchell.)

Student's Information

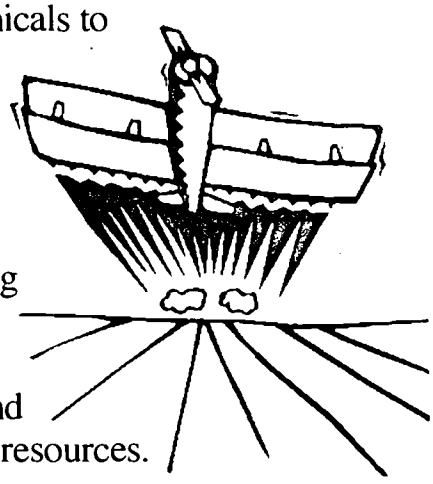
Dead trees on Mount Mitchell

Various factors can contribute to forest decline. Very seldom is there one **limiting factor** that stunts or kills trees; rather, it is usually a combination of factors. Limiting factors such as extremes of climate, air pollution, diseases, and insects (such as the **balsam woolly adelgid**) will weaken a tree at various stages in its life. Some signs of stress are yellowed leaves or needles, wilted or dead branches, deformed leaves or needles, and slow growth. Several limiting factors acting on the tree at the same time can kill the tree or even an entire forest.





Many plants and animals affect **natural communities**, but none more so than humans. We clear-cut forests and often plant only one tree species in their place. We build dams, roads, and developments which affect the natural world around us. We pollute the air and water, and spray chemicals to kill weeds and insects. As our population continues to grow, we are placing even greater demands on our forests and other natural resources.



Post-Visit Activity #2 Forest Stewardship

Major Concepts:
- Conservation of natural resources
- Stewardship
- Responsible environmental action

Learning Skills:
- Writing a stewardship plan
- Carefully considering consequencees of actions

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

Location: Classroom

Group Size: Class

Estimated Time: 1 - 1 1/2 hours

Appropriate Season: Any

Materials:
Provided by educator:
Per student: One copy of Student's Information and Forest Stewardship Plan
Per class: (Optional activity) empty cereal or other food boxes made from paper, old nature magazines, recycled drawing paper, scissors, paste or glue sticks, crayons, markers, pens or pencils, names and addresses of politicians, postcard stamps

Credits: The story, "The Tailor" by Nancy Schemmel, and paper facts, are from *Spinning Tales Weaving Hope*, edited by Ed Brody, Jay Goldspinner, Katie Green, Rona Lenthal, and Jack Porcino. Stories for World Change Network, New Society Publishing, Philadelphia, PA, 1992 (pp. 211, 214).

Objectives:
- List at least two stewardship actions that individuals could take to improve the health of trees and forests.
- Explain the positive consequences of each action listed above.
- Define at least two of the four types of responsible environmental actions: ecomanagement, persuasion, consumerism, and political action.
- Choose one type of responsible environmental action and write a forest stewardship plan, outlining the steps in taking action.

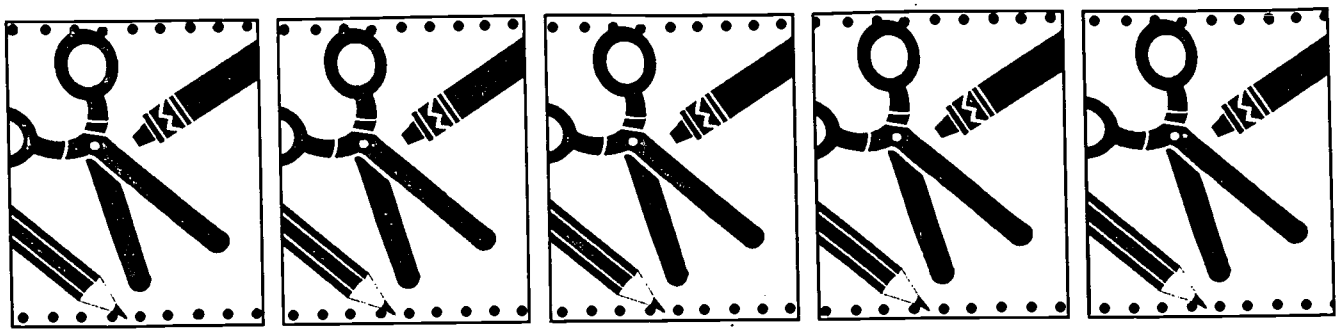
Instructions:
1. Photocopy the Student's Information and Forest Stewardship Plan for each student. Ask them to read the Student's Information and then work on their plans. (Students could work individually or in small groups to write their plans.)

2. Discuss their plans and, if desired, provide materials and class time for students to take responsible action. Another possibility is to allow students to vote on the best action plan and the entire class could work on the plan together.

Assessment:
Several weeks after students have written their stewardship plans, ask them to report on actions they have taken. They should also evaluate the success of their actions when they have concluded their activities.

Modifications:
1. Write the following paper facts on the blackboard:
- Paper makes up a least 50 percent of the United States' municipal waste.
- Publishing a typical big-city Sunday newspaper uses 10,000 trees.
- Making recycled paper takes 61 percent less water and produces 70 percent less pollution than making new paper.

Ask students to create bumper stickers or posters based on these facts. Or, ask students to do research in the media center or on the World Wide Web to find more statistics about trees and forest products.



2. Read or tell the story; "The Tailor" by Nancy Schimmel (see page 5.2.7). After reading the story, look up the word "recycle" in the dictionary and copy it onto the chalkboard. Discuss what recycling is and why it is important. Point the discussion toward trees and the many ways we depend on them. (See Student's Information in On-site Activity #3.)

3. Guide students in making recycled postcards from cereal boxes and magazines by cutting off the ends and sides of boxes with scissors. Cut pictures of trees from magazines, or draw pictures on recycled drawing paper, and paste onto the colored side of the postcard. Let dry. Ask students to write a few short sentences about recycling or other issues that involve trees and forests. They should include their name and a return address. Have students address postcards to a political official — local, state or national. Teacher or students can be responsible for stamping and mailing postcards.

Elected Officials' Addresses:

The President

The White House
1600 Pennsylvania Ave., NW
Washington, DC 20500

The Honorable ...
United States Senate
Washington, DC 20515

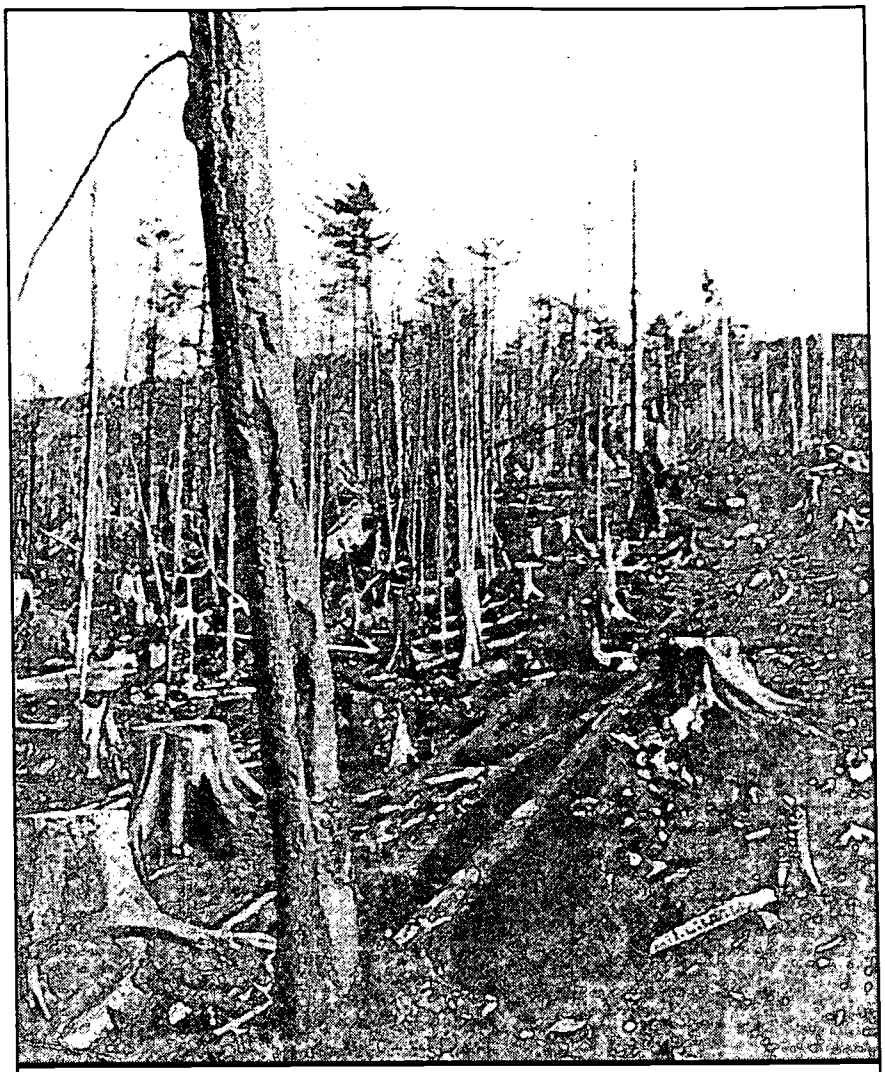
The Honorable ...
United States House of Representatives
Washington, DC 20515

*If addressing any particular bill, identify its name and number.

Student's Information

In the early 1900s, logging operations nearly destroyed the magnificent **spruce-fir forest** of Mt. Mitchell. Alarmed citizens worked with Governor Locke Craig, to convince the state legislature to pass a bill protecting Mt. Mitchell by making it the first state park in North Carolina. The Division of Parks and Recreation is now responsible for protecting Mt. Mitchell and all its **natural communities**. The division manages the park for the safe enjoyment of all North Carolina citizens. The division, along with all the park visitors, must exercise good stewardship so that future generations will be able to see and enjoy the natural resources and scenic beauty of Mt. Mitchell, the highest peak east of the Mississippi.

What do you think might have happened if concerned citizens, back in 1915, had not taken action? One possibility is that you might not have had the opportunity to visit Mt. Mitchell, or if you were able to visit, it might look very different than it does today. Actions each of us take every day can make a difference in the natural environment and can affect our families, friends, and future generations. Each of us can choose to act wisely to protect and conserve our natural resources, or to act thoughtlessly, with little or no concern for others and other forms of life. Sometimes it is difficult to decide which actions are the best ones to take. We may need to do some research before we choose the best course of action.



The Result of Logging Operations in the Black Mountains in the early 1900s. Photograph from Raymond Pulliam, "Destroying Mt. Mitchell," *American Forestry*, XXI (February, 1915), p. 89.

During your visit to Mt. Mitchell State Park, you learned some facts about the park and made some firsthand observations. You may be wondering how you can help the trees and forests on Mt. Mitchell, or in other areas of our state. Generally there are four kinds of stewardship actions you can take: ecomanagement, persuasion, political action, and consumerism.

Ecomanagement — This action is a direct, physical action to manage the

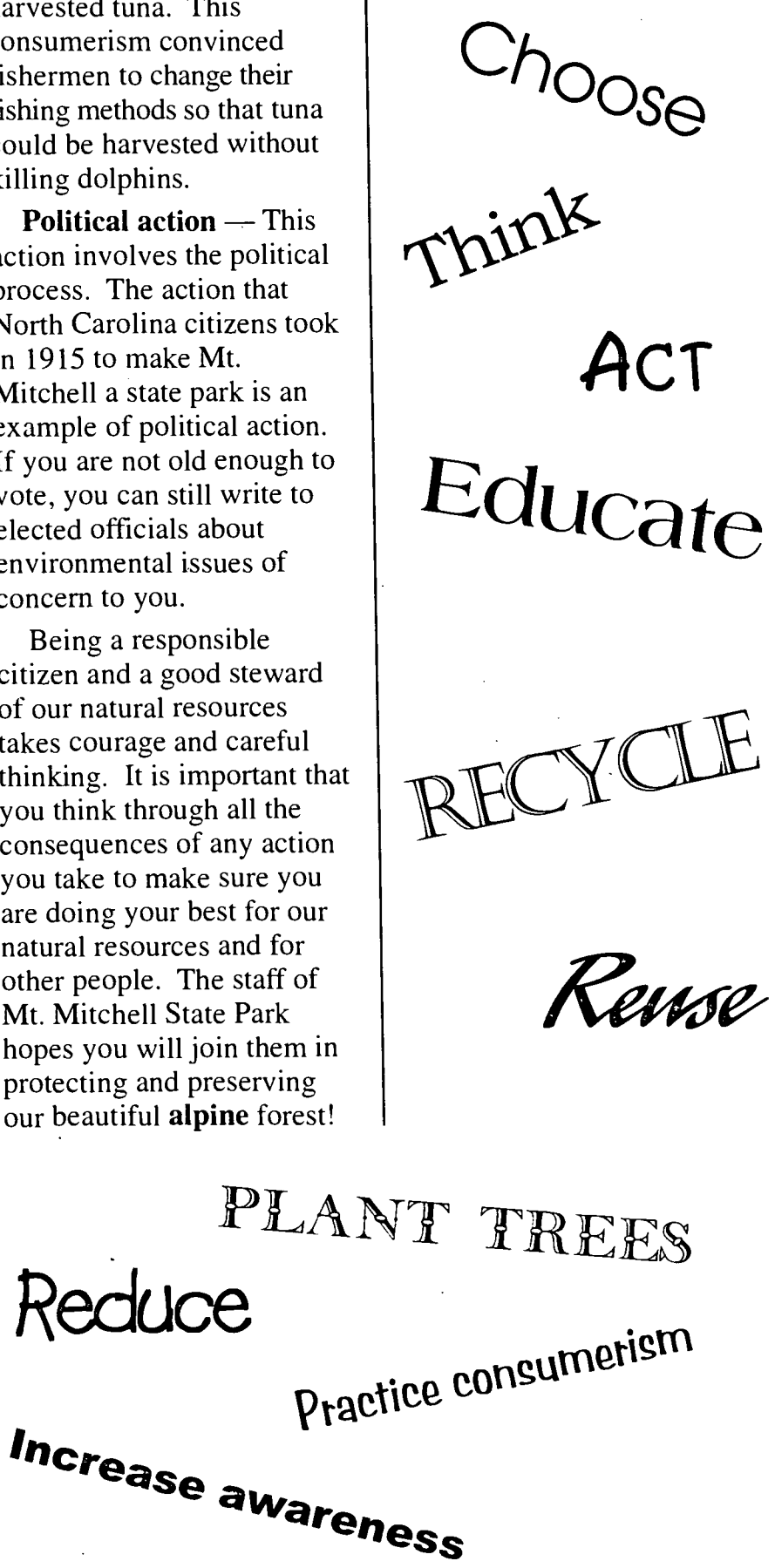
environment. For example, you or your class may plant new trees or recycle paper. Both these actions help trees. By planting new trees, you are replacing trees that have died or have been harvested. By recycling paper, you are reducing the number of new trees that need to be cut to make new paper.

Persuasion — This action involves educating other people about an environmental problem and motivating them to take action to solve the problem. For example, you would be using persuasion if you created a poster, a song, or a play that tells other people about the possible effects of acid rain on trees and what they could do to reduce air pollution.

Consumerism — This type of action involves what you choose, or refuse to buy. For example, you could choose to buy only recycled paper. If enough people used recycled paper, there would be a greater demand for this product. The paper companies would be encouraged to produce more recycled paper and use fewer new trees to make paper. This action is an economic action and can be very effective. Have you ever heard of dolphin-safe tuna? For many years, people refused to buy tuna fish because so many dolphins were accidently killed when fishermen harvested tuna. This consumerism convinced fishermen to change their fishing methods so that tuna could be harvested without killing dolphins.

Political action — This action involves the political process. The action that North Carolina citizens took in 1915 to make Mt. Mitchell a state park is an example of political action. If you are not old enough to vote, you can still write to elected officials about environmental issues of concern to you.

Being a responsible citizen and a good steward of our natural resources takes courage and careful thinking. It is important that you think through all the consequences of any action you take to make sure you are doing your best for our natural resources and for other people. The staff of Mt. Mitchell State Park hopes you will join them in protecting and preserving our beautiful **alpine** forest!



Forest Stewardship Plan

Name: _____

1. List six things in the classroom that are made from trees.

2. List three ways that trees benefit people, other than by providing useful paper and wood products.

3. Explain why it is important to protect and conserve our trees and forests.

4. How do you think you could help save trees? Develop a forest stewardship plan. First, describe the action you would like to take in one sentence:

_____

_____

_____

5. What type of environmental action is this? Circle the best answer:

Ecomanagement Persuasion Consumerism Political action

6. What are the steps you will take before, during and after you perform your stewardship action?

List the steps you will take, one at a time. Continue on another sheet of paper, if needed.

7. What will be the positive consequences, or good effects, of your stewardship action? List them below:

8. Will there be any negative consequences, or harmful effects? If yes, list them below:

9. How could you avoid these negative consequences?

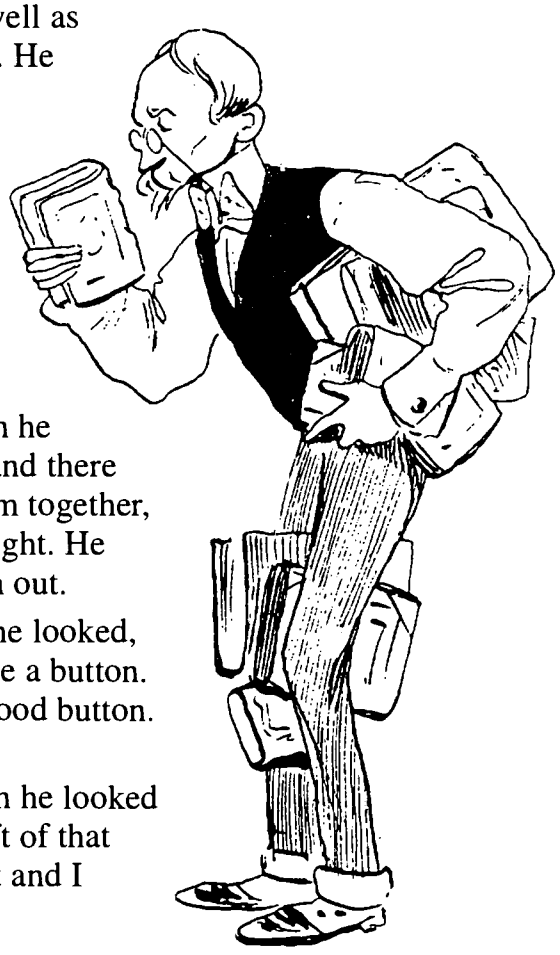
10. What materials and information will you need in order to take your stewardship action?

"The Tailor"

by Nancy Schimmel

IN A VILLAGE once lived a poor tailor. He had made overcoats for many people, but he had never made one for himself, though an overcoat was the one thing he wanted. He never had enough money to buy material and set it aside for himself, without making something to sell. But he saved and saved, bit by bit, and at last he had saved enough. He bought the cloth and cut it carefully, so as not to waste any. He sewed up the coat, and it fit him perfectly. He was proud of that coat. He wore it whenever it was the least bit cold. He wore it until it was all worn out.

At least he thought it was all worn out, but then he looked closely and he could see that there was just enough good material left to make a jacket. So he cut up the coat and made a jacket. It fit just as well as the coat had, and he could wear it even more often. He wore it until it was all worn out.



At least he thought it was all worn out, but he looked again, and he could see that there was still enough good material to make a vest. So he cut up the jacket and sewed up a vest. He tried it on. He looked most distinguished in that vest. He wore it every single day. He wore it until it was all worn out.

At least he thought it was all worn out, but when he looked it over carefully, he saw some places here and there that were not worn. So he cut them out, sewed them together, and made a cap. He tried it on, and it looked just right. He wore that cap outdoors and in, until it was all worn out.

At least it seemed to be all worn out, but when he looked, he could see that there was just enough left to make a button. So he cut up the cap and made a button. It was a good button. He wore it every day until it was all worn out.

At least he thought it was all worn out, but when he looked closely, he could see that there was just enough left of that button to make a story, so he made a story out of it and I just told it to you.

Post-Visit Activity #3

Recycle a Forest — Leave a Log Alone

Major Concepts:
- Decomposers and decomposition
- Forest resource management

Learning Skills:
- Listening; participating in creative interpretations
- Applying concepts and ideas
- Observing, classifying, communicating and predicting

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

Location: Classroom

Group Size: Class

Estimated Time: 50 minutes (35 minutes without "*Magic School Bus*" story)

Appropriate Season: Any

Materials:
Provided by educator:
Per student: Student's Information and worksheet
Per class: *The Magic School Bus Meets the Rot Squad,* by Joanna Cole, Scholastic Inc., 1995.

Credits: *The Magic School Bus Meets the Rot Squad,* Schoolastic's, 1995; *The Secret Life of a Forest* by Richard M. Ketchum, pp. 48-51.

Objectives:

- List three decomposers and describe their roles in returning dead trees to soil.
- Explain why park managers often choose to leave dead trees and logs alone.
- List the pros and cons of not disturbing dead trees or logs on the school grounds or in the students' neighborhoods.

Educator's Information:

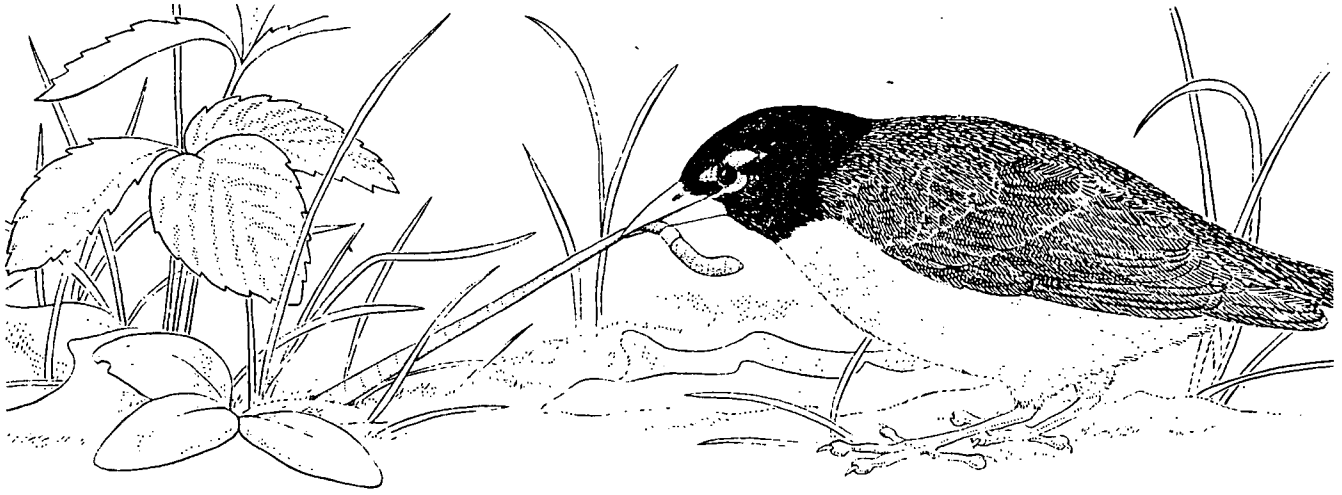
This post-visit activity makes students aware of how beneficial rotting logs are to all living things. During the activity students identify the various **decomposers** in a rotting log. They then participate in a simulation to learn the different roles each of these decomposers plays in breaking down logs and enriching the soil.

Instructions:

1. Ask for volunteers to look up the word ***decomposition*** in the dictionary and copy it onto the chalkboard. If available, read the book, *The Magic School Bus Meets the Rot Squad.*

2. After reading the story, distribute copies of the Student's Information sheet to each student.

3. Ask different students to read sections of the Student's



Information aloud. Write these key words on the board as they read: **fungi, bacteria, slime, earthworms, insects.**

4. Clear an area in the center of the classroom. Divide the students into five groups by having them number off from one to five.

5. Assign each number to a key word that was listed on the board earlier. Group 1 = fungi, Group 2 = bacteria, Group 3 = slime, Group 4 = earthworms, Group 5 = insects.

6. Explain to the students that they will role play decomposers as they break down an imaginary log in the center of the room.

Simulation Activity — The Decomposing Log

1. Ask the students which decomposer produces **rhizomorphs** which help them attach to logs (fungi). The students role-playing fungi should stand on the sides of the imaginary log, bend over slightly, and hang their arms down. They are now rhizomorphs. Have them chant, "Our job is eating logs."

2. Ask the students what fungi produce as they feed on dead logs (slime). Have the students role-playing slime lie down in the middle of the log. These students chant, "Fungi to slime takes time."

3. Ask the students what feeds on the slime, releasing carbon into the air (bacteria). The students role-playing bacteria should crouch on the floor near the slime and chant, "We care, we care, making carbon for the air."

4. Ask the students which decomposer feeds on the dead wood and digs access tunnels for water, fungi, and bacteria (insects). Tell the insects to move freely around and between the other decomposers. Tell them to chant, "Bore, bore, we want more."

5. Ask the students which decomposers burrow through the soil making channels for air and water (earthworms). The earthworms should get down on the floor, stretch out, and begin moving slowly in the soil around the log. They chant, "Eat it all, make it small."

6. When the rotting log is completely assembled, have all students act out and chant their parts, one group at a time, and then simultaneously.

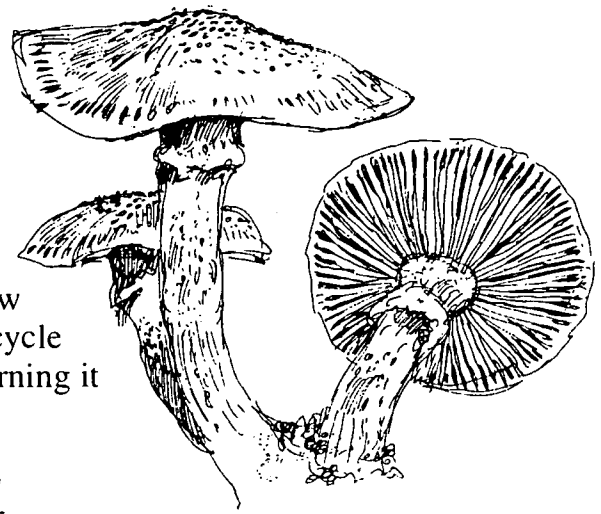
7. When the simulation is complete, ask the students to return to their seats. Review the major decomposers and how each one helps to recycle the dead tree by returning it to the soil.

Discuss: Why do park managers often choose to leave dead trees alone?

Possible answers: Dead trees are an important part of most **natural communities**. Dead trees provide **habitat** (food, shelter and moisture) for many living things. Decaying leaves and wood enrich the forest soil by releasing **nutrients** needed for plant growth. If dead plant materials were removed, the natural community would lose nutrients over time. The nutrients might have to be replaced through the use of fertilizers and new topsoil before healthy plants could grow.

8. Discuss: Is it always wise to leave dead trees alone? Should we ever remove dead trees or branches on the school grounds or in our own backyards? (Have students recall times when storms may have caused tree damage and what was done in these instances.)

Possible answers: Sometimes standing dead trees or dead limbs are



removed to prevent them from falling on people, houses or cars. Sometimes dead trees are removed to reduce the amount of fuel available for a forest fire. Sometimes dead trees or limbs are removed and burned to prevent the spread of disease to healthy trees in the area (if the trees were killed by a disease).

Assessment:

Ask the students to list (on the Leave A Log Alone Worksheet) the pros and cons of leaving dead trees alone in their backyards or on the school grounds. As a class, develop guidelines that might help people decide when to remove a dead tree and when to leave it alone.

Pros -

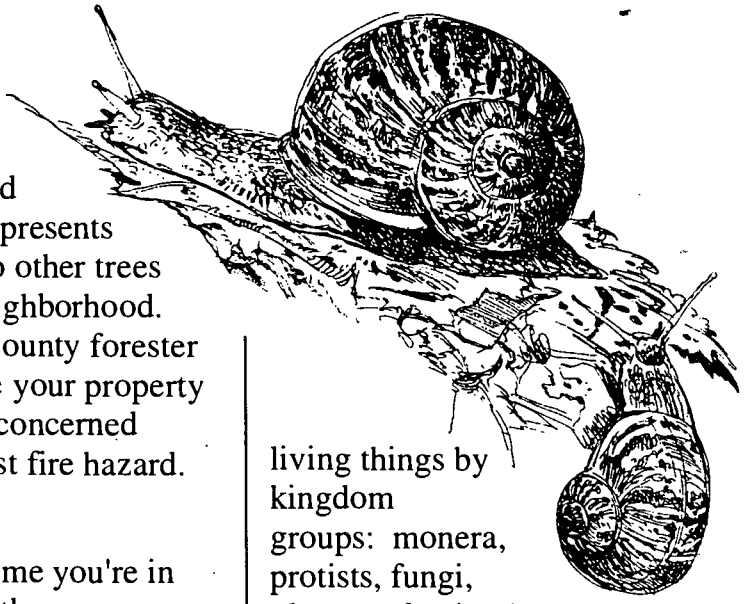
- provide habitat for many animals and plants
- enrich the soil by providing humus
- recycle nutrients such as carbon

Cons -

- could fall on people or damage property
- might create a fire hazard
- might cause disease to spread to healthy trees

Guidelines or rules -

- Try to leave dead trees alone whenever possible.
- For safety reasons, dead trees next to buildings, roads and trails should probably be removed.
- If a tree is killed by a disease, find out what may have killed it and whether it presents a danger to other trees in your neighborhood.
- Ask your county forester to evaluate your property if you are concerned about forest fire hazard.



Extensions:

1. The next time you're in the woods with your students and you see a rotting log, do some exploring. Have the students stand next to the log and close their eyes. Ask them to tap the rotting wood and listen. Is the sound sharp or dull? Have them run their hands over the surface of the log. What does it feel like? Is it cool or warm, wet or dry, rough or smooth? Ask them to cup some of the decaying wood in their hands, if possible, and smell. What does the odor remind them of?

Next, ask them to explore the log with their eyes open. Tell them to look at what's on top, underneath and inside the log by prying off small pieces at a time. Ask them to find several decomposers and investigate them closely. How did the living things get there? What are they doing now? What and how do they eat? Identify the living things if you can, using field guides to aid you. Classify the living things by kingdom groups: monera, protists, fungi, plants and animals.

After you have finished your exploration, please return the log and the creatures to their original locations. Ask the students what they think this log will look like ten years from now, and tell them about humus and how important it is to life.

2. Ask the students to draw a picture of a decaying log community. Color it and label the different members.

3. Develop a play for a PTO meeting or another class demonstrating the need to leave logs alone. (The main character could be a spruce or fir seedling needing the right soil.)

4. Do research on animals that depend on standing dead trees for nesting habitat.

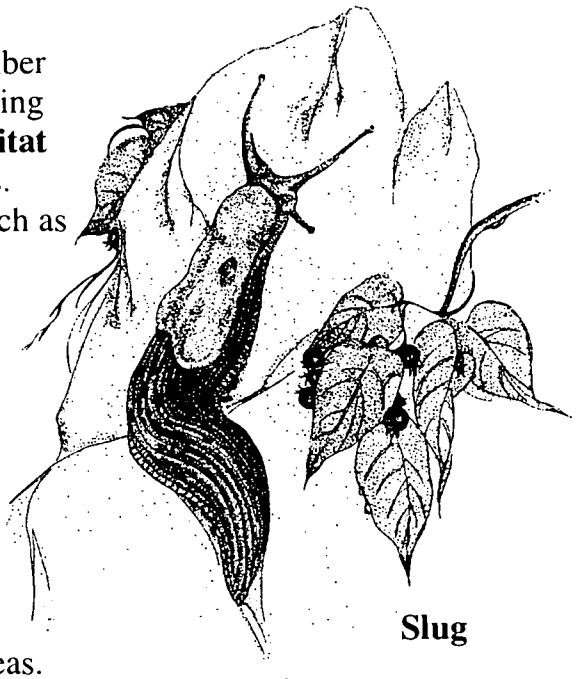
5. Ask students to write stories or draw pictures that illustrate what they predict the natural community on Mt. Mitchell might look like in 50 years, if left alone.

Student's Information

When you visited Mt. Mitchell, what was the most surprising or shocking thing you saw? If you answered, "all the dead trees," you're not alone. Many visitors comment on the large number of dead trees standing and lying on the ground. They want to know what's killing the trees and why the rangers don't remove them from the park.

Because you participated in the pre-visit and on-site activities in this EELE, you already know what scientists think may be killing the trees at Mt. Mitchell. Past logging operations and fires, air pollution, the **balsam woolly adelgid**, severe weather and the tree's slow growth rate all contribute to tree death. As a tree becomes older, it has trouble transporting water and **nutrients** to its different parts. The number of dead wood cells in the tree increases year after year until the tree finally dies.

So why doesn't the park staff remove the dead trees at Mt. Mitchell? Unless they pose a threat to park visitors, the dead trees at Mt. Mitchell are left alone for a number of reasons. First, standing dead trees provide **habitat** for a variety of animals. Birds and mammals such as owls, woodpeckers, bluebirds, raccoons, and squirrels often live and nest in them.



Slug

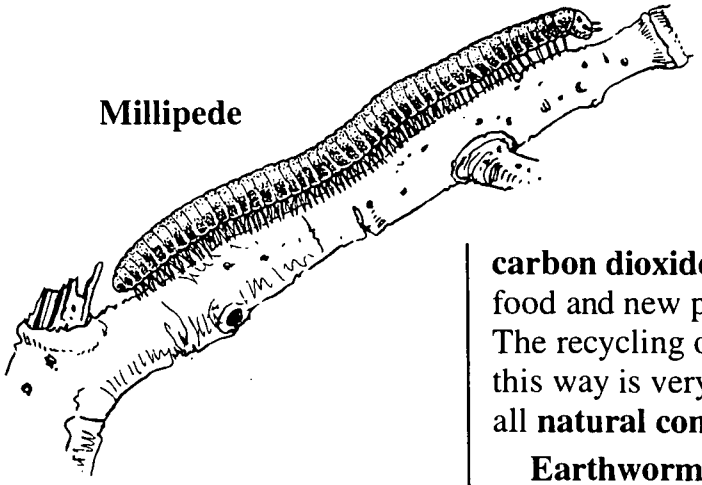
In addition, both standing and fallen trees provide wood-eating **insects** such as termites and beetles with food, shelter, and nesting areas. These insects feed on the trees, softening the wood and digging access tunnels through which water, **fungi**, **bacteria**, and small animals can enter. They lay their eggs in the soft wood, providing the newly hatched **larvae** with an immediate food source. Other animals feed on the fungi and insects already living in the dead trees.

When a tree falls to the ground, decomposers such as bacteria, fungi and insects work to break down the tree into rich topsoil called **humus**. Humus provides valuable nutrients which plants must have to live. Without humus, there would be no plant growth. And without plant growth, many animals would starve. Humus is a critical part of the **food chain**.

Let's look more closely at how the **decomposition** or the rotting process occurs. When a branch or tree falls to the ground, it is immediately attacked by insects and other small animals on the ground. These animals bore through the tree, crunching it into smaller pieces, and leave their **excretions** behind. Beetles, termites, snails, slugs, and millipedes all participate in this activity.

Next, water enters the fallen tree through the holes dug by these insects making the log a perfect spot for fungi to grow. Fungi thrive in dark, moist places. They

Earthworms



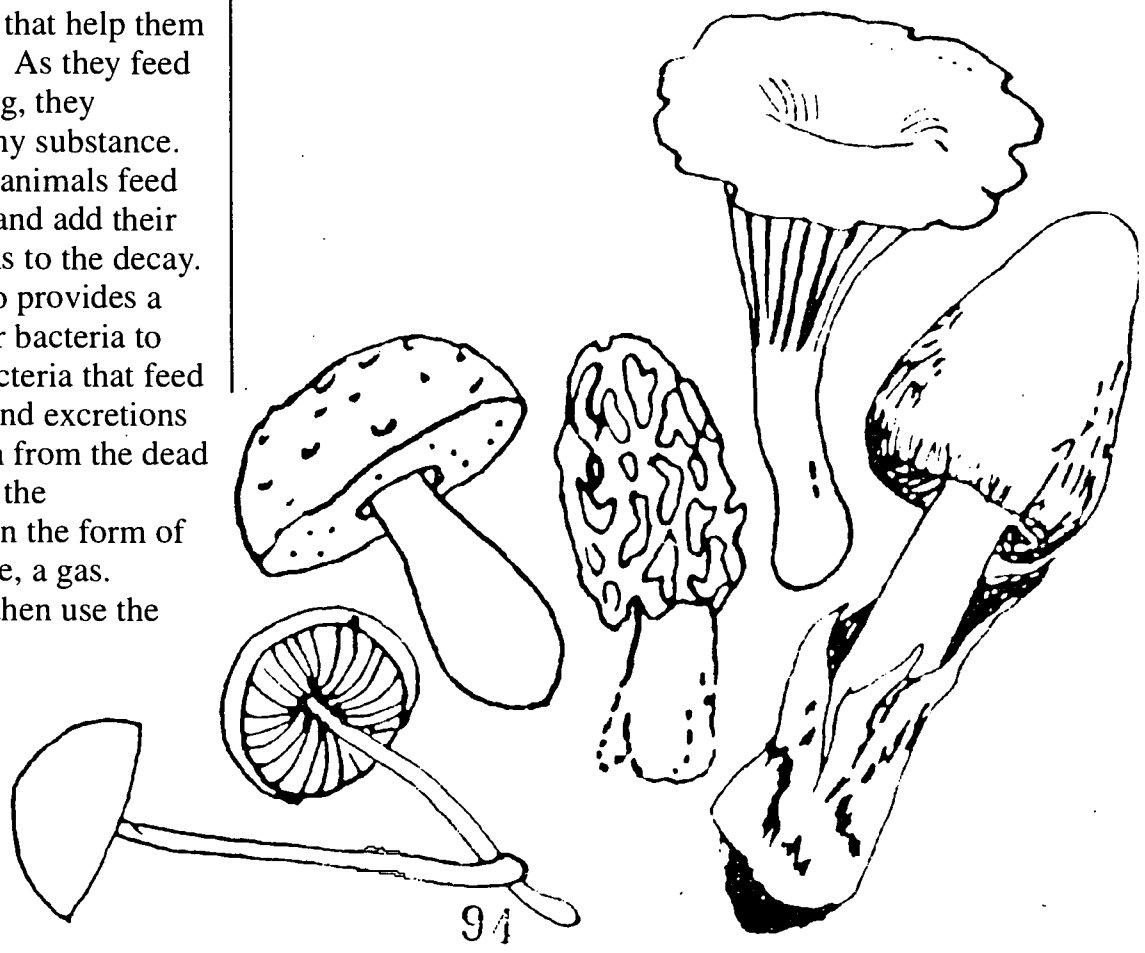
Millipede

are neither plants nor animals, but represent a unique group of living things that live on decaying material. Common examples are mushrooms, molds and mildew. Fungi spores are transported to the decaying log by wind, rain, and insects.

Some fungi produce rootlike structures called **rhizomorphs** that help them attach to logs. As they feed on the dead log, they produce a slimy substance. In turn, small animals feed on this **slime** and add their own excretions to the decay. The slime also provides a great place for bacteria to grow. The bacteria that feed on the slime and excretions put the carbon from the dead tree back into the environment in the form of carbon dioxide, a gas. Green plants then use the **carbon dioxide** to make food and new plant tissues. The recycling of carbon in this way is very important to all **natural communities**.

Earthworms also help this process along by burrowing through the soil and making channels for air and water to reach plant roots. Millions of earthworms in each acre of forest floor are capable of eating 18 tons of decaying material in just one year! After they digest leaves and wood pieces, the earthworms add their nutrient-rich excretions to the soil.

In summary, the standing dead trees and fallen logs at Mt. Mitchell are not removed because they are an important part of the spruce-fir forest. They provide food and shelter for many living things. They help new plants to grow by releasing carbon into the air and decomposing into a rich layer of soil called humus.



Leave a Log Alone — Worksheet

What are some of the pros and cons of leaving dead trees in your backyard? Would you ever remove a dead tree from your yard?

PROS - Dead trees should be left alone because ...

1.
2.
3.

CONS - Dead trees may cause a safety hazard if ...

1.
2.
3.

My recommendations for dead trees and logs:

In a state park: _____

_____

_____

In my backyard: _____

_____

_____

At my school: _____

_____

_____

VOCABULARY

Acidic - 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 or acid depostion - Rain, or other precipitation, having a pH below the normal pH of rain (pH 5.4), usually caused by air pollution from vehicle exhausts and coal-burning furnaces.

Adapted - Changed or developed to best survive a particular environment. For example, forests develop only where soil types, moisture and sunlight are balanced to the proper degree. Mountain plants have made adjustments, so they are able to live at high altitudes with intense cold, on poor quality soils.

Alpine - Of, or pertaining to, high mountains.

Aluminum - A silvery-white, ductile metallic element, the most abundant in the earth's crust, but found only in combination with other elements, chiefly in bauxite ore.

Bacteria - Unicellular microorganisms, the majority of which exist independently of living hosts and are involved in processes of decomposition of dead animal and plant material.

Balds - Natural grasslands or shrub thickets occurring on high mountain peaks.

Balsam - Any of the various trees yielding an aromatic, resinous substance, especially the balsam fir.

Balsam woolly adelgid - *Adelges piceae* is a small sucking insect that attacks only fir trees (Abies species). This pest was introduced into eastern North America from Europe at the turn of the 20th century.

Bark - Layers of dead wood or cork on the outside of the tree that protect the phloem and other parts of the tree from injury and disease. Each tree species has a characteristic bark which helps in identification of the tree.

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

Calcium - A fairly soft, silvery-white alkaline-earth metal. It occurs naturally as calcite, gypsum and fluorite. Calcium is very reactive, reacting with water to give a surface layer of calcium hydroxide, and burning in air to give a nitride and oxide.

Cambium - The growing layer of the tree between the phloem and the sapwood. The cambium makes new phloem, sapwood and cambium cells every year.

Carbon dioxide - The atmospheric gas that plants use for photosynthesis. Carbon dioxide is produced with animals exhale and when plant materials or fossil fuels are burned. (Scientists call carbon dioxide a "greenhouse gas" because it traps heat in the earth's atmosphere. Some scientists predict global warming due to the increase in the amount of atmospheric carbon dioxide in recent history.)

Chlorophyll - The green pigment in the leaves or needles of a tree that helps capture light energy needed for photosynthesis to occur.

Coniferous - Any tree that bears cones such as pine, Fraser fir, and red spruce.

Cove hardwood forest - These forests occur in the Southern Appalachians in sheltered mountain valleys on north- and east-facing slopes, from 1,500 to 4,500 feet. Cove forests are among the richest, most magnificent deciduous forests found anywhere on earth.

Deciduous - Trees and shrubs which lose their leaves during seasonal changes.

Decomposer - Something that causes once-living plants or animals to rot or decay.

Decomposition - The process in which once-living plants or animals decay, or are broken down by bacteria, fungi or other decomposers.

Diameter - The thickness or width of anything, especially a circle or sphere.

Dormant - A relatively inactive or resting condition in which some processes are slowed down or suspended.

Earthworm - A terrestrial annelid worm of the class Oligochaeta that burrows into and helps aerate and enrich soil.

Erosion - The natural process by which material is removed from the earth's surface.

Evergreen - Having foliage that persists and remains green throughout the year.

Excretion - The waste matter that is eliminated from the blood, tissues, or organs.

Fahrenheit - A temperature scale that registers the freezing point of water at 32 degrees Fahrenheit and the boiling point of water as 212 degrees Fahrenheit under standard atmospheric pressure.

Food chain - The transfer of food energy from the source in plants through a series of animals, with repeated eating and being eaten.

Fossil fuel - A fuel such as gasoline, oil or coal, which is made from dead plants and animals that lived millions of years ago.

Fungi - A kingdom grouping which includes yeasts, mushrooms, molds, and mildews which reproduce mostly by means of spores and lack chlorophyll.

Global warming - The observed increase in the average temperature of the Earth's innermost atmosphere, which is believed to be the result of the greenhouse effect.

Gradient - An ascending or descending part; an incline.

Habitat - An area that provides an animal or plant with adequate food, water, shelter, and living space in a suitable arrangement.

Heartwood - Dense, dead wood that forms the central core of the tree. It provides support for the tree.

Humus - Decomposed material in the soil that is a highly complex mixture of organic and inorganic substances.

Insect - A small invertebrate animal having an adult stage characterized by three pairs of legs, a segmented body with three major divisions, and usually two pairs of wings.

Larva - The wingless, often worm-like form of a newly hatched insect. In complete metamorphosis, the larva is the stage between the egg and the pupa.

Lateral root - Roots that spread out from the tree and cover a broad area. Lateral roots are usually close to the surface of the earth.

Lead - A soft, malleable, ductile, bluish-white, dense metallic element, extracted chiefly from galena and used in containers and pipes for corrosives, in solder and type metal, bullets, radiation shielding, and paints.

Limiting factor - An environmental condition that, when present in too great or too little an amount, has a negative effect on the survival of a species or population.

Litmus paper - Specially treated paper used as an acid-base indicator.

Mercury - A silvery-white poisonous metallic element, liquid at room temperature. It is used in thermometers, barometers, vapor lamps, and batteries, and in the preparation of chemical pesticides.

Migration - The movement of animals from one region to another by chance, instinct or plan.

Natural community - A collection of populations of plants and animals that associate with each other and their physical environment.

Nitric acid - A transparent, colorless or yellowish, fuming corrosive liquid. This highly reactive oxidizing agent is used in the production of fertilizers, explosives, and rocket fuels and in a wide variety of industrial metallurgical processes.

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.

Northern hardwood forest - These forests occur at higher elevations, between 3,500 and 5,500 feet. They are like those found in the New England states, and are comprised primarily of American beech, sugar maple, yellow birch and eastern hemlock.

Nutrient - A substance required for growth and development. Plants, for example, need water and minerals in order to grow and reproduce.

Oak-hickory forest - These forests occur over the southern- and eastern-facing outer slopes of the Blue Ridge Mountains below 3,500 feet and in the interior mountain basins. The most common trees are white, red and chestnut oaks, but black and scarlet oaks are plentiful as well.

Organism - Any living individual; any plant or animal.

Ozone - A gas that is found in two layers of the Earth's atmosphere — the troposphere (ground-level) and the stratosphere (seven to ten miles above the earth). The ozone in the stratosphere protects living things from the harmful UV rays of the sun. The ground-level ozone is a major component of smog and can seriously impair the human respiratory system. Ground-level ozone is also implicated in plant damage, such as yellowing of the leaves or needles.

pH - (p)otential of (H)ydrogen ion activity; a measure that indicates the relative acidity or alkalinity (basicity) 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.

Phloem - Wood cells forming tubes which transport sap (sugar and other nutrients) from the leaves to the rest of the tree. Phloem is also called the inner bark.

Photosynthesis - The process, occurring in all green plants, in which water and carbon dioxide are transformed into simple sugars and oxygen in the presence of sunlight.

Piedmont - An area lying at the foot of a mountain or mountain range.

Plot - A small piece of ground, generally used for a specific purpose. A measured area of land.

Rhizomorphs - A rootlike part, such as a threadlike structure, that forms the vegetative body of some fungi.

Sapwood - Dead, wood cells that form tubes which transport water and minerals from the roots to all other parts of the tree. Sapwood is also called xylem.

Slime - Any of various fungi having a vegetative body consisting of a slimy mass of protoplasm.

Spruce-fir forest - Coniferous forests of the northern United States, southern Canada, and peaks in the Southern Appalachians above 5,500 feet.

Stomata - Microscopic holes on the underside of a leaf or needle which allow gases to enter and exit. Plants take in carbon dioxide and give off oxygen and water vapor.

Sulfur dioxide - A pungent, colorless gaseous pollutant formed primarily by the combustion of fossil fuels, especially coal.

Sulfuric acid - A highly corrosive, dense oily liquid, colorless to dark-brown depending on its purity and used to manufacture a wide variety of chemicals and materials including fertilizers, paints, detergents and explosives.

Taproot - A root that goes straight into the ground and helps to anchor the tree or plant. Taproots go much deeper than lateral roots. Not all trees or plants have a taproot.

Windbreak - A hedge, fence, or row of trees serving to lessen or break the force of the wind.

Xylem - See Sapwood.

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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: Mount Mitchell State Park
Route 5, Box 700
Burnsville, NC 28714

Fax: ( ) 675-4611

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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 **Mount Mitchell State Park**. Studies have shown that "hands-on" learning improves children's attitudes and performance in a broad range of school subjects.

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

Child's name _____

Does your child:

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

- Have other allergies? _____

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

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

_____ _____
Parent's signature date

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

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

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

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

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

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

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

5. General comments _____
   _____
   _____
   _____

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

6. Group (school) name _____

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

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

Mount Mitchell State Park
Route 5, Box 700
Burnsville, NC 28714
Fax: (704) 675-4611

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

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