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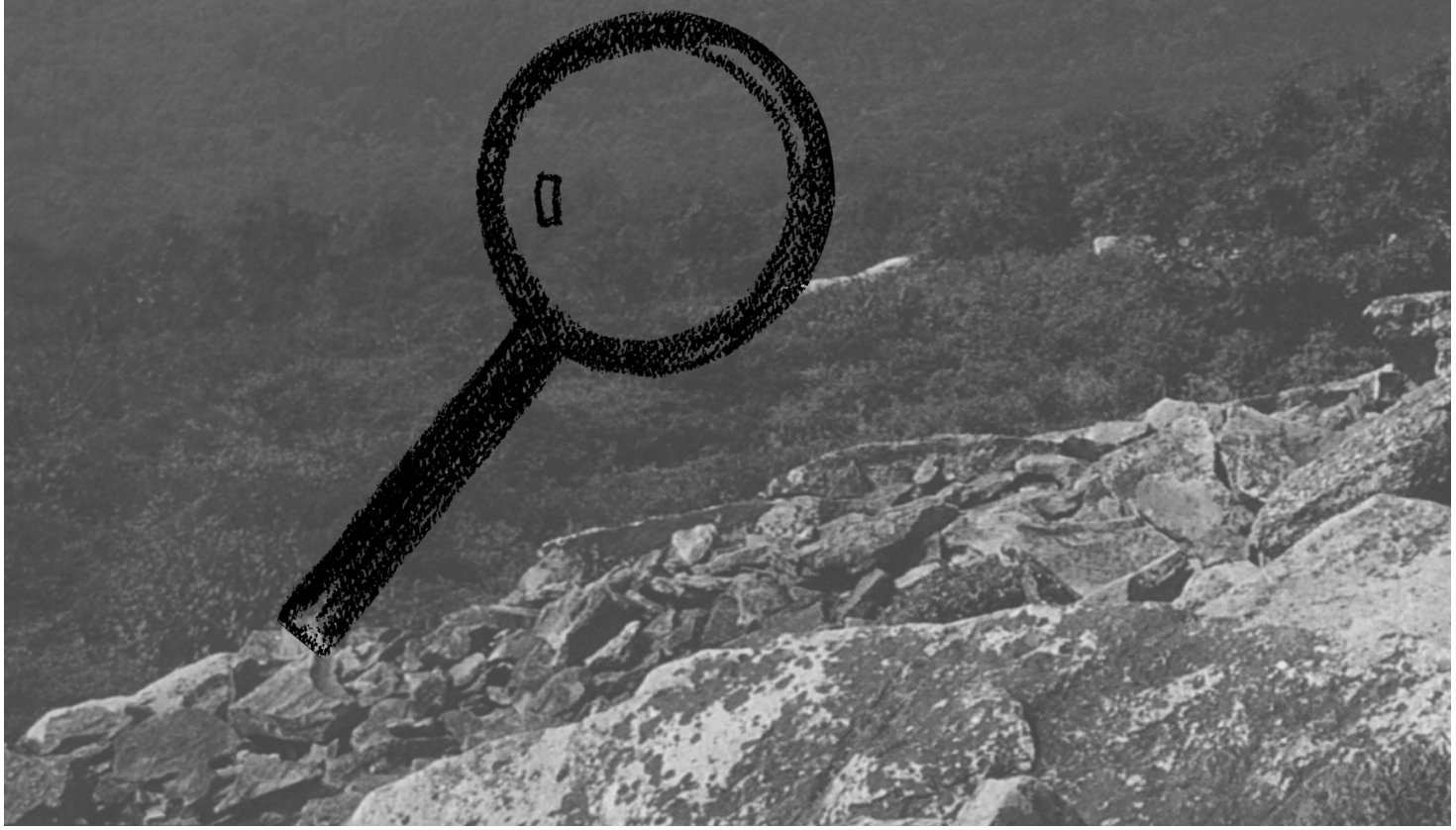
The Natural Inquirer

A Research and Science Education Journal



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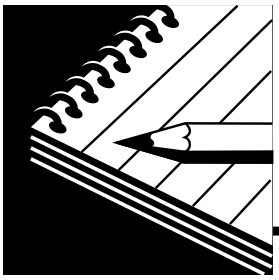

TEACHER'S NOTE

Although students will learn about natural resources by reading these articles, one of the main purposes of the journal is to introduce the work of scientists to middle school science students. Our goal is to stimulate an interest in natural resource and life sciences by presenting the research activities of a variety of scientists. In the articles, reflection questions are placed at the end of each section. These reflection questions are oriented toward helping the teacher conduct a class discussion about the problems, methods, and findings associated with each research article. These questions should stimulate critical thinking about the research. Critical thinking and discussion may be encouraged by using small groups, although entire class discussions may also be helpful. Note that the answers to the questions should not be considered right or wrong. They are only intended to stimulate critical thinking.

The articles themselves, as well as the journal's overall format, are designed to imitate the format of a professional research journal. Prior to publication, this journal's articles were reviewed by the primary scientist and by a young reviewer between the ages 9 and 16. When introducing the journal, the teacher may want to bring the students' attention to the list of youth editors. A discussion of the advantages and disadvantages of peer review is suggested. Again, there are no right or wrong answers. The purpose of this discussion would be to consider one of the many activities and procedures of science—In this case using other scientists to review the completed research.

On first page of each article, we have included three additional sections. The first section highlights an item having to do with scientific methods or concerns. The second section presents a Discovery activity, which provides the teacher with a hands-on activity related in some way to the article. A list of vocabulary words follow the Discovery activity. Understanding these words will be crucial to the student's comprehension of the article.

This journal was created by the Urban Tree House, an education program of the USDA Forest Service. It was produced as a summer project for college interns, sponsored by the Forest Service and the Hispanic Association of Colleges and Universities. We want your comments and suggestions. Also, if you are interested in having your class participate in research to understand the effectiveness of this journal, please contact

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ABOUT THE NATURAL INQUIRER

Scientists report their research in journals, which are special booklets that enable scientists to share information with one another. This journal, The Natural Inquirer, was created so that scientists can share their information with you and with other middle school science students. Each article tells you about scientific research conducted by scientists in the USDA Forest Service. All of the research in this journal is concerned with natural resources, such as trees, forests, wildlife, and outdoor activities. First, the article will tell you about a scientific principle, technique, or special concern of scientists. Then, YOU are the scientist as you do the Discovery activity. The vocabulary section will help you understand the article.

At the end of each section of the article, there are Reflection boxes, questions to help you think about the research. These questions are not a test! They are intended to help you think more about what the scientists did. Your teacher may also use the questions in a class discussion.

The research in this journal is just a small part of what scientists study in natural resources. Other things that are studied are water, soils, wildlife, and insects. Scientists also study how the various parts of the forest interact and depend on one another. In the Forest Service, scientists study natural resources throughout the United States. They try to solve problems and advance our understanding of how to take better care of our natural resources.

What are Scientists?

Scientists are people who collect and evaluate information about a wide range of topics. Scientists have some qualities that you may have also. To be a successful natural resource scientist, you must:

Be curious
— You must want to know something, and be interested in learning.

Be enthusiastic
— You must be very interested in a particular subject.

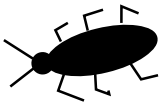
Be careful
— You must be accurate in everything you do.

Be open-minded
— You must be willing to listen to new ideas.

Question everything
— You must think about ideas and what you read. You must not be willing to accept what you read without thinking about it yourself. You must be a reflective person!

Care about the environment
— You must have interest in and respect for the natural world. You must want to protect the environment.

Why? What if...? Is that true?



Wood Roaches for Dinner Again?
The Baby Red-cockaded Woodpecker's Diet

VOCABULARY
Vocabulary in article marked in italics

Arthropods
Invertebrate animals with jointed bodies and limbs

Bole
Trunk or stem of a tree

Cavities
Hollowed sections in trees where woodpeckers make homes

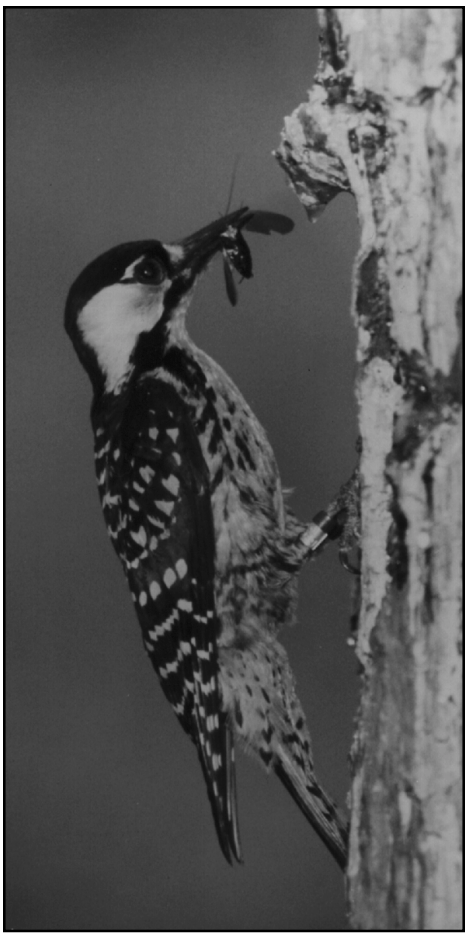
Larva
Immature form of an insect, after it hatches from its egg

Nestling
A young bird that has not left its nest

Prey
An animal taken by a predator for food

Pupa
Metamorphic insect which is enclosed in a cocoon or case

Specimen
An individual or a part considered representative of the group as a whole

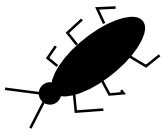


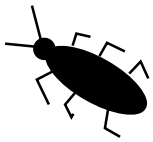
Scientists are often interested in studying the relationships between processes. The scientists in this study wanted to know about the relationship between insect populations and the diet of baby woodpeckers. Scientists realize that there are connections between everything in nature. Therefore, they often conduct research to better understand how plants, animals and other natural processes **vary** in relationship to each other. For example, if there is a lot of rain one year, there may be more vegetation than usual in the forest. This vegetation provides more food for deer, who may then reproduce and survive in greater numbers than usual. Thus, there is a relationship between rainfall and the number of deer. The study of relationships in nature is called **ecology.**

Discovery

You are a scientist who wants to find out what woodpeckers and other birds eat. Food sources are located on the bark of pine trees. Get an old bed sheet and put it under a small pine tree in the woods. Shake the tree vigorously. Collect the insects that have fallen onto the sheet. These will be used for *Further Discovery,* at the end of this article. To complete this activity you will need a copy of *A Golden Guide: Insects.*

Adapted from:
Hanula, James L. and Kay E. Franzreb. 1995. Arthropod prey of nestling Red-cockaded woodpeckers in the upper coastal plain of South Carolina. *Wilson Bulletin.* 107: 485-495





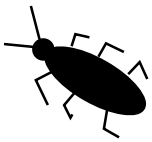
Introduction

Red-cockaded woodpeckers are an endangered species that live in areas from eastern Texas all the way to the Atlantic coast. These woodpeckers prefer to live in areas where pine trees are 80 years old or older. The reason woodpeckers live in older trees is because it is much easier to make nesting *cavities,* which are hollow holes in the trees. Old trees are also an ideal place to find an abundance of food. Not much is known about what Red-cockaded woodpeckers eat. Without this information, human activities in the forest could be reducing the woodpeckers' food supply and threatening their existence even more. To help forest managers protect the woodpeckers, scientists Jim Hanula and Kay Franzreb are studying what the woodpeckers feed their babies. The scientists are conducting research at the Savannah River Site in Aiken County, South Carolina to learn more about the types of *prey* that are part of the woodpeckers' diet. Little is known as to what types of *prey* the woodpeckers eat except that they find food on branches and live tree *boles,* which are the trunks of trees. Adult woodpeckers provide the best information because they feed the baby woodpeckers. Observing the adults as they feed the *nestlings* provides good information on the diet of *nestlings* without touching them.

Reflection

1 What are the scientists trying to accomplish by conducting this research on the Red-cockaded woodpecker?

2 If you were the scientists, how would you find out what the nestlings are eating?



Methods

One problem that the scientists face is that woodpeckers are difficult to study because they move very rapidly. Video cameras cannot be used because the birds are too far away and the *prey* cannot be identified. For this reason, four high-powered automatic cameras were used so that close-up pictures of the woodpeckers could be taken from a distance. The cameras were enclosed in a waterproof box with two windows through which cameras could be aimed and focused on the spot where the woodpeckers would be returning with food. The boxes were mounted on stands which were four meters tall. Each camera could take up to 250 photographs before the film had to be replaced. Are you wondering how the cameras knew when to take the pictures? Monitors were placed two meters above the *cavities* on the trunks of the trees. Invisible infrared light beams were then let out by the monitors which went down to two meters above the ground where they were caught by a device connected to the cameras. Every time the woodpeckers crossed the beams, pictures were taken before they entered the nest *cavities.* Have you ever seen a movie where a burglar is trying to break into a bank or store? You notice that when the burgler crosses the red or blue beam, an alarm is set off and the police are alerted about the burglary. The camera is triggered in the same way. The scientists wanted to know the time and date the photographs were taken, and what bird approached the cavity. The cameras automatically marked the time and date on the photographs as they were taken. The bird that approached the cavity was identified by the color of leg band it possessed on its legs. Before the cameras were used to photograph the woodpeckers, U.S. Fish and Wildlife Service biologists placed leg bands on each of them. This information helped the scientists determine which bird was involved with feeding the *nestlings*.

Reflection

1 Why is it important for cameras to record the time and date the photograph was taken?

2 What types of prey do you think the woodpeckers gathered when they fed the nestlings?

Results

Twenty-eight different types of *prey* were identified from over 3,000 photographs (Figure 1). They consisted of *arthropods. Arthropods* are all the invertebrate animals that have jointed bodies and limbs. These types of *arthropods* may include beetles, ants, and spiders. There can be different stages of *arthropods* such as the *larva, pupa,* and adult stages. The *larvae* are the beginning stages of the *arthropod's* life span. *Pupa* are in a stage of change found in cocoons or cases, such as a caterpillar before it turns into a butterfly. Adult stages include those invertebrates that have reached a mature stage and can no longer change into another form.

Drs. Hanula and Franzreb took all the pictures to the Georgia Natural History Museum where they were able to identify the different *arthropods* by using *specimens*. *Arthropods* that were found included wood roaches, wood borer beetles, moths, spiders, ants, centipedes, insect *larvae,* and grasshoppers. These are just several types of *arthropods* that were identified.

Seventy percent of the woodpeckers' diet consisted of wood roaches. Wood borer beetles and moth larva accounted for five percent each while spiders made up four percent of the diet. As you can see, wood roaches made up a very large percentage of the diet. According to Dr. Hanula, this could be due to a very large population of wood roaches in the forest at the time of the feeding cycle which lasts from the end of May until the beginning of July. About twenty other studies have been conducted to see if the woodpeckers really rely on the wood roach for their diet, or if other *arthropods* are just as important. Most of the studies have indicated that wood roaches do make up most of the diet. Percentages may be lower in other areas but wood roaches are apparently fed to baby Red-cockaded woodpeckers most of the time.

Prey of the Red-Cockaded Woodpecker

(Percentage of Arthropods Gathered)

Figure 1: As you can see, 70% of the woodpeckers' diet consisted of wood roaches. Why might the percentage be so high?

Reflection

1 What might be other reasons that wood roaches are fed more than other arthropods?

2 What do you think forest managers can do to protect the food sources of Red-cockaded woodpeckers?

Further Discovery

Count the number of arthropods that you collected on the bed sheet. *Using A Golden Guide: Insects* try to identify the arthropods that you have collected. List or draw as many arthropods as you can identify.

1

2

3

4

5

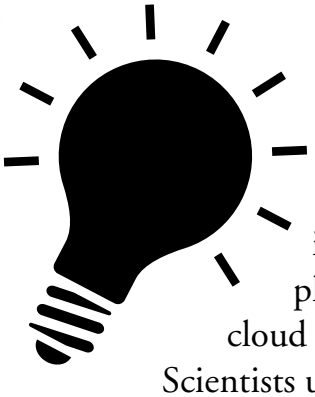
6

7

8

Thinking Like a Scientist

Natural resource scientists use many different skills to uncover information. One of the most important skills a scientist uses is **observation.**



Scientists observe the world around them and keep a record of their observations. Observations can be recorded with numbers (such as **counting** the number of birds at a bird feeder every day), with words (such as **writing** about the behavior of baby wolves as they grow up), or with pictures (such as **photographing** a rose every day as it blooms). You can be a scientist too, and **record your observations** of something. For example, you can observe and record your dog's behavior at the same time every morning and evening, you can observe your classmates' interactions as they play on the playground, or you can observe the cloud patterns and weather every day. Scientists usually wonder why or how something is or becomes the way it is. How can you think like a scientist every day? Observe the world around you!

There's a lot to see and learn!

It's a Jungle Gym Out There!
An Introduction to Outdoor Recreation

VOCABULARY

Vocabulary in article marked in italics

Outdoor recreation
An activity done outdoors for enjoyment

Questionnaire
Printed or written form of questions used to gather information

Random Draw
To pick someone or something without showing preference

Sample
A small subset group, representative of the entire group

Trend
A behavior pattern occurring and developing over a period of time

Adapted from:
Cordell, H. K., B. L. McDonald, B. Lewis, M. Miles, J. Martin, and J. Bason. 1996. "United States of America". In Cushman, G., Veal, A. J., and J. Zuzanek, Eds. *World Leisure Participation in the Global Village*, Wallingford, Oxon, UK: CAB International.

Discovery

Brainstorm: Make a list of ten of your favorite things to do outside, such as bicycle riding, nature activities, and sports. A student volunteer can be picked to list these activities on the board. Each activity should be listed once, even if more than one person chose it. Then, go through the list and count the number of students who said they have done each of the activities in the past year. Calculate the percent of students who said they did each. (See page 20 for help with calculating percentages.) Save this list. You will be creating your own chart to show how you and your classmates participate in outdoor recreation

Introduction

Do you like to play outside? If you are like most Americans, you answered yes! Almost everyone in the United States enjoys *outdoor recreation*, which is an activity that is done outside for fun and enjoyment. But what if you couldn't go swimming, because there were no pools to swim in? Unless we understand what kinds of *outdoor recreation* activities people like, we cannot provide facilities and places for them to do the things they like to do. So that government and private businesses can provide the kinds of places and things that people want to do for *outdoor recreation*, scientist H. Ken Cordell and his colleagues studied what people across the

The scientists in this study used the ***random draw*** approach to select a *sample* of people for the study. Because scientists cannot study everyone or everything in the United States or even everyone or everything in a particular group, they pick a *sample*. A *sample* is a number of people or things carefully selected because they are similar to the larger population. They are picked randomly, which means that everyone or everything in the whole population has an equal chance of being picked without showing preference. For this study, scientists used a computer-generated random list of household phone numbers from across the entire United States. Once a household was contacted by phone, a person in that household was asked a series of questions about their *outdoor recreation* activities.

United States like to do for *outdoor recreation*. Their study was a kind of science called social science. Social science helps scientists to describe people's attitudes and behaviors. Understanding people's attitudes and behaviors helps to better meet their needs.

Methods

To find out what kinds of *outdoor recreation* people like, Dr. Cordell and his colleagues developed a *questionnaire* that included questions about what people do for fun outdoors, and how often they do those activities. Many of the same questions had been asked in past *questionnaires*, enabling the scientists to look at *outdoor recreation trends*. By understanding *trends*, scientists can begin to predict what might happen in the future. The scientists also asked people where they most often did *outdoor recreation* activities. For example, you might play most often in your backyard, but sometimes your family takes a vacation to a national park or to the beach. Dr. Cordell and his colleagues asked these questions by telephone. They asked over 17,000 people over the age of 15 years these questions, and entered their responses into a computer. The computer calculated how many people did different *outdoor recreation* activities. It also enabled the scientists to tell park and forest managers what kind of *outdoor recreation* activities people like you and your family enjoy doing.

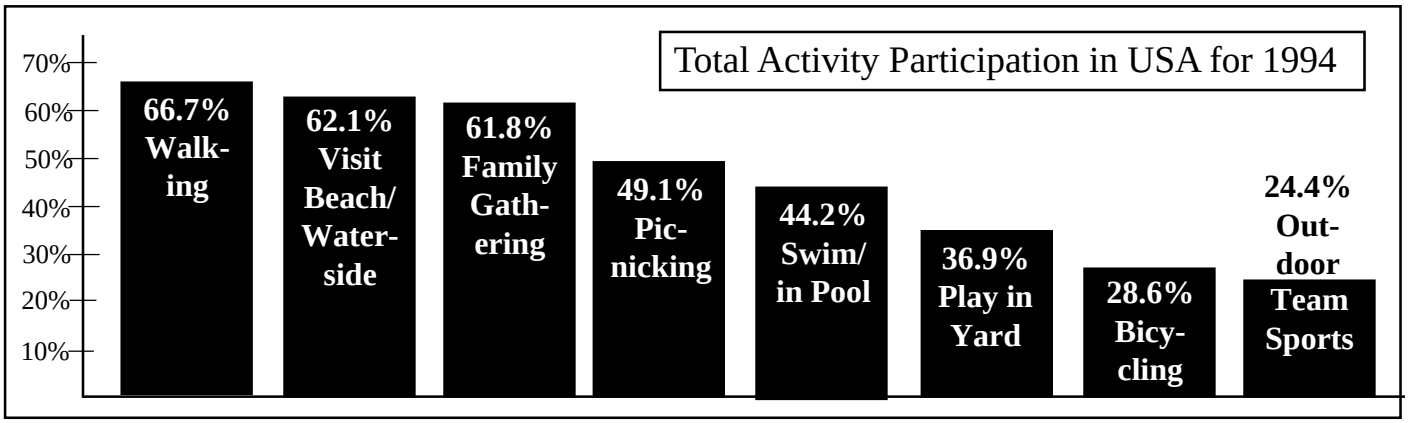
Reflection

1 What question are the scientists trying to answer?

2 How would **you** find out what Americans like to do for outdoor recreation?

Results

Dr. Cordell and his colleagues found that 94.5% of Americans said they participated in some form of *outdoor recreation*. Then the participants told them exactly which activities they took part in. Most activities are enjoyed by both males and females, but for some activities, males participate more than females. The scientists also found some differences in participation between younger and older people. What do you think they found? What they found was that for activities that take a lot of energy, younger people participate more often. For activities that don't require as much energy, older people participate as much as younger people. For example, older people don't do outdoor team sports very much, but they like to watch birds and wildlife, visit historic areas, go sightseeing, and visit nature centers. Another factor that influences what people do and where they go includes income. How and why do you think income influences participation?



Dr. Cordell and his colleagues found that *outdoor recreation* activities are becoming more diverse and more popular. Activities like snowboarding, roller-blading, and bungee jumping were unknown 20 years ago. They found that Americans continue to participate in *outdoor recreation*, and Dr. Cordell predicts that participation will continue to increase in the future.

Further Discovery

Using the bar chart at above as a guide, draw bars on the empty chart below that match five of the activities you listed at the beginning of this article. On the left side of the chart, you see percentages marked from 10% to 100%. Your teacher will help you construct the bar chart using those percentages. Use colored pencils to color each bar a different color. Compare your bar chart with your classmates'. Do they look the same? Why or why not? What does your chart tell you about your classmates' outdoor recreation activities?

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%

Activities _____ _____ _____ _____ _____

_____ _____ _____ _____ _____

Reflection

1 What are the advantages of using the telephone to ask people questions?

2 What are the disadvantages of using the telephone to ask quesitons?

3 What other ways could scientists find out what people like as outdoor recreation?

4 Do you agree with Dr. Cordell's prediction that participation in outdoor recreation will increase in the future? Why or why not?

Attack of the Killer Anthracnose!

Control of Dogwood Anthracnose

Take anything you don't hurt my dogwood!

VOCABULARY

Vocabulary marked in article in italics

Anthracnose (an thrak' nose)
Plant disease identified by dark spots and blisters; caused by imperfect fungi

Conidia (ka nid' e a)
A spore which develops into Anthracnose

Control
Organism or object used for comparison in an experiment

Dogwood
A type of deciduous tree with flowers

Fungicide
An agent that destroys fungi or prevents its growth

Fungus
Organism that contains no chlorophyll and is parasitic; for example, mold, mushrooms, mildew

Landscape
The visual land, such as trees, water, and sky

Photosynthesis
Formation of carbohydrates when chlorophyll is exposed to light; refers to the ability of plants to make their own food with the use of sunlight

Adapted from
Britton, Kerry O. 1995. Epidemiology and control of Dogwood Anthracnose. IUFRO Working Group. In Caprettig P. *et al.* eds., *Shoot and Foliage Disease in Forest Trees, Party Proceedings*. pp. 96-99.

The scientist in this study used a popular scientific technique to compare **experimental treatments** to normal conditions. In this study, the scientist compared trees sprayed with chemicals (the experimental treatment) to trees that were not sprayed with chemicals. The trees which were not sprayed are called ***controls***. *Controls* are used in many types of experimental research. They help scientists to evaluate the usefulness of the experimental treatments.

Discovery

Mix flour, water, and sugar in the proper proportions to make bread dough. Add a package of dry bread yeast (a type of fungi) which has been dissolved in a glass of water. Divide the dough into three equal parts and put each part in a pan. Put one pan in a hot place (such as a 400 degree oven), one in a cold place (such as a refrigerator), and one in a warm place (such as your classroom). Observe and compare the three loaves after a couple of hours.

Under which environmental condition is the yeast the most active (that is, which loaf has expanded the most in size)? Does this experiment use a control? Why do you think a control is or is not needed for this experiment? What can you conclude from this experiment?

Introduction

Many diseases affect the health of trees throughout the United States. One species affected in the eastern part of the country is the *Dogwood*. The *Dogwood* is affected by a disease called *Dogwood Anthracnose*. The symptoms of *Dogwood Anthracnose* include leafspots that begin at the tips of leaves (Fig. 1, page 15). If the weather is hot and dry, the disease will not spread. If the weather is warm, wet, and humid, however, the disease is likely to spread. *Conidia* are like the seeds of the *fungus* which are responsible for spreading the disease. *Conidia* are spread by splashing rain and can infect other leaves if they remain wet for up to 48 hours.

The lower branches of the tree are the first victims of the disease. The fungus enters through the leaves on the sprouts and grows into the tree trunk. This can cause the tree to die quickly. *Conidia* can survive on twigs and dead leaves over the winter. Once the leaves die, the tree's health is in danger (Fig. 2). Without leaves, *photosynthesis* does not take place and the tree eventually dies.

The *Dogwood* is one of people's favorite trees in the south. Many homeowners use the *Dogwood* for landscaping around their homes. For this reason, Kerry O. Britton studies *Dogwood Anthracnose* to find out what is most effective for preventing it.

[go to the Reflection Questions on this page]

Methods

The scientist put two-year-old, healthy dogwood seedlings into pots and placed them under an infected tree in southwestern North Carolina. By doing this, Dr. Britton could be sure the healthy seedlings would be at risk for infection from *Dogwood Anthracnose*. Remember the disease is spread during rainy weather. The seedlings were sprayed with two types of *fungicides*, which we call F1 and F2 for short. Spraying occurred at different time intervals to determine how long the *fungicides* worked. Dr. Britton also observed untreated seedlings to measure how quickly the disease spread. The seedlings that were not sprayed are known as "*controls,*" and they show the difference between treated and untreated trees. Dr. Britton counted the dead leaves on each tree to determine which type of *fungicide* was more effective and economical to use.

[go to the Reflection Questions on page 15]

Reflection

1 What problem is the scientist trying to solve?

2 Why do you think the disease spreads much more rapidly when there is a lot of moisture? (HINT: Do mushrooms and mildew, other types of fungi, grow better in wet or dry conditions?)

Fig. 1: Displays the beginning stages of Dogwood Anthracnose. Notice the leaf spots beginning to develop.

Fig. 2: Here, leaves are rotted and killed as a result of being heavily infected with Dogwood Anthracnose

Results

Dr. Britton found that F1 and F2 were equally effective in the treatment of *Dogwood Anthracnose*. The only difference between the two *fungicides* was that it took fewer applications of F1 to prevent the disease. The scientist found that six treatments throughout the summer stopped the disease very well. It took twelve treatments of F2 to equal the effectiveness of F1. Dr. Britton also found that treating infected leaves which had been wet for over a 48 hour period with F1 proved to be very effective. F1 can kill the *fungus* even after the *fungus* gets inside the leaves. It only took two applications during wet weather throughout the whole summer to stop the disease.

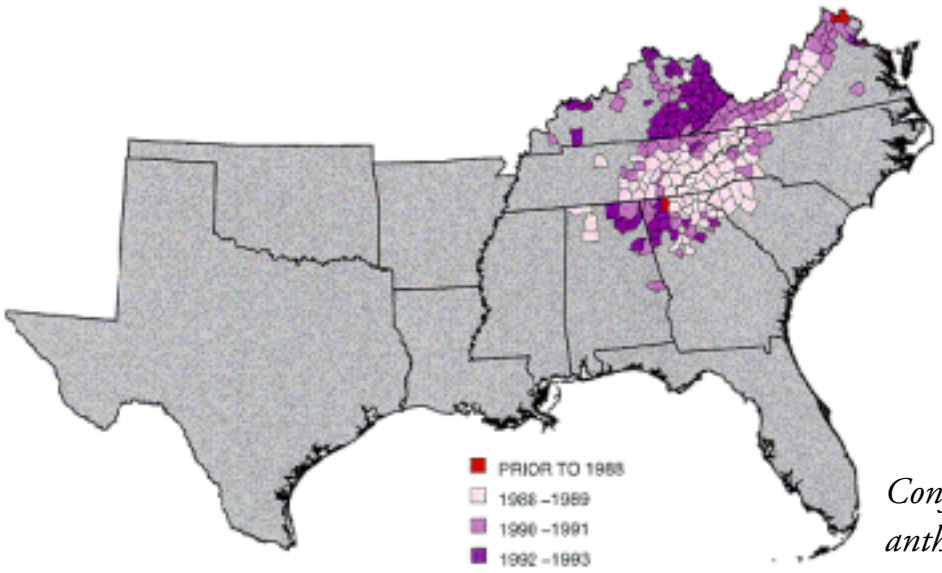
Reflection

1 Why do you think the scientist used many different time intervals for spraying the trees?

2 Why do you think scientists use a control (untreated seedlings) in their research?

3 What do you think would have happened to the healthy seedlings if there had been no rain during the experiement?

Homeowners might favor F1 because it requires fewer applications. F1 *fungicide* is more expensive, but usually equals the price of F2 after the additional applications of F2 have been applied for effective results. With proper timing during wet weather, the disease can be prevented with fewer applications of F1.



Confirmed dogwood anthracnose infections by county.

Reflection

1 Why do you think it is important to find the most effective chemical and at the same time make sure it is not too expenisive?

2 Which *fungicide,* if any, would you use on your own Dogwood trees to kill the disease? Why?

To Spray or Not to Spray
Soil Fumigation in Southern Forests

VOCABULARY
Vocabulary marked in article in italics

Fumigant
An agent used in fumigation

Fumigation
To apply smoke, liquid vapor, or gas to destroy harmful organisms

Fungicide
An agent that destroys fungi or prevents fungal growth

Herbicide
An agent that destroys plants or prevents plant growth

Methyl Bromide
Poisonous gas used to kill plants, worms, or insects

Nurseries
Area where plants and trees are grown from seed

Ozone Layer
Upper layer of atmosphere which protects earth's surface from harmful solar radiation

Questionnaire
Printed or written form of questions used to gather information

Seedlings
Small, young trees

Adapted from: Fraedrich, Stephen W. 1994. Soil fumigation in southern forest tree nurseries: Current status and future needs for pest management. *Diseases and Insects in Forest Nurseries*, Dijon (France),October 3-10, 1993. Ed. INRA, Paris, 265-280.

Sometimes scientists use methods from both social and biological sciences. This is called using **mixed methods**. This scientist wanted to know about people's use (social science) of a chemical before he began to explore alternatives to the chemical (biological science). With the results of the social science research, the scientist was better prepared to explore alternatives that would meet the needs of the people who use the chemical.

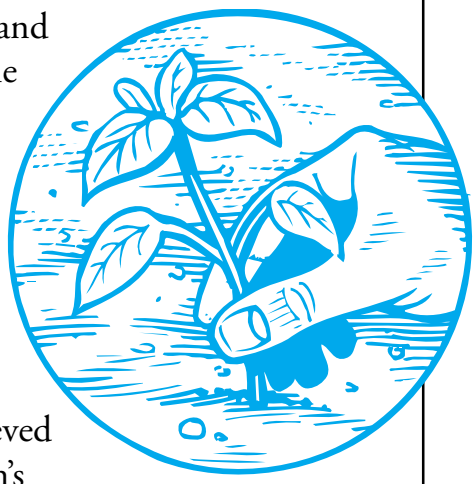
Discovery

You are a scientist who would like to develop a biodegradable plastic container for soft drinks. You want to know how many people prefer using recyclable plastic bottles as compared with aluminium cans. You also want to know if people would use a biodegradable container, even if it would cost more. As a class, develop a short questionnaire that would answer these questions. When you go home, ask your family, friends, and neighbors the questions your class has developed and record their answers. Keep these answers! You will use them after you read this article.

Would you buy biodegradable soft drink containers?
What if it cost more than a regular plastic container?

Introduction

Forestry operations depend on the continuous supply of healthy tree *seedlings*. *Seedlings* are small trees grown from seeds in *nurseries*. To provide healthy seedlings, chemicals are applied to the soil in a procedure called soil *fumigation*. The chemicals kill weeds, insects, and diseases. One of the most effective chemicals used is *methyl bromide*. Although *methyl bromide* is effective in helping healthy seedlings grow, it is also believed to damage the earth's *ozone layer*. The *ozone layer* helps to protect the earth's surface from the sun's harmful rays. Some people feel that *methyl bromide* should not be used by the nursery operators because it may be causing problems with the *ozone layer*. Because of these concerns, restrictions are being placed on the future use of *methyl bromide* as a *fumigant*. Nursery operators will no longer be able to use methyl bromide after the year 2002. Scientist Stephen W. Fraedrich has begun studying potential alternatives to the use of methyl bromide. But before he could begin studying the alternatives, he needed to know about the current use of methyl bromide.



(Now do the Reflection at right!)

Methods

To help him understand the current use of methyl bromide, Dr. Fraedrich mailed a *questionnaire* to nursery operators in the southern United States. The purpose of the *questionnaire* was to determine how many *nurseries* used methyl bromide, and how often they used it. Although 95 questionnaires were sent, not all of the operators responded. Fifty-seven, or 60 percent of the questionnaires, were returned to the scientist. After the questionnaires were returned, the scientist calculated the percentage of the responses to each of the questions. This research provided the scientist with a way of learning about the use of methyl bromide as a *fumigant*.

Reflection

1 Why do you think the scientist needed to study the current use of methyl bromide?

2 If you were the scientist, how would you find out about the current use of methyl bromide?

Reflection

1 What does the scientist know about the fumigation practices of the nursery operators who did not respond to the questionnaire? Why is this important?

2 What are some other ways to find out about the fumigation practices of nursery operators?

Results

Dr. Fraedrich found that soil *fumigation* is practiced at 96 percent of the *nurseries* that responded to the questionnaire. Between 65 percent and 79 percent of the operators fumigate either before each crop or before every other crop of *seedlings* are planted. Methyl bromide is the most commonly used chemical for soil *fumigation*. Only one nursery operator said he or she had never tried methyl bromide. Ninety-four percent of the operators said that the main reason they used methyl bromide was because it is more effective than other chemicals at killing weeds. *Herbicides* are also chemicals used to kill weeds. According to operators, the weeds soon grow resistant to *herbicides* and more of the herbicide is needed for effective results. Other types of chemicals used as alternatives are *fungicides*. Most operators prefer not to use *fungicides* because they are too expensive and can harm the environment. Even the best alternatives were not as effective as *methyl bromide*. Because known alternatives are not as effective, and little is known about effective alternatives, operators will be faced with a dilemma when the use of *methyl bromide* is restricted.

Soil is fumigated by pouring liquid into the soil and covering it with plastic.

Reflection

1 What dilemma will be faced by operators when they can no longer use methyl bromide?

2 Although methyl bromide may possibly hurt the earth's ozone layer, we also need healthy seedlings that can grow into healthy trees. What are some solutions to this problem?

Further Discovery

As a class, combine all of your answers together and calculate the percentage of responses you found for each question. Here is how you calculate percentages:

Assume your class has asked 60 people the questions in your questionnaire. Twenty-five of them prefer plastic, 30 prefer aluminum, and five do not prefer one over the other. To calculate the percentage of people who prefer plastic:

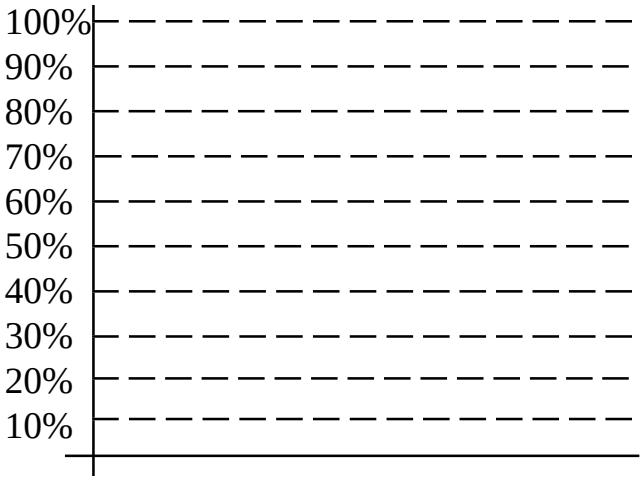
60 people total
25 prefer plastic

Divide 25 by 60 total people. You get an answer of .416, which you should round to .42. To get the final answer, multiply .42 by 100. This gives you a final answer of 42%.

25/60=.416, rounded to .42
.42 X 100= 42%

After you have finished calculating percentages, create a bar chart to show your results. If you need help with creating the bar chart, go to page 10 to see an example.

Use the following to create your bar chart



Labels for your questions:

Before & After:
A Look at Our Land
Land Use History of Jones County, GA

VOCABULARY
Vocabulary in article indicated in italics

Climatology records
Historical records describing the weather of a region

Elevation
Height; altitude

Land Use
Ways humanity has used the land

Natural history
Historical chain of natural events; development of a natural object

Oral history
History passed down through word of mouth

Productivity
The quality or state of being productive

Site
A place

Social history
History of what people have done, including how people used land

Soil Surveys
Maps depicting soil types throughout a geographic region

Soil erosion
The depletion of soil by water, wind, glacial ice, and human activities

Vegetative cover
Plants which cover the earth

Adapted from:
Edwards, Boyd M. 1983.
Land-use in Jones County, Georgia: An historic perspective. *Georgia Journal of Science*, 41:71-78.

Most scientists use numerical data or information to measure and understand their research. However, not all data are numerical. Some data may be in the form of words and pictures. These data are called **qualitative data**. The scientist in this study used qualitative data to study the history of a particular piece of land. Qualitative data help social scientists to understand things in more depth than they could understand by using numbers.

Discovery

Go outside and look at the land surrounding your school. Imagine how the land that makes up your schoolyard could have looked two hundred years ago. Observe the different plant and animal species around the playground. Look at the land itself. Is it hilly, or is it flat? Are there man-made structures surrounding the school, or is it a natural setting? Use your sense of sight, scent, and hearing to observe. Record your findings. What do you think the land looked like 10 years ago? Find 10 ways the land has changed in the past 10 years. Why has it changed? In what ways has the land remained the same?

Introduction

Much of what humans do depends on the land that we live on. As humans have become more technologically and scientifically advanced, we have modified the land in so many ways that sometimes it is hard to imagine what the land used to be like. No matter how much humans change the land, it is still important to understand the history and characteristics of land. If scientists can help us understand how our activities have impacted the land, we can act more carefully in the future to protect the health of the land.

Throughout time, land has transformed in many ways. Many changes occur naturally. The earth is constantly changing by means of volcanoes, earthquakes, and other natural phenomena. Can you name other natural ways the earth changes?

In addition to the natural changes, there are changes that humans have caused. For example, think of different towns and cities that you have seen. Now think of how the land where the cities now stand must have looked two hundred years ago. Chances are the land was cleared of most plants and wildlife. Wildland has been and continues to be cleared for farmland and other human activities.

The relation between humans and land has existed since the beginning of mankind. A scientist named Boyd Edwards is very interested in this topic. He believes that by knowing land's past and present, we can better understand it, and therefore, take better care of it. His belief led to a study in which Dr. Edwards researched land use, which simply means how humans use land. He studied Jones County, Georgia (Fig. 1). While he focused on different ways people used the land, Dr. Edwards also researched the land itself.

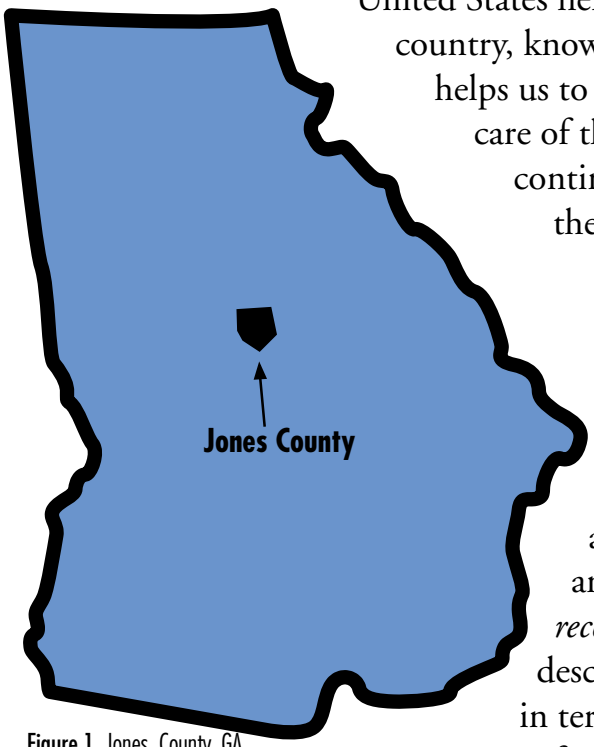


Figure 1. Jones, County, GA

Methods

To understand what Jones County is like today, Dr. Edwards traced its *natural history* and its *social history* from the past until the present. Much like knowing the history of the United States helps us to understand our country, knowing the history of land helps us to understand how to take care of the land so that it can continue to be healthy into the future.

Dr. Edwards first studied *the natural history* of Jones County. He gathered most of his data from existing sources, such as *soil surveys*, books, and from *climatology records*. Dr. Edwards described the *natural history* in terms of what kind of soils are found in Jones County, the makeup of its rocks, its *elevation*, its water systems, its normal climate including average temperature and rainfall, and its *vegetative cover*.

Then Dr. Edwards began studying the *social history* of Jones County. The *social history* is the history of how people used and changed the land. The *social history* of Jones County began with the American Indians, the area's first human inhabitants. Much of what we know about the American Indians was first passed down through word of mouth, which is called *oral history*. Therefore, it is difficult for a scientist to find much information on early American Indian life.

Reflection

1 What kinds of things do you think make up a piece of land's natural history?

2 What kinds of things do you t hink make up a piece of land's social history?

To find out about how White American settlers used the land, Dr. Edwards went to the library, visited museums and county government offices, and talked to people who were told by their parents, grandparents, and great-grandparents about life in Jones County. Dr. Edwards also used photographs to help him understand how the land was changed over the years. In all these different ways Dr. Edwards was able to gather a wealth of information on land use in Jones County.

Results

Dr. Edwards discovered that the American Indians did not change the land very much, even though they did use it and they did make some changes. White settlers had a much bigger impact on the land, and because the land was good for farming, most of the forest in Jones County was cut down for raising crops. In the early 1800's, cotton plantations brought prosperity to White farmers. After the Civil War, farming changed considerably and almost everyone was forced to start over. At this time, much of the forests in Jones County began to grow again. In the 1920's, the remaining cotton crops were killed by the boll weevil (Figure 2). Forestry became important as forests began to replace cotton fields.

Because of the intensive farming that occurred in Jones County, much of the once-rich topsoil had been *eroded* (Figure 3). Landowners worked with government scientists, including scientists from the United States Forest Service, to restore the land's health. After World War II, people moved from rural areas to cities, and even more of Jones County became forested again. [Now do the Reflection Questions above]

Today, 87% of the land is forested.

Dr. Edwards believes that we can do a better job of protecting the land's health and *productivity* in the future if we understand its *natural* and *social history*. He hopes that we will not only think about our uses of the land today, but that an understanding of *land use* history will help us to think about protecting the land for future generations.

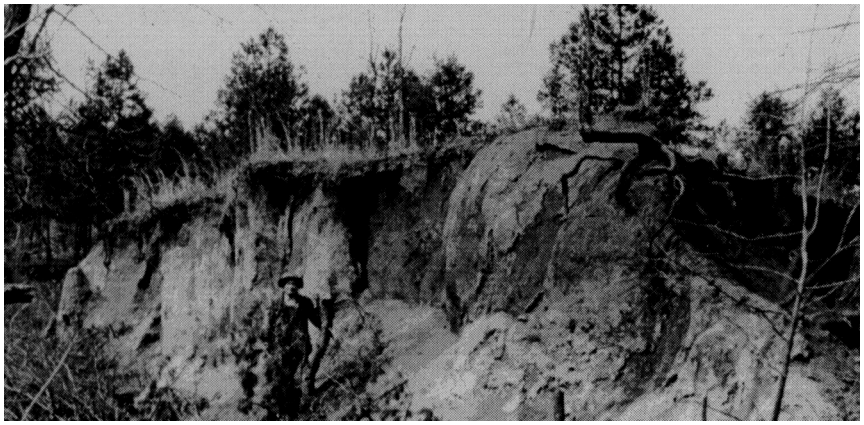


Figure 3. Land after it has been used for crops. Notice how much the soil has eroded. With all the top soil depleted (used up), much work will be required before this land can be farmed again.

Reflection

1 How does knowing the history of your own family—where you used to live and now live, knowing your sisters and brothers and family over the years—help you to understand who you are today?

2 If you wanted to find out what the land was like before your own house and yard were there, where would you go to find the information or whom would you ask?

3 What kind of natural and social changes might be caused by building a new elementary school on a piece of forest land?

4 In what ways can students and teachers help protect the health of the land surounding a school?

Further Discovery

It is now the year 2020 (How old are you now?)
In small groups, pretend you are writing the land use history of the land surrounding your school. What kind of physical and social changes have taken place since the current year? Discuss the land use history your group has written with the whole class. What are the similarities and differences in your histories? Use the space below to describe the changes in words and drawings.

On Top of Old Smokey

Computer Wind Model for Predicting Smoke Movement

VOCABULARY
Vocabulary in article indicated in italics

Complexity
The condition of being highly complicated, a situation where many different factors are affecting what happens

Computer model
The use of a computer to simulate real life conditions

Debris
Scattered remains left after destruction

Drainage
The gradual emptying of liquid or moisture

Landscape
The visual land, such as trees, water, and sky

Nocturnal
Active or occurring at night

Prescribed Burns
Controlled fires used to improve forest habitat

Simulate
To look like or act like a natural process

Topography
Relative position or elevation of land

Wildland
Land that is not cultivated or used for civilization

Adapted from:
Achtemeier, Gary L. and James T. Paul. 1994. A computer model for predicting smoke movement. *Southern Journal of Applied Forestry*, 18:60-64.

The natural world is very complex. This makes it hard to study. In the past, scientists had to investigate only one part of nature at a time because they could not study the *complexity* and interaction of all of nature's functions at the same time. Computers are better able to handle the *complexity* of studying natural functions. Computers can be programmed in such a way that they mimic the conditions in nature. The scientists in this research are working on developing a *computer model* of how forest fire smoke moves across the land. *Computer models* may not be perfect, but they help scientists understand the interaction of many different natural functions such as the movement of air because of temperature and pressure changes.

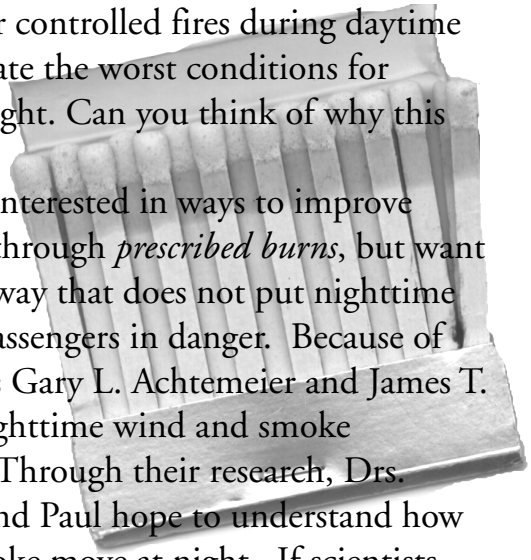
Discovery

When air cools, more molecules can be packed into the same amount of space. This gives the air more mass, and it has higher pressure. To discover whether cool air is heavier than warm air, try this experiment. Go to a refrigerator and open the door. Observe, using your sense of feeling, whether there is a difference in the temperature of the air between the top and the bottom areas of the refrigerator. Can you feel air coming out of the refrigerator? Does it come from the top or the bottom? Think about how the air moves from the refrigerator as you read about how air moves during the night in mountain valleys.

Introduction

Wildland fires occur both purposefully and by accident. Purposeful fires include fires set by individuals to remove fallen leaves or other *debris*. Often, foresters set small controlled fires on purpose called *prescribed burns*, to improve forest health and to reduce the chance of larger, uncontrolled forest fires. These kinds of fires may be helpful to some individuals and the environment, but they can also create hazardous driving conditions due to decreased

visibility. This situation is especially dangerous at night, when fog often further decreases visibility. Unfortunately, the safest weather conditions for controlled fires during daytime often also create the worst conditions for visibility at night. Can you think of why this might be so?



Foresters are interested in ways to improve forest health through *prescribed burns*, but want to do so in a way that does not put nighttime drivers and passengers in danger. Because of this, scientists Gary L. Achtemeier and James T. Paul study nighttime wind and smoke movements. Through their research, Drs. Achtemeier and Paul hope to understand how wind and smoke move at night. If scientists better understand *nocturnal* wind, they can reduce the chances of putting drivers in danger by picking safer weather conditions for *prescribed burns*.

[Now consider Reflection questions below]

Methods

Everyone knows how hard it is to predict the weather. In the same way, it is difficult to study wind and smoke movements for all the different land and climate conditions. To study a variety of weather and *landscape* conditions, Drs. Achtemeier and Paul used a computer to *simulate* the conditions associated with nighttime wind movements. These different conditions include air temperature and temperature changes, air pressure, wind speed and direction, land *topography*, and other *landscape* features such as roads, streams, rivers, and forests. All of these conditions affect the amount and direction smoke moves, even hours after a fire has stopped actively burning.

Drs. Achtemeier and Paul entered weather and *landscape* information into a computer. The weather and *landscape* information

Reflection

1 What problem are the scientists tyring to solve?

2 What are some of the barriers the scientists face when studying nighttime wind and smoke movements?

matched the conditions from a real situation. In the real situation, a forest fire had caused smoke to fill a highway at night. To test the accuracy of the *computer model*, the scientists compared the model with what actually happened.

Results

By testing the *computer model* against a real situation, Drs. Achtemeier and Paul found that the *computer model* is not yet advanced enough to determine the best weather conditions for prescribed forest fires. They found that every forest area has unique characteristics such as *topography* and weather conditions that need to be considered. The scientists found that smoke seems to follow certain patterns under certain conditions. For instance, they determined that when air cools off at night, it develops *drainage* patterns that move in different directions and follows the low areas of the *topography*, much like a stream running downhill. Even when the air feels calm and still, it is still moving in these patterns. Smoke will most often move into low places at night. If foresters burn in a valley, the smoke may stay in the valley. If they burn toward the higher mountain ridges, smoke may travel in many directions as it moves close to the earth.
This study has helped foresters to better understand the potential movement of smoke from *prescribed burns*. But although foresters have learned a lot about how smoke moves at night, they still have more to learn. What other things might affect the movement of smoke at night?

Reflection

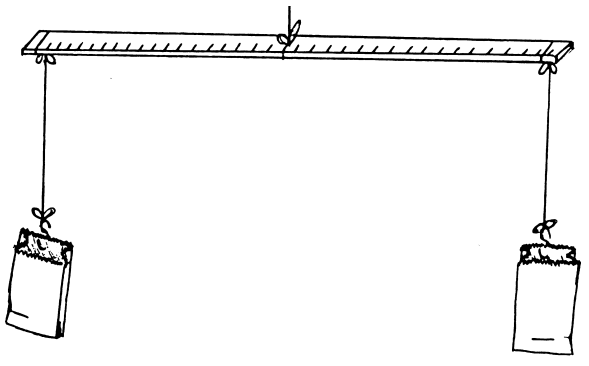
1 Why is it important to compare the computer model with a real situation?

2 What are the advantages of using computers to predict smoke movement?

3 What do you think are the disadvantages of using computers to predict smoke movement?

Further Discovery

Which is heavier--warm or cold air? To test which has a higher pressure and is therefore heavier, get two jars with lids, a yard stick, two lunch-sized paper bags, two paperclips, and three pieces of light weight string. Take the lids off of the jars. Place one in a freezer (or another cold place) and leave the other in your classroom. Tie one piece of string to the middle of the yardstick. You will use this to hang the yardstick. Tie the other two pieces of string onto each end of the yardstick, making sure that they are of equal length. Open the paperclips and tie one to the end of each of the strings. Hang the yardstick by the middle string. Open the bags and hang them on the paperclips. Make sure that everything is balanced. When everything is balanced, put the top on the jar that is in your classroom. When you have carried the jar to the bag, take the lid off and tip it over one of the bags, as if you were pouring water from the jar and into the bag. What happens to the bag? Now put the top on the jar that is in the freezer. When you have carried the jar to one of the bags, take the lid off and tip it over one of the bags, as if you were pouring water from the jar and into the bag. What happens to the bag? Now, can you answer the question about which is heavier-warm or cold air?



Write your answers and conclusions in this space.

What is the Forest Service?

The Forest Service is part of the federal government. It is made up of thousands of people who care for the nation's forest land. The Forest Service manages over 150 National Forests and almost 20 National Grasslands. National Forests are similar in some ways to National Parks, except that unlike National Parks, National Forests are used for many purposes. These purposes include providing clean water, places for wildlife and fish, places for people to hike, camp, and do other outdoor activities, healthy soil, trees for lumber, minerals, and many other uses. Some people in the Forest Service are natural resource scientists, whose research is presented in this journal. Forest Service scientists work to solve problems and provide new information about natural resources so that we can make sure our environment is healthy, now and into the future.