

Natural

INQUIRER

Volume 7, Number 1 • Wilderness Benefits Edition

Wilderness Benefits Edition

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Natural Inquirer

Wilderness Benefits Edition • Volume 7, Number 1 • Spring 2006

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Editorial Review Board



Natural Inquirer editorial review board hard at work.

Comments about individual articles in this edition from the *Natural Inquirer* editorial review board:

"It was very interesting learning about GIS. I think I could explain to someone else if I needed to."

"Good job at what you're doing. Keep it up."

"It's a great issue but some of the words were difficult. Maybe some should be explained in detail a little better."

"Good facts. Very informative."

"There are very good questions for the readers."

"I like how the method is included."

"Put more of the scientists comments or stories in there to make it interesting."

"Very Good! Consider a large print version."

"I think there are too many words that must be defined. People do sometimes get tired of looking up words."

"The article was really interesting. I really think that kids our age will enjoy this article, because everyone loves frogs!"

"Put your definitions on the very end of the article."

"Good title, very catchy." (In reference to the article "It's Elemental, My Dear")

"I think y'all did a good job of wording the paragraphs. And the graphs & charts are very well explained."

"Loved the little trivia, needs more to make it more catchy."

"Those are really good photographs."

"How do they absorb oxygen through their skin?" (In reference to the article "As the Frog Hops")

"I thought it was an interesting article and it would persuade anyone into interest of the wilderness!"

"Needs 2 be worded better."

"It's a good magazine, even though it's confusing some times."



Natural Inquirer review board providing comments and ideas.

Note to educators

As teachers of science, you want your students to acquire abilities that will enable them to conduct scientific inquiry, and you want them to gain an understanding of the scientific inquiry process. Scientific inquiry can best be taught by integrating minds-on and hands-on experiences. Over time, such experiences encourage students to independently formulate and seek answers to questions about the world we live in. As educators, you are constantly faced with engaging your students in scientific inquiry in new and different ways. In an age of abundant technology, standard teaching strategies can become monotonous to today's learners. The *Natural Inquirer* provides a fresh approach to science and a view of the outside world that is larger than the classroom and can still be used while in the school setting.

The *Natural Inquirer* is a science education resource journal to be used with learners from Grade 5 and up. The *Natural Inquirer* contains articles describing environmental and natural resource research conducted by the United States Department of Agriculture (USDA) Forest Service scientists and their cooperators. These are scientific journal articles that have been reformatted to meet the needs of middle school students. The articles are easy to understand, aesthetically pleasing to the eye, contain glossaries, and include hands-on activities. The goal of the *Natural Inquirer* is to stimulate critical reading and thinking about scientific inquiry and investigation while learning about ecology, the natural environment, and natural resources.

Science Education Standards and Evaluations:

In the back of the journal, you will find a matrix that allows you to identify articles by the national science education standards that they address. You will also find evaluation forms in the back of the journal. Please make copies of these evaluation forms and have your students complete them after they complete each article. Also, please complete the evaluation form for teachers. Send the evaluation forms to the address listed below. The address is also listed at the bottom of the evaluation forms. You and your students may also complete the evaluation forms online by visiting <http://www.naturalinquirer.usda.gov>.

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Educator Resources:

Visit the updated *Natural Inquirer* Web site at <http://www.naturalinquirer.usda.gov>. From this site, you can read and download lesson plans, word games, and other resources to help you use the *Natural Inquirer* in your classroom.

Visit the *Natural Inquirer* Web site:
<http://www.naturalinquirer.usda.gov>



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About the *Natural Inquirer*

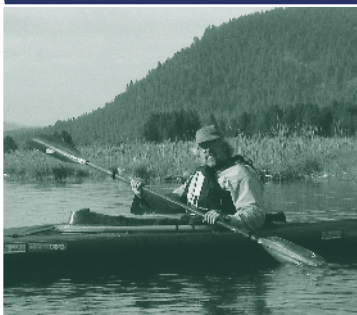
Scientists report their research in journals, which are special booklets that enable scientists to share information with one another. This journal, the *Natural Inquirer*, was created so that scientists can share their research with you and with other middle school students. Each article tells you about scientific research conducted by scientists in the USDA Forest Service. If you want to know more about the USDA Forest Service, you can read about it on page 81 of this journal, or you can visit the *Natural Inquirer* Web site at <http://www.naturalinquirer.usda.gov>.

All of the research in the *Natural Inquirer* is concerned with nature, such as trees, forests, animals, insects, outdoor activities, and water. First, you will

“meet the scientist” who conducted the research. Then you will read something special about science and about the natural environment. You will also read about a specific research project. This is written in the format that scientists use when they publish their research in journals. Then, YOU will become the scientist when you conduct the FACTivity associated with each article. Don’t forget to look at the glossary and the special sections highlighted in each article. These sections give you extra information.

At the end of each section of the article, you will find a few questions to help you think about what you have read. These questions are not a test! They should help you to think more about the research. Your teacher may use these questions in a class discussion.

Who are scientists?



Scientists are people who collect and evaluate information about a wide range of topics. Some scientists study the natural environment. To be a successful environmental scientist, you must:

✦ **Be curious**—You must be interested in learning.

✦ **Be enthusiastic**—You must be interested in an environmental topic.

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

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

✦ **Question everything**—You must think about what you read and observe.

Welcome

to the Wilderness Benefits Edition of the *Natural Inquirer*!

In 1964, the U.S. Congress passed the Wilderness Act. This act established the National Wilderness Preservation System. The National Wilderness Preservation System encompasses 106,498,016 acres in the United States. Although that may seem like a big number, it only makes up 4.7 percent of the land in the United States! Wilderness is found in all but six States with a large portion, almost 54 percent, of the wilderness in Alaska. Federal wilderness lands are managed by four Federal agencies: the USDA Forest Service and the U.S. Department of the Interior's National Park Service, Bureau of Land Management, and the Fish and Wildlife Service.

Wilderness is defined as an “untrammeled” area. “Untrammeled” means that these lands are free from human control. There are no developments such as houses, lodges, or restaurants allowed in wilderness. Additionally, no motorized or mechanical equipment—such as bikes, cars, and snowmobiles—is allowed in wilderness. Due to the “wildness” of wilderness, there are many benefits to humans from these areas. Some of these benefits are summarized below.

Some Benefits of Wilderness

- ✱ Ecosystem services—Provides protection for streams and other bodies of water, supports biodiversity, helps with climate stability, and helps purify air and water (For more information on ecosystem services, visit <http://www.esa.org>).
- ✱ Scientific values—Offers a “real world” laboratory to study the natural world.
- ✱ Geological values—Preserves unique geological areas such as volcanoes, geysers, glaciers, mountains, fossils, and caves.
- ✱ Educational values—Provides opportunity to learn about different ecosystems and wildlife, as well as land ethics, in an outdoor classroom.

- ✱ Aesthetic values—Protects land from development so that natural beauty is of primary importance as well as providing solitude and inspiration.
- ✱ Historical and Cultural values—Preserves areas that remind us of the past like burial grounds, cave paintings, and archaeological sites.
- ✱ Recreational values—Provides opportunities to engage in activities such as hiking, skiing, canoeing, fishing, hunting game, and enjoying the outdoors.

You will read about some of these wilderness benefits in this edition of the *Natural Inquirer*. Because some people have never visited wilderness, it is important to learn about the benefits these areas can provide.

Fun Facts About Wilderness

- ✱ President Lyndon B. Johnson signed the Wilderness Act in 1964.
- ✱ More than 12 million individuals visit wilderness lands each year.
- ✱ In wilderness, people can hike, ride horses, hunt, fish, ski, raft, camp, and enjoy natural beauty.
- ✱ There are many important people such as Aldo Leopold, Arthur Carhart, Robert Marshall, Howard Zahniser, Ansel Adams, and Rachel Carson who helped support the wilderness cause. Each of these individuals contributed to the establishment and preservation of wilderness.
- ✱ The smallest wilderness is Pelican Island, Florida, which has 5 acres of land.
- ✱ The largest wilderness is Wrangell-Saint Elias, Alaska, which has 9,078,675 acres of land.

Go to <http://www.wilderness.net> for more great information and resources about wilderness!

It's Elemental, My Dear!



***What Makes an Experience
Different at Gates of the Arctic
National Park and Preserve?***

Glossary:



relationship (re la shun ship): When two or more things are connected in some fashion.

element (el uh ment): Any of the parts or qualities of a thing, especially a necessary one.

outdoor recreation (out dôr rek re a shun): Activities done outside for fun, such as hiking, boating, or playing baseball.

wilderness (wil dūr nes): Area designated by Congress to be preserved in a wild and natural condition as part of the National Wilderness Preservation System.

manager (ma ni jūr): A skilled person who directs or manages something.

designate (dez ig nat): To choose or appoint; to give a name to.

Congress (kong gres): The group of elected officials in the United States that makes the laws. Congress is made up of the Senate and the House of Representatives.

native (nat iv): Naturally occurring in an area.

subsistence (sub sis tens): The act of living or stay alive, getting the items necessary to live, such as food, clothing, and shelter.

boreal (bôr e ul): Relating to a northern climate, with long, cold, and dry winters. The trees in a boreal forest are evergreen.

Meet the Scientists

▼ **Dr. Glaspell:** My favorite science experience was having no idea what time of the day or night it was while interviewing visitors under the 'midnight sun' in Gates of the Arctic National Park.



▲ **Dr. Watson:** My favorite science experience was when I spent 5 months in Finland at the Arctic Centre in Rovaniemi (Rô van e em e) learning about wilderness areas in the north and the people who live there.



Thinking About Science

Do you like nature but science is your least favorite subject? You could still become an environmental scientist! Some environmental scientists are social scientists. Social scientists study individuals or groups of people. Instead of working with chemicals or microscopes, environmental social scientists study the *relationship* of individuals or groups of people to the natural environment. They often do this by observing people or by asking them questions. In this study, the scientists wanted to know which elements of an *outdoor recreation* experience were important to people visiting a *wilderness* in Alaska.

The scientists wanted to identify elements of visitor experiences that wilderness *managers* could track. Some of the elements might be things that people can change. Other elements might be things that people cannot change. Weather is one example of an element

Meet the Scientists



▲ **Dr. Kneeshaw:**
My favorite science experience was when I flew into the base camp of Mt. McKinley in Denali National Park and Preserve. I talked with people who climb mountains about their experiences on North America's largest mountain peak.



▲ **Dr. Pendergrast:**
My favorite science experience was going with my father and uncle on Saturday mornings to the Pendergrast Chemical Company. Saturday afternoons were spent hunting through junk yards for pumps, pipes, motors, and so forth with Dad and Uncle Bob. I had my Handy Andy Tool Kit and could take apart anything I wanted to; and for a couple of cents a pound could buy the most amazing stuff!

Glossary continued

tundra (tun dru^h): Treeless flat plains found in cold arctic climates, and covered with grasses, mosses, and small shrubs.

wildlife (wīld lif): Animals that live in the wild.

species (spe sez): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.

ecosystem (e kō sis tem): Community of plant and animal species interacting with one another and with the nonliving environment.

remoteness (re mōt nes): The quality of being far away.

analysis (uh now luh sis): Separating something into its parts to examine it.

questionnaire (kwes chun nair): A list of questions used to gather information from people.

sample (sam pul): A part or piece that shows what the whole group or thing is like.

constrain (kän strān): To hold in or keep back by force.

Pronunciation Guide

<u>a</u>	as in ape	<u>ô</u>	as in for
<u>ä</u>	as in car	<u>u</u>	as in use
<u>e</u>	as in me	<u>ü</u>	as in fur
<u>i</u>	as in ice	<u>oo</u>	as in tool
<u>o</u>	as in go	<u>ng</u>	as in sing

Accented syllables are in **bold**.

that affects your outdoor experience. The person you are with is another element that affects your experience. Think about your favorite outdoor activity. There is at least one element that affects how much you enjoy yourself when you do that activity. What is that element?



Thinking About the Environment

Gates of the Arctic National Park and Preserve is located in the northern third of Alaska (**figure 1**). Gates of the Arctic is a national park, but was also *designated* a wilderness by *Congress* in 1980. For centuries, Gates of the Arctic National Park and Preserve has been inhabited by *native* people. Today, native people still use this area for *subsistence*, and other people go there to do things such as hiking, backpacking, and rafting. This area was created by glaciers, which carved large valleys and wild rivers (**figure 2**). It is now covered with *boreal* forests and arctic *tundra* (**figures 3 and 4**). This area also has an abundance of wildlife. Some of the larger wildlife *species* include caribou (**kair uh bu**), Dall sheep, wolves, and bears (**figure 5**).

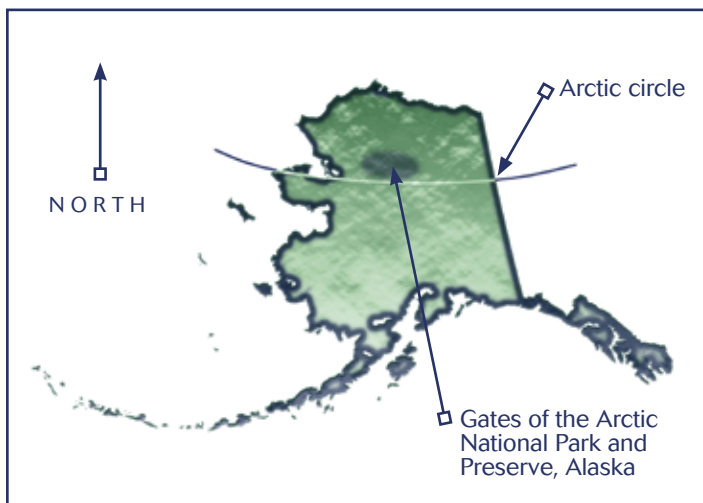


Figure 1. Location of Gates of the Arctic National Park and Preserve.



Figure 2. Gates of the Arctic National Park and Preserve. (Photo by Suzan Stutzman and courtesy of <http://www.wilderness.net>).

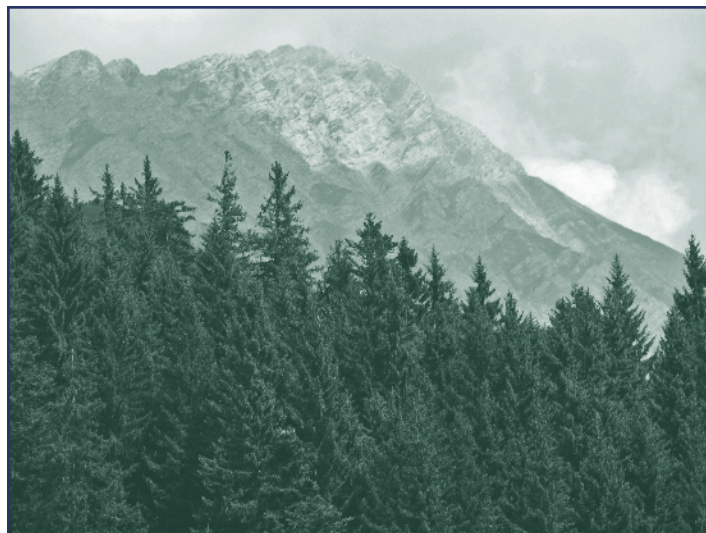


Figure 3. Forests in Gates of the Arctic National Park and Preserve are boreal forests, which are mostly coniferous (evergreen trees with cones).

Wondering About Wilderness



Figure 4. Much of the land within Gates of the Arctic National Park and Preserve is arctic tundra. (Photo courtesy of <http://wilderness.net>.)



Figure 5. Caribou are one of the species found in Gates of the Arctic National Park and Preserve. (Photo courtesy of <http://www.wilderness.net>)

The Gates of the Arctic National Park and Preserve contains two types of ecosystems. Both of these ecosystems require cold temperatures. The first is an evergreen forest called a boreal forest. The most common tree in Alaska's boreal forest is spruce. A waxy coat on the needles of most boreal trees helps to protect them from the cold. The decomposing needles that fall to the forest floor are highly acidic (uh **sid** ik), discouraging most other plants from growing in the forest. As the spruce needles decompose, they become part of the soil. The acid in the soil that comes from the needles prevents most other plants from absorbing nutrients.

The other ecosystem is the tundra. The tundra is a large expanse of grassland plains and, for most of the year, the tundra is covered with ice and snow. The tundra has a top layer of permafrost (**pür** muh frost). The permafrost is a layer of soil that stays frozen all year. In the summer, the very top layer of permafrost begins to thaw during the long days of the short summer. This provides a watery habitat for insects, waterfowl, caribou, and other wildlife.

Introduction

Wilderness managers want to do the best job they can, for both wilderness and for people who visit wildernesses. To do this, they want to know what is important to visitors. This could be things like having good information, seeing wildlife, or feeling completely free. These are examples of elements that affect the experience that people have when they visit wilderness.

In this study, the scientists wanted to identify the most important elements of an experience in Gates of the Arctic National Park and Preserve. Other scientists had already done similar research in other wildernesses. Therefore, the scientists had some ideas about what might make a wilderness experience different than other outdoor recreation experiences. Gates of the Arctic, however, is different from many other wildernesses because of its location, large size, and remoteness. When people visit this area, they are visiting a vast natural area. The closest town to the park boundary is the small village of Anaktuvuk Pass (**figure 6**). Therefore, the scientists thought that the elements of an experience in this wilderness might be different than in most other wildernesses.



Figure 6. Anaktuvuk Pass, the town closest to Gates of the Arctic National Park and Preserve. (Photo by Brian Glaspell)

Reflection Section



Think about what it would be like to be in an area as remote as Gates of the Arctic National Park and Preserve. Think of three things that you would expect to see, do, or feel if you were in an area that far away from cars, phones, buildings, or other people. Remember that in a wilderness, you cannot use any motorized vehicles or equipment. Share your ideas with your class. Discuss the benefits and disadvantages of visiting such a remote place.

If you were the scientist, how would you find out what some of the elements of experience are for people visiting Gates of the Arctic National Park and Preserve?

Methods

Remember that the scientists had a reason to believe that visits to this wilderness might be different from visits to other wildernesses. To get an idea of what some of the elements might be, they talked with 94 visitors to Gates of the Arctic National Park and Preserve. They spoke with each visitor at the end of his or her trip to the wilderness. The scientists audio-recorded these conversations. Then, they typed the conversations exactly as they were recorded. Using the typed copies, the scientists examined what people said about their experience in Gates of the Arctic National Park and Preserve. This was the first part of their *analysis*.

The scientists used what people said about their experience and created a *questionnaire*. The purpose of the questionnaire was to find out if a larger *sample* of visitors felt the same way as the first 94. The questionnaire was sent to the homes of 242 people who visited Gates of the Arctic National Park and

Preserve. The scientists used a computer program to group the answers into smaller categories that represented the important experiences people had while visiting this wilderness. This was the second part of their analysis.

Findings

As a result of their conversations with the 94 visitors, the scientists read over 1,000 pages of text. Some of the things that people said in the conversations are shown in **figure 7**. Remember that the scientists took the comments from the conversations and used them to develop questions for the questionnaire. The scientists received questionnaires from 83 percent of the people. As a result of their computer analysis, the scientists identified five categories that they considered elements of experience at Gates of the Arctic National Park and Preserve (**table 1**).

Reflection Sections



- Why do you think that the scientists audio-recorded the conversations?
- Do you think that the scientists received responses from all 242 people who were sent the questionnaire? Why or why not?

Number Crunches

How many questionnaires did the scientists receive? Multiply .83 by the number of questionnaires that they sent.

The landscape is big.	The area is remote.
I had a feeling of timelessness.	I was physically challenged.
I felt free.	I felt like I could have been the first visitor.
I enjoyed seeing the wildlife.	The scenery was beautiful.
There were a lot of mosquitoes.	I often felt uncertain about what to do.
I felt that other visitors shared my values.	I felt that I was far from any help.
The area is really far north.	I had to change my plans while in the wilderness.

Figure 7. Some of the comments made about the experience at Gates of the Arctic National Park and Preserve. These comments came from conversations with 94 visitors.

Table 1. Five elements of experience at Gates of the Arctic National Park and Preserve. This list was developed from the computer analysis and is based on responses to the questionnaires.

	Elements of experience and some examples to help describe the element	Percentage of people saying that this experience was important to them
1	The Gates Experience	99
	It was a big landscape.	
	I felt a sense of discovery.	
	I was free from the clock.	
	I felt that I was far from civilization.	
2	Free-Roaming Wildlife	95
	I saw a lot of wildlife.	
	I saw evidence of wildlife.	
	The animals were not used to seeing people.	
3	Freedom From Rules and Regulations	94
	I did not feel <i>constrained</i> by park management.	
	I did not feel constrained by regulations.	
4	Problems With Access	59
	It was difficult to find information about Gates of the Arctic.	
	It was difficult to get to Gates of the Arctic.	
5	Risk and Uncertainty	33
	I often felt that my safety was at risk.	
	I was often uncertain about what would happen next.	
	The weather conditions were challenging.	

Reflection Section

🍁 Look at figure 7 and table 1. Each of the comments in figure 7 should fit somewhere in table 1. See if you can place each item from figure 7 under one of the five elements in table 1.

🍁 Which of the elements in table 1 do you think that wilderness managers can change? Discuss why or how managers might or might not be able to change each of these elements with your classmates.



Discussion

Gates of the Arctic managers might decide to use these five elements. The elements might help them to do a better job for the visitors. If the managers decide to use them, they will have to figure out how to measure each of the elements. Remember, however, that these elements only tell a small part of the story. When people visit a wilderness, there are many aspects to the experience that may never be fully known or understood.



Wondering About Wilderness

What is the difference between wild lands and wilderness? Wild lands, sometimes also called wilderness, are natural areas rich in biological diversity, and they provide many benefits to people and other animals. But how is the wilderness that is referred to in this

edition of the *Natural Inquirer* different from wild lands? A wilderness is an area of natural land or water with special legal protection. Land with this legal protection is part of a national system called the National Wilderness Preservation System. In a wilderness, people can visit but cannot

remain. They cannot take anything mechanical into a wilderness, including vehicles. Within a wilderness, nature rules! For more information about wildernesses, read page 5 in this journal or visit <http://www.wilderness.net>.

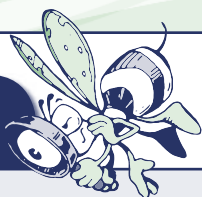
Reflection Section



- Look at table 1, element 2 (Free-Roaming Wildlife). Name one way that managers might measure this element.
- Why do you think that managers will have to measure any of the elements that they decide to use?

From Glaspell, B., Watson, A., Kneeshaw, K., and Pendergrast, D. (2003). Selecting indicators and understanding their role in wilderness experience stewardship at Gates of the Arctic National Park and Preserve, *The George Wright FORUM*, 20(3): pp. 59-71.

FACTivity



The question you will answer with this FACTivity is: What are some of the things that make a visit to Gates of the Arctic National Park and Preserve different than a visit to other wildernesses or other natural areas? The method you will use to answer this question is as follows:

After your teacher divides your class into small groups of 4-5 students,

appoint someone to record your discussion. Look at each element in table 1 and the example descriptions, one at a time. Using a discussion format, answer all three of the following questions for each element. You can use the chart on the next page as a guide to completing this exercise.

1. The element expresses something about a relationship. Was the relationship

between a person and some other thing or things? If so, what was or were the other thing or things? Was the relationship between the person and something else inside of them, like a feeling or emotion? If so, what was it? Was it a combination? If so, how?

2. The scientists thought that the remoteness of Gates of the Arctic National Park and Preserve might make the experience there different than other wildernesses. How might this element be different for a visitor to Gates of the Arctic than for a visitor to a wilderness located near a large city like Atlanta, Georgia, or Los Angeles, California?

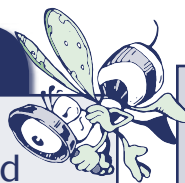
3. Think about natural areas that are not wildernesses. When people hike and camp in these areas, they can drive off-road vehicles and carry any kind of

machines that could help them survive or be more comfortable in the outdoors. How might this element be different for people when visiting natural areas that are not wildernesses, compared with Gates of the Arctic National Park and Preserve?

Pick someone from your group to present your findings to the class. Were the different groups' findings similar or different? Discuss the findings with your classmates and come to a group agreement about the similarities and differences and the reasons for those similarities and differences between outdoor recreation experiences at three types of areas: (1) Gates of the Arctic National Park and Preserve, (2) other wildernesses, and (3) natural areas that are not federally protected wilderness.

Question	Group Discussion and Answers
Element One	
1	
2	
3	

FACTivity Extension



Visit Gates of the Arctic National Park and Preserve Web site at <http://www.nps.gov/gaar/home.htm>. After having a chance to read about Gates of the Arctic National Park and Preserve, discuss some of the key values represented by this area with your classmates.



If you are a Project Learning Tree-trained educator, you may use PLT Activity #54, "I'd Like To Visit a Place..." as an additional activity resource.

Wilderness Makes Cents!

***How Much Are People Willing
To Pay for Wilderness?***



Meet the Scientists



▲ **Dr. Bowker:** One of the great joys I receive from being a scientist has been seeing both of my children pursue science degrees in college. This is a photograph of me with my daughter Rosalina.



▲ **Dr. Bergstrom:** When I was a senior in high school, we took a biology field trip to a salt water marsh on the coast of Virginia. As part of this trip, we walked through the marsh in mud up to our knees—but this was really cool because we got to see up close all of the plants and animals that lived there, like little crabs that rushed around in front of us like kids running around here and there on a playground. This was one of the first times I realized that all of nature (including mud!) has interesting and fun things in it that are important to all of us. Now I spend a lot of time in all kinds of natural places and continue to be amazed by the beauty and wonder of our natural world!



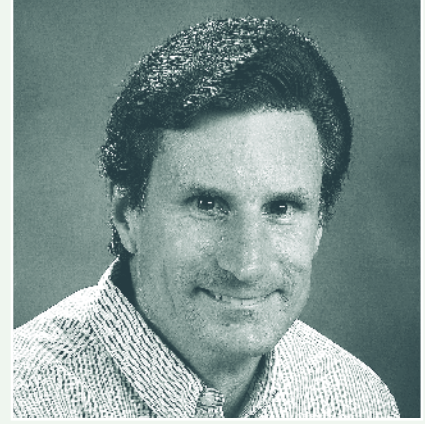
▲ **Dr. Harvard:** My favorite science experience was visiting and doing research in Iceland. You can see me here floating on a small iceberg in front of part of the Myrdalsjokull glacier in Iceland. Iceland has a variety of geological, geographical, and biological mysteries to experience and study. These include glaciers, volcanoes, geysers, waterfalls, hot springs, tectonic plates and earthquakes, Viking ruins, wild blueberries, Icelandic horses, and Icelandic sheep.



▲ **Dr. Cordell:** One of my favorite science experiences is visiting wilderness areas to examine and photograph where and how people are recreating. In this photograph, I am canoeing in the Okefenokee Wilderness, located in southern Georgia. The Okefenokee Wilderness is unique because it is a large freshwater swamp, accessible only by boat, and it is one of the largest undeveloped natural areas in the Eastern United States.



▲ **Dr. English:** My favorite science experience was working with my son Peter to compare flight times and distances of five different paper airplane designs. We made 3 planes of each design and flew each plane 10 times. We averaged the distance covered and time in the air for the 30 flights for each design. The results showed which design flew "best." What a fun experiment!



▲ **Dr. Loomis:** My favorite science experience is getting the results of a survey back and finding the *monetary* values that people have for protection of a *natural resource*. It is usually higher than I would have expected.

Glossary:



monetary (mon uh tair ə): Having to do with money.

natural resource (na cha rôl rē sôrs): A supply of something in nature that takes care of a human need, such as oil.

representation (rep rē zen tə shun): A likeness, picture, image, etc.

legally (lē guh lē): Based on law.

unique (ū nek): Being the only one. Unusual.

social scientist (so shul sjē nist): A scientist who studies individual humans, groups, and their actions or relationships.

passive (pas iv): Not active, but acted upon.

economic (ē kō nom ik): Having to do with the management of money in a home, business, or government.

average (av rij): The usual kind or amount. The number gotten by dividing the sum of two or

more quantities by the number of quantities added.

questionnaire (kwes chen nair): A list of questions used to gather information from people.

Pronunciation Guide

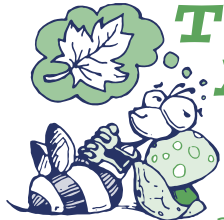
<u>a</u>	as in ape	ô	as in for
ä	as in car	<u>u</u>	as in use
e	as in me	ü	as in fur
i	as in ice	<u>oo</u>	as in tool
o	as in go	ng	as in sing

Accented syllables are in bold.

Thinking About Science



To discover new information, scientists must have one of two things. They either need new data, or they need a new way to examine existing data. Data are *representations* of the things that scientists want to understand. Most of the time, we think of data as numbers that represent measurements or counts of the things being studied. Data can also be words or pictures that represent the objects being studied. In this study, the scientists were interested in some of the benefits that people receive from wilderness. To understand those benefits, the scientists examined existing data in new ways. The data they used were numbers, and those numbers came from research that had been done by other scientists.



Thinking About the Environment

Wildernesses are places that are *legally* protected from human development. As areas that are not developed, people enjoy *unique* benefits from them. One type of benefit that people receive from wilderness is the chance to do things like hike, camp, and canoe in a totally natural area, away from things like roads, electricity, and buildings. This type of benefit is called a recreation use benefit by social scientists.

Another type of wilderness benefit identified by *social scientists* is called a *passive* use benefit. There are three types of passive use benefits. One of these is appreciation felt because of having the option to visit a wilderness in the future.

A second type of passive use benefit is appreciation of being able to pass along to their children the opportunity to use wilderness in the future. A third type of passive use benefit is just knowing that wilderness exists, even if the person never plans to visit them. In this study, the scientists considered both the recreation and the passive use benefits of wilderness.

Introduction

One of the ways that social scientists determine how much benefit people receive from something is to find out how much they would be willing to pay for it. For example, pretend that you are buying a new shirt. You are considering a number of shirts that cost between \$15 and \$35. The more money you spend on a shirt, the less you will have to spend on other things. If you are willing to spend more money, social scientists would say that you are indicating that the more expensive shirt will provide greater benefit than the one that you would spend less on. All of them will keep you covered, but the benefit might include being in style. If being covered is all that you care about, you might spend as little money as possible.

In this study, the scientists wanted to know how much money people would be willing to spend to receive recreation use benefits from wilderness. They also wanted to know how much money people would be willing to spend to receive passive use benefits from wilderness. If you need to refresh your memory on these types of benefits, reread “Thinking About the Environment.” The scientists wanted to estimate how much, across the entire United States, these benefits are worth to the American public.

Reflection Section



- ✦ Reread the first paragraph under “Introduction.” What are some of the benefits you might receive from buying one shirt instead of another?
- ✦ Restate what the scientists wanted to discover by doing this research.



Figure 1. Net economic value is what someone is willing to pay for something over what they actually paid. If the man on the right paid \$50 to go on this recreation trip while in Alaska, what is the net economic value of the trip for him?

Method

The scientists decided to use the results of earlier research to determine the worth of wilderness benefits. You do the same thing when you search the Internet or use the library to gather information for a school project. The scientists were interested in finding information about something called *net economic value*. Net economic value is the amount that a person would be willing to pay for something beyond what they are required to pay for it (**figure 1**). For example, the net economic value of a stylish shirt would be the amount a person would be willing to pay for it above what they actually paid for it.

For recreation use benefits, net economic value is the amount a person would pay to participate in an activity beyond what they have to pay. For example, let's say that a person has to pay for gas and food, and then they have to pay a fee to use an area for recreation (**figure 2**). They pay \$20 a day for these expenses. If they would be willing to pay \$30 a day, the net economic value of their trip would be \$10 ($\$30 - \$20 = \10). The same thing is true of passive use benefits. Let's say that a person pays \$25 every year to help protect a wilderness by joining a group that helps to protect the area. If they would be willing to pay \$50 a year to join the organization, what would be the net



Figure 2. People are required to purchase a special permit to use wilderness for recreation.

economic value of protecting the area for that one person? (Hint: Subtract the amount they pay from the amount that they would be willing to pay to join the organization.)

After looking at previous research, the scientists calculated an average net economic value. This average net economic value came from the different amounts that the scientists found in different studies. **Figure 3** shows the average net economic values for wilderness recreation trips and for passive use benefits.

Recreation Use Benefits (Average per person)	Passive Use Benefits (Average per person)
\$68 per trip	\$67 per year

Figure 3. Average net economic value of a wilderness trip taken by one person and average net economic value of passive use benefits for one person over a year’s time.

Now that the scientists had estimated an average value for individuals, the next step was to estimate a value for the entire American public. This is how they determined the value of recreation use benefits: The scientists multiplied the average net economic value of a wilderness trip for one person by the number of wilderness recreation trips taken each year by everyone visiting wilderness. To find the number of trips taken each year, they examined earlier research.

Estimating the value of passive use benefits across the entire United States population was more difficult. Not every person places a passive use value on wilderness. If the scientists multiplied the average net economic value of passive use benefits by the total

United States population, their number would not be accurate.

Number Crunches

If the scientists multiplied the average net economic value of passive use benefits for one person by the total United States population, would their number be too large or too small?

The scientists decided to use a number that represents a percentage of the number of households in the United States. The percentage they used was 50 percent. That was the percentage of households from which people agreed to answer questions about the benefits of wilderness. For example, if scientists had asked people in 1,000 households to answer a questionnaire, only 500 people, or 50 percent, agreed to answer. Although people have many reasons for not answering a questionnaire, one of the reasons might have been that the person did not feel any benefit from wilderness. In the United States, there are 110 million households. Therefore, the scientists multiplied the average passive use benefit (from figure 3) by 55 million.

The scientists then divided the two benefit totals by the total number of acres in wildernesses in the United States, which is 106.5 million acres. The resulting two figures represent the dollar amount of benefit per acre for the two types of benefits.

Reflection Section

- Look at figure 3. Explain in your own words what each of the dollar values represents.
- Reread the last sentence in the “Methods” section. What might be one advantage of knowing the dollar amount of benefit per acre for each of the two types of benefits?



Findings

The results of the scientists' calculations are shown in **figures 4 and 5**.

Recreation Use Benefits	Passive Use Benefits
\$465 million	\$3.7 billion

Figure 4. Net economic value of wilderness recreation use benefits and passive use benefits for the entire United States.

Recreation Use Benefits	Passive Use Benefits
\$4.39 per acre	\$34.50 per acre

Figure 5. Net economic value of wilderness recreation use benefits and passive use benefits for each acre of wilderness land in the United States.

Discussion

People do not always agree that wilderness provides benefits. Because wildernesses are owned by the public, it is important to understand whether the public receives benefits from wilderness. Many of the benefits that people receive from wilderness are hard to identify. It is harder still to place a value on those benefits. This study indicates that Americans benefit from using wilderness for recreation use. Even greater than this, Americans feel that they receive a benefit from wildernesses even if they do not use them for recreation. They also want to have wilderness available for future generations.

Reflection Section

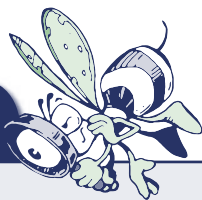
Recreation use benefits and passive use benefits are not the only benefits of having wilderness. Name at least one other benefit of having wilderness.

Reflection Section

- Look at figures 4 and 5. Compare the amounts in each column. Would you say that recreation use benefits or passive use benefits have greater value to the American public? Why?
- Think about what the numbers in figures 4 and 5 represent. If you need to refresh your memory, reread "Thinking About the Environment" at the beginning of this article. What would you conclude about the benefits people receive from wilderness?

From Harvard III, J. E., Bowker, J. M., Bergstrom, J. C., Cordell, H. K., English, D. B. K., and Loomis, J. B. (2005). The net economic value of wilderness. In: Cordell, H. Ken, Bergstrom, John C., & Bowker, J.M. (2005). *The Multiple Values of Wilderness*. State College, PA: Venture Publishing.

FACTivity



In this FACTivity, your class will determine the average net economic value of five different music CDs. You can also do this activity by determining the average net economic value of a single music download, of DVDs, or of any product or service that most of you are likely to purchase. If most of your classmates do not purchase their own CDs, select a product or service that must be paid for out of allowance money.

Create a list of CDs and then write each CD name on a separate small piece of paper. Fold each piece of paper and place the pieces into a container. Your teacher will have one of your classmates select five pieces of paper from the container. These will be the names of the five CDs with which you will work.

Once you have selected five CDs, agree as a class on the price of each CD. This is the price that was paid to purchase the CD.

Create your own chart with six rows and four columns based on the following example. Add column headings identified in the example chart. Write the names of the CDs and the artists in column 1, the price paid to purchase the CDs in column 2, and what you would be willing to pay to purchase each CD in column 3. This can be any price but it should represent the maximum you would be willing to pay to purchase the CD. Calculate the net economic value for each CD by subtracting column 2 from column 3 and record in column 4.

Report your values for column 4 to your class. (*Note: if column 4 values are negative, the CD has zero net economic value.*)

Example chart for music CDs

Name of CD and of artist	Price paid to purchase	Maximum amount willing to pay to purchase	Net economic value (Subtract column 2 from column 3)

Now you will calculate the average net economic value for each of the five CDs. One student should write each classmate's values for the first CD in a list on the board. Add the values in the list and divide the total by the number of values in the list. This is the average net economic value of that CD. Do this

for each CD and write the average net economic values on the board.

Discuss the results of your calculations with your classmates. Are the average net economic values about equal for the five CDs? If there are differences between some of the CDs, why do you think this is so?

FACTivity Extension

Overnight, have each of your classmates ask their parents or guardians the same question regarding each of the five CDs. That question is “What is the maximum amount you would be willing to pay to purchase this CD for your own enjoyment?” Calculate again the average net economic value

of each CD from the viewpoint of your parents or guardians. Compare those values with the values you calculated from the classroom activity. Is the average net economic value of the CDs different for your parents or guardians than for your classmates? If so, why do you think that is?



If you are a Project Learning Tree-trained educator, you may use PLT Activity #50, “400 Acre Wood,” as an additional activity resource.

Wondering About Wilderness

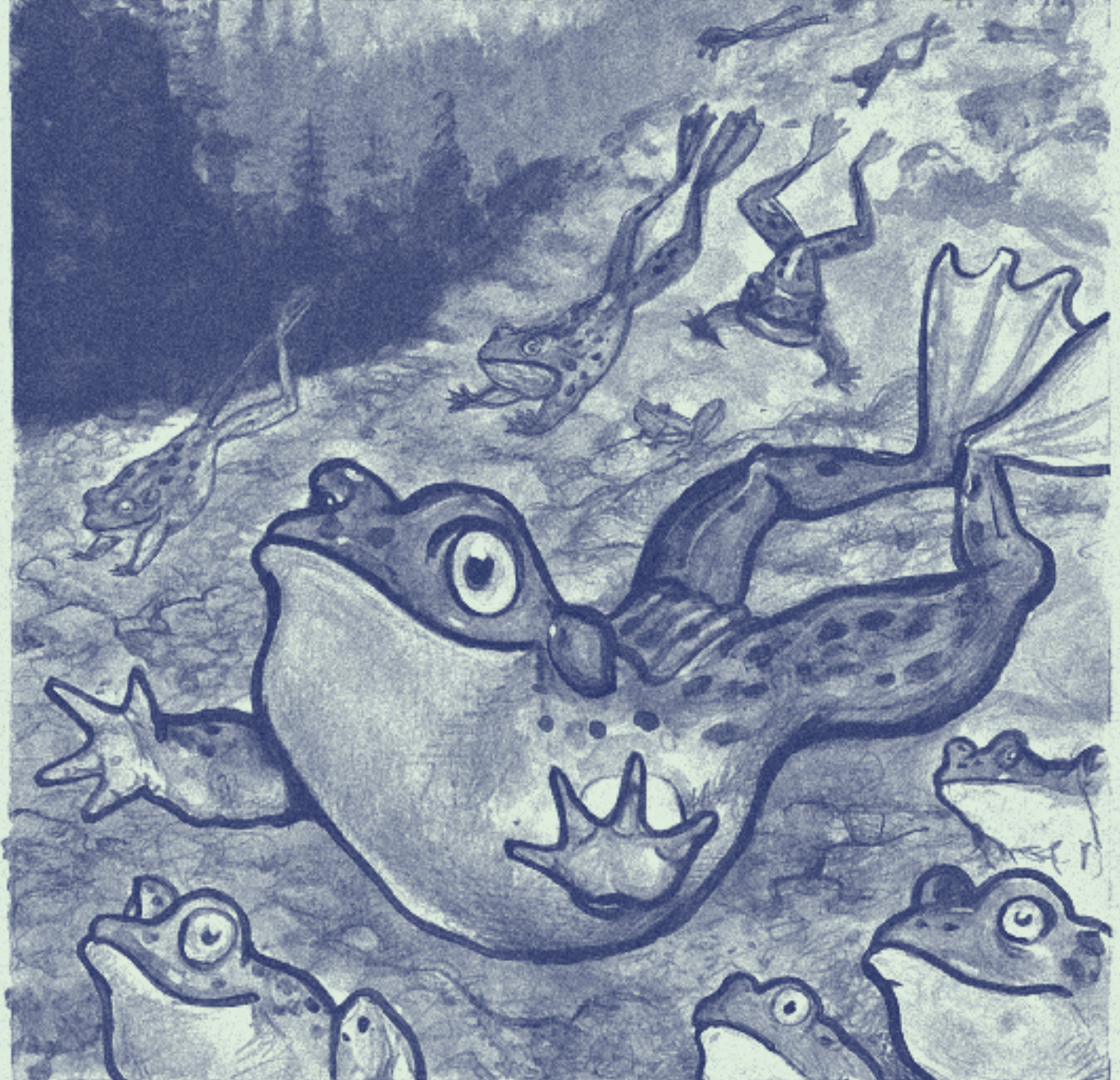
Take a moment to think about the difference between natural lands and more developed areas in and around cities and towns. You probably have seen some natural lands being developed for shopping centers, roads, houses, and other buildings. What was once a forest becomes something quite different. Did you know that some natural lands are legally protected from development? These lands are called wilderness. They are mostly found in the Western United States, but many wildernesses are found in the East as well. This article describes some of the benefits American citizens receive from wilderness, even if

they never visit a wilderness. For more information about wildernesses, read page 5 in this journal or visit <http://www.wilderness.net>.



As the Frog Hops:

***What Routes Do Frogs Travel
in Mountain Environments?***



Meet the Scientists



▲ **Dr. Pilliod:** My favorite science experience is going out at night to look for frogs and toads. I use flashlights to find them clinging to branches in the trees, floating in ponds, or among fallen leaves and vegetation along streams. Sometimes I only see their beady eyes shining in the dark. I often work at night because that is the time when some frogs are most active. For example, I am studying the effects of disease on a *boreal* toad population in Wyoming. During the daytime I can find a couple of toads in the pond, but around 11 p.m. they appear in the pond by the hundreds. I am studying how social behavior influences the spread of disease in these toads.



▲ **Dr. Ritson:** It is hard to pick my favorite science experience since I have had so many different types of experiences in geology, oceanography, chemistry, and biology. Remembering my time in Idaho with Dr. Pilliod always brings a grin to my face. Having the time to get to know a place, people, and a population of frogs is awesome. I spent 3 years watching the mountains turn from white (snow covered) to green (with new plants) to brown (as the vegetation dries out) to white again.

I learned where every secret lake, pond, and puddle was and the routes to and from them. Actually, the frogs taught me a lot of short cuts over the years as we followed them. It was awesome what I learned from these frogs (but I had to be patient and take time to observe them). I still don't know how they know where the different lakes are or how to use a short cut between them, but these questions keep me curious.



▲ **Dr. Peterson:** My favorite science experience was working on a study of where garter snakes like to hide at night. Garter snakes are interesting and live in beautiful areas. My *colleagues* and I were doing our study at a mountain lake in northern California. We used a variety of techniques to discover that snakes usually chose rocks of intermediate thickness to hide under at night. This allowed them to digest their prey at the best body temperature and prevented them from getting too hot or too cold.

Glossary:



boreal (bôr rē ul): Relating to a northern climate, with long, cold, and dry winters. The trees in a boreal forest are evergreen.

colleague (kă lēg): A fellow worker in a profession or office.

Congress (kŏng gres): The group of elected officials in the United States that makes the laws. Congress is made up of the Senate and the House of Representatives.

migration (mī gră shun): The act of moving from one place to another.

elevation (el uh vă shun): The height of a place or thing above sea level.

population (păp yoo lă shun): The whole number of

individuals of the same type occupying an area.

habitat (hab uh tat): Environment where a plant or animal naturally grows and lives.

hibernate (hī būr nat): To pass the winter in a sleeping or resting state.

species (spe sez): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.

native (nat iv): Naturally occurring in an area.

amphibian (am fib e un): Any organism that is able to live both on land and in water.

natural resource manager (na cha rôl rē sôrs ma nī jūr): Skilled person who takes care of natural resources.

foraging (for ij ng): The act of taking food by animals, usually taken by browsing or grazing.

silt (silt): Very small particles left as sediment in water.

wetland (wet lend): Area of land with lots of soil moisture.

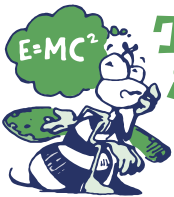
metamorphosis (met uh môr fuh sis): The process of change in the form of some animals from an immature stage to an adult stage.

wildlife: (wild lif): Animals that live in the wild.

Pronunciation Guide

<u>a</u>	as in ape	<u>ô</u>	as in for
<u>ă</u>	as in car	<u>u</u>	as in use
<u>e</u>	as in me	<u>ü</u>	as in fur
<u>i</u>	as in ice	<u>oo</u>	as in tool
<u>o</u>	as in go	<u>ng</u>	as in sing

Accented syllables are in bold.



Thinking About Science

Sometimes, environmental scientists must do their research in natural areas away from the disturbance of humans. In the United States, there are few natural areas left where people have not disturbed the land and water. When Congress created the National Wilderness Preservation System, they intended that among its many purposes, wilderness would be used for scientific research.

In this research, the scientists wanted to study the *migration* of frogs at high *elevations*.

They needed to find a large natural area that had several *populations* of frogs and was not disturbed by human activity. They identified an area called Skyhigh Basin, which is located within Frank Church-River of No Return Wilderness in Idaho (**figures 1 and 2**). As part of a wilderness, Skyhigh Basin is protected from machines and all human development. Because it is almost 12 miles from a road, few people go there. It was the perfect place to study the migration of frogs.

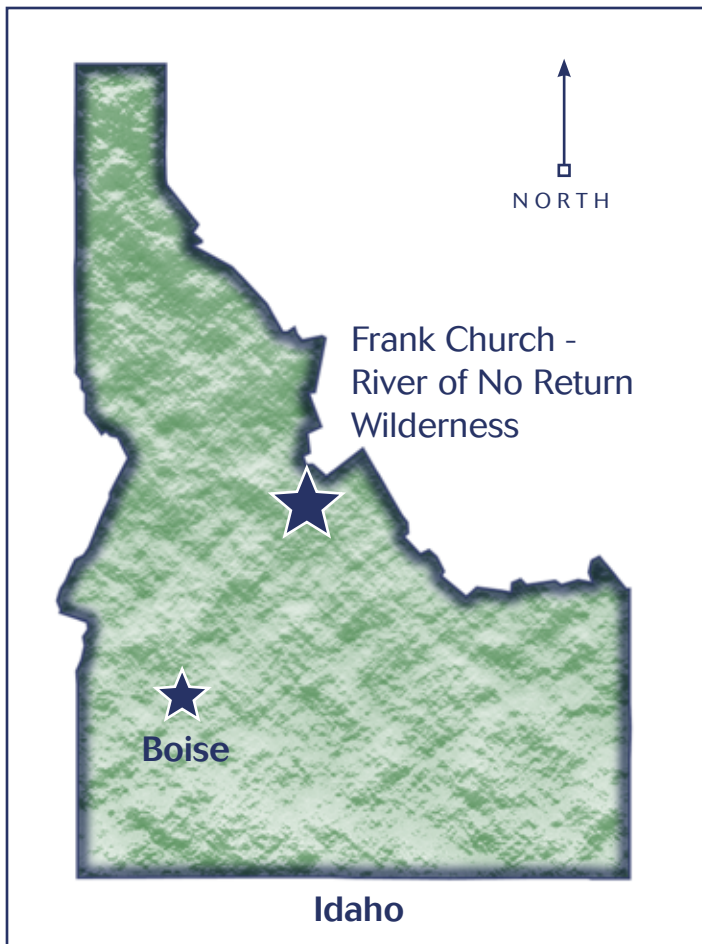


Figure 1. Location of Frank Church - River of No Return Wilderness in Idaho.

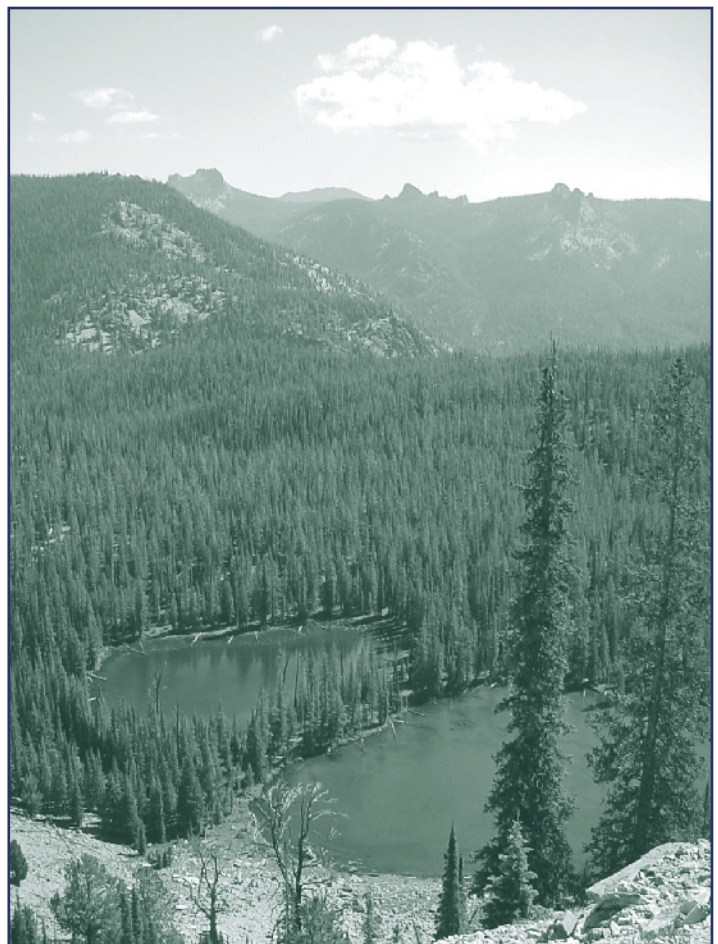
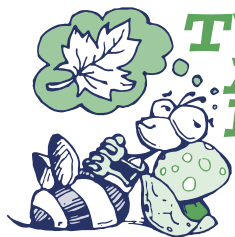


Figure 2. Skyhigh Basin.



Thinking About the Environment

Did you know that frogs are complex animals? For many frogs, each season brings the need for a different *habitat*. You probably know that as tadpoles, young frogs must have water to live. Actually, frogs need watery habitat throughout their lives. They need areas to reproduce, find food, and *hibernate*. Because one area might not provide for all of these needs, frogs can migrate from area to area, depending on the time of year.

In this research, the scientists wanted to know how far and to which habitats a certain *species* of frog migrated. This particular species is called the Columbia spotted frog. Although it is found throughout the mountains of the Northwestern United States, its population has become threatened in some areas. One of the reasons is the introduction of non-*native* trout, which eat the tadpoles. Other reasons for the decline in frog populations include taking water from natural streams and lakes for human purposes and the loss of habitat to human development, such as buildings and roads.

Introduction

Frogs are a species of *amphibian*. In recent years, there has been a decline in the numbers of amphibians worldwide. This decline is thought to be caused by many things. A few of those reasons are mentioned in the “Thinking About Environment” section.

Natural resource managers need to have more information to protect frog populations. Not much is now known about the habitats needed by frogs. The scientists in this study wanted to discover the types of habitats needed by Columbia spotted frogs at different times of the year (**figure 3**). In the early summer, these frogs breed and lay their eggs. The adults then spend the summer finding food, an action called *foraging*. During the winter, they hibernate under water. (The frogs do not breathe while under water, but absorb oxygen from the water through their skin.) The scientists also wanted to find out how far Columbia spotted frogs will travel or migrate to reach different habitats, and which routes they take when they are migrating.

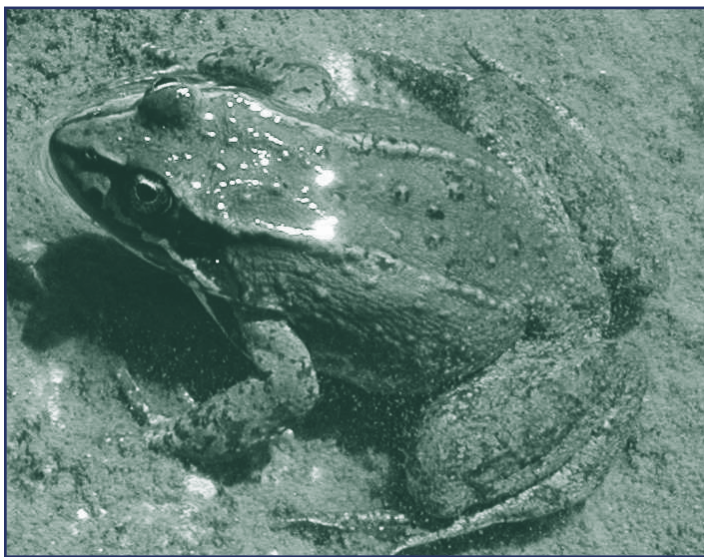


Figure 3. Columbia spotted frog.

Reflection Section



Do you think that a nonnative species of animal should be allowed to harm the population of a native species? Why or why not?

The last paragraph in the “Introduction” describes three things that the scientists wanted to discover. Restate these three things as questions.

Methods

The first thing the scientists did was identify and map all of the bodies of water in Skyhigh Basin (**figure 4**). Beginning in the early spring, the scientists walked around the edge of each lake and pond and looked for Columbia spotted frogs (**figure 5**). They also looked for frogs while walking along the banks of streams. In nearby water-filled meadows, the scientists walked back and forth through the meadows looking for frogs.

When frogs were found, they were caught, measured, weighed, and released. The sex of each frog was also recorded along with its measurements and weight. The scientists marked the toes of each frog. The marking indicated the habitat in which each frog was first captured.

Some of the female frogs were fitted with a transmitter that was placed around the waist (**figure 6**). The transmitter allowed the scientists to track the movements of the female frogs. The scientists checked the female frogs every 1-3 days to make sure that the transmitters were not cutting the frogs’ skin. If the frog had any shallow cuts, the scientists put Neosporin® ointment on the skin before releasing the frog. If the cuts were deep, the scientists removed the transmitters so that the frogs would not be harmed. The scientists tracked the

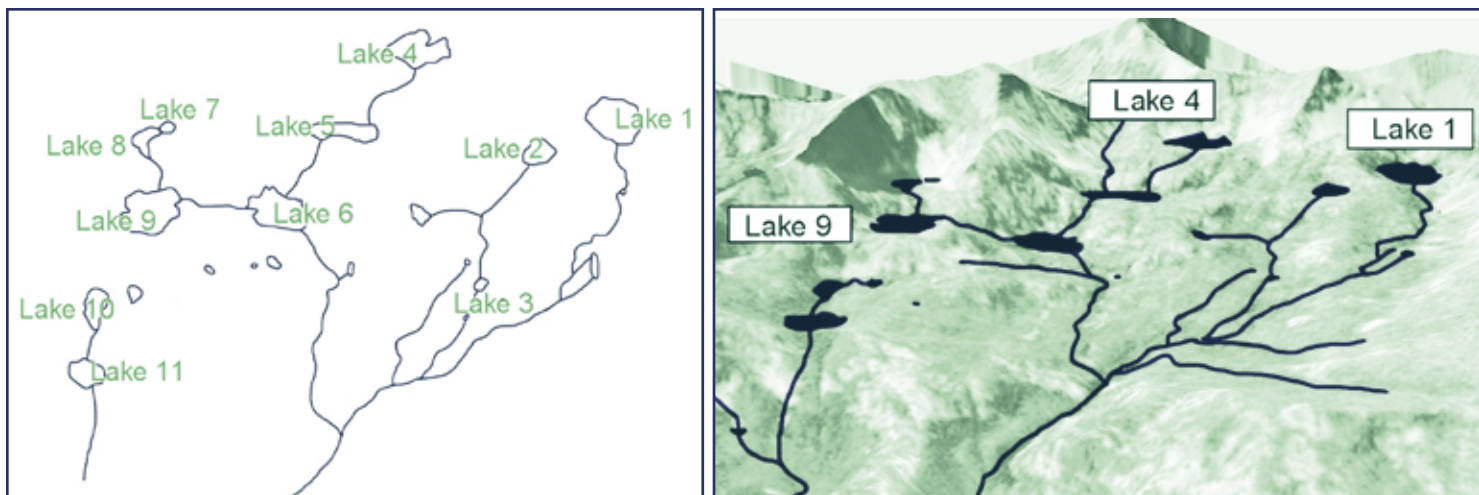


Figure 4. The study site in Skyhigh Basin. In this figure, a photograph is shown on the right. The location of the lakes is shown in blue. The streams are shown as blue lines. Lakes 1, 4, and 9 are identified. On the left, the location of all of the lakes is shown as a map. Using the map as a guide, locate the 11 lakes on the photograph.

movements of the frogs throughout the summer and into the early fall.

When frogs were found during their breeding season, the areas in which they were found were identified as breeding habitat. When frogs were found during the

middle and late summer, the areas in which they were found were identified as summer foraging habitat. In late August and early September, the areas in which frogs were found were identified as winter habitats.



Figure 5. Scientists looking for frogs in the lakes. (Photo by Peter Landres)

Reflection Section



❖ The scientists marked the toes of each frog that was found. Can you think of one reason why the scientists would want to identify the frogs that had been caught?

❖ The scientists were careful not to harm the frogs during their research. Do you think that scientists should take care not to harm the animals that they study? Why or why not?



Figure 6. Scientist placing a transmitter on a female frog.

Findings

The scientists identified a number of different habitats according to the use that was made of the habitat (**figure 7**). Shortly after laying eggs in early July, some of the adult frogs began to leave the breeding habitat for summer foraging. A greater number of female frogs migrated from their breeding habitat than males or young frogs that had not yet begun to breed. After 4 weeks, adult male frogs were found up to 424 meters away

from the breeding habitat. Adult females were found up to 1,033 meters away.

Number Crunches

How many yards away from their breeding habitat were adult male and female frogs found? Multiply the number of meters by 1.09 to find out. To find out how many feet this is, multiply the number of meters by 3.28.

The scientists wondered if the difference in distances migrated was due to the sex of the frog or its size. The scientists found that larger frogs migrated farther than smaller ones.

At the end of the summer, the frogs migrated to winter habitat. The scientists found that the youngest frogs traveled up to 350 meters from breeding habitat to winter habitat areas. These young frogs had recently undergone *metamorphosis*, and so had spent the summer growing from tadpoles into frogs. The scientists found that the adult frogs traveled up to 708 meters in a day. Some of the female frogs traveled between 50 and 160 meters per hour. Most of the females migrated during the nighttime when the temperatures were cooler.

Time of year	Habitat use	Description of habitat
Early July	Breeding	Small, <i>silt</i> -bottomed lakes with no fish; or larger, rock-bottomed lakes with little vegetation.
Early July to late August	Summer foraging	All types of <i>wetland</i> habitats.
Mid-August and later	Winter habitat	Large, deep rocky lakes with a constant flow of water into and out of the lake. Some of these lakes had nonnative trout living in them.

Figure 7. Types of habitats used by Columbia spotted frogs.

Number Crunches

How many feet did the youngest frogs travel to reach winter habitat areas? Up to how many feet did the adult frogs travel in a day? What proportion of a mile is this? (Divide the number of feet by 5,280 to find out.) What was the range in speed traveled by some of the females in feet per hour?

The scientists found that when the female frogs migrated from place to place, they generally traveled in a straight line. They did not follow the streams that connected the habitats (**Look again at figure 4, under “Methods”**). By traveling a straight distance over dry ground, the frogs shortened the distance they had to travel by up to 1 kilometer (1 kilometer = .621 miles) (**figure 8**).

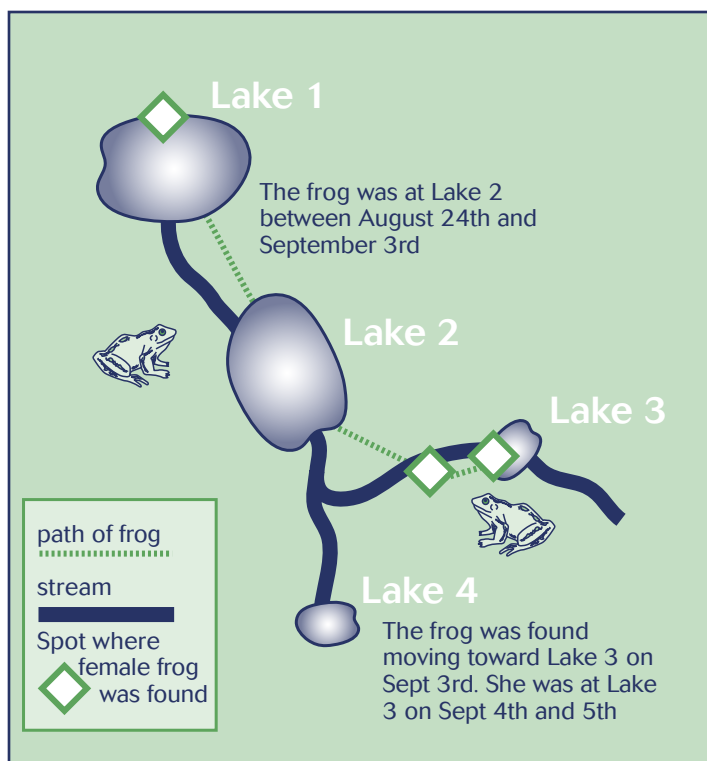


Figure 8. An example of the migration pattern of one of the female frogs. You can see that these frogs generally traveled in a straight-line direction.

Reflection Section



- ✶ The scientists found that the female frogs migrated farther than males. They also found that larger frogs migrated farther than smaller frogs. What does this tell you about the size of male and female frogs?
- ✶ If you were a natural resource manager and you wanted to protect the Columbia spotted frog, would you only focus your attention on the lakes, ponds, and streams where frogs breed, forage, and spend the winter? Why or why not?

Discussion

This research indicates that frogs living in the high mountains of the American West need a diversity of water bodies as well as the drier habitats between them. Scientists had previously thought that frogs migrated only along streams or other water bodies. The scientists in this study found that frogs will also travel across dry areas to reach a desired water body. Frogs generally travel when it is raining or at night, which may help them travel across areas with no water. A frog's ability to travel quickly may also help them to travel across dry areas.

If natural resource managers want to protect the Columbia spotted frog population or similar frog species, they should focus on at least two things. First, they should protect many types of water bodies in mountainous (**mown** ten us) areas of the American West (See figure 7 under “Findings,” above). In addition, the scientists suggest that managers should protect the dry land areas within 1 kilometer of these water bodies.

Reflection Section



- ❦ What new thing did the scientists learn about the migration of Columbia spotted frogs?
- ❦ Why do you think the scientists suggest protecting dry land areas within 1 kilometer of a water body?
- ❦ Do you think that the scientists could have done this study in an area that was not a wilderness? You might want to reread “Thinking About Science” before you answer this question.

From Pilliod, D. S., Peterson, C. R., and Ritson, P. I. (2002). Seasonal migration of Columbia spotted frogs (*Rana luteiventris*) among complementary resources in a high mountain basin. *Canadian Journal of Zoology*, 80: 1849-1862.

Wondering About Wilderness



What are public lands? Public lands are lands owned by the citizens and managed by a government agency for citizens' benefit. Our Nation's largest areas of public lands are managed by the Federal Government. There are many categories of Federal public lands. One of these categories is wilderness. Wilderness is different than any other Federal land. Land that is wilderness has been granted legal protection from human development. Because of this protection, wilderness provides many benefits. What wilderness benefit is being presented in this article? For more information about wilderness, read page 5 in this journal or visit <http://www.wilderness.net>.

FACTivity

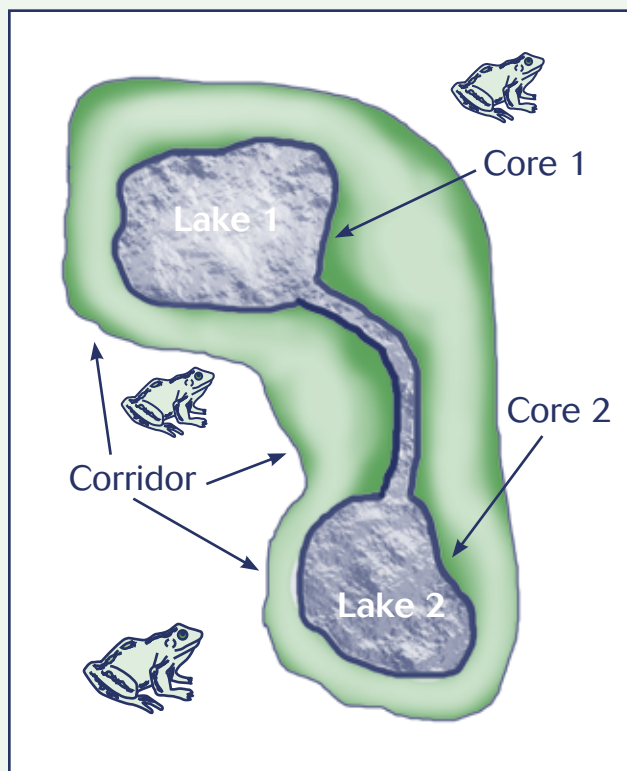
In this study, the scientists discovered that wildernesses provide good habitat for frogs because the land and water are protected from human activities. In a society, all of the land and water cannot be protected from human activities. There are many areas of land and water that are available to wildlife, such as frogs, but they are not protected from human activities as is wilderness. Many of the animals living in these areas need to migrate, like the frogs in this study.

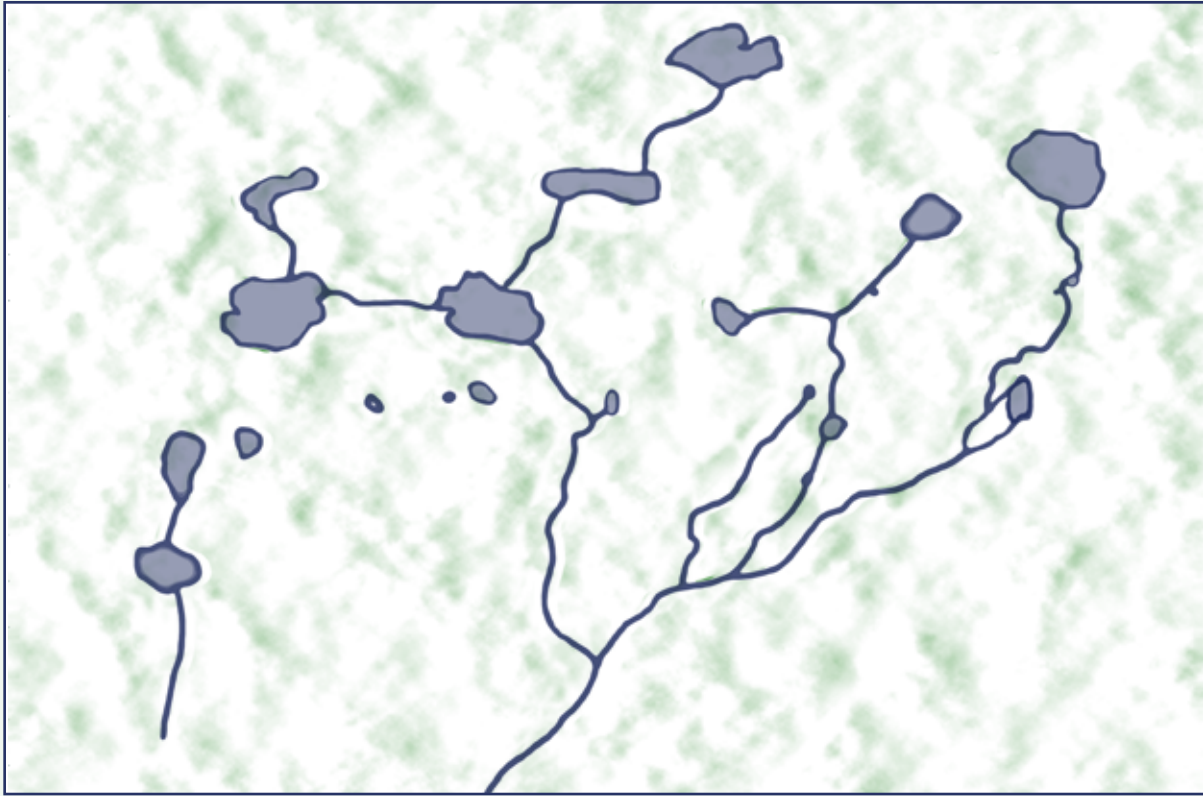
There is a way that we can help migrating wildlife to live in areas that are not protected in the same way that wildernesses are protected. This involves the protection of two types of land or water. One type of land or water is called the core. The core is where the animals breed, forage, and

spend the winter. As an example, the cores in this study are the bodies of water where the frogs breed, forage, and hibernate. The other type of land or water is called a corridor (**kôr uh dôr**). The corridors in this study would include the routes taken by the female frogs as they moved to and from bodies of water. Because the land and water in this study is wilderness, the core and corridors do not need additional protection. In nonwilderness, however, we might want to identify core land and water areas and corridors and give them special protection from certain kinds of human activities. That way, we could provide and protect the habitat needed by migrating wildlife in areas that cannot be set aside as wilderness.

In this FACTivity, you will use the same map as shown in figure 4, without the lakes being identified by number. Using the results from this study, you will modify the map by drawing in core areas and the corridors that might be used for frog migration. An example of a core area and corridor is given on the left. On the map on page 35, draw core areas and corridors for the Columbia spotted frog. Use different colored pencils to identify which areas are the cores and which are the corridors.

In small groups of 3-4 students, share your maps with each other. Are your maps similar or different? Hold a discussion about why you drew your map the way that you did. Each small group should appoint a reporter to share your discussion and maps with the class.





FACTivity Extension:



Visit these Web sites and conduct additional research on wildlife corridors and wildlife migration.

- ▣ http://www.wildlands.org/l_intro.html
- ▣ <http://www.conservationeconomy.net/content.cfm?PatternID=21>
- ▣ <http://www.learner.org/jnorth/>
- ▣ <http://www.safnet.org/archive/corridors501.cfm>

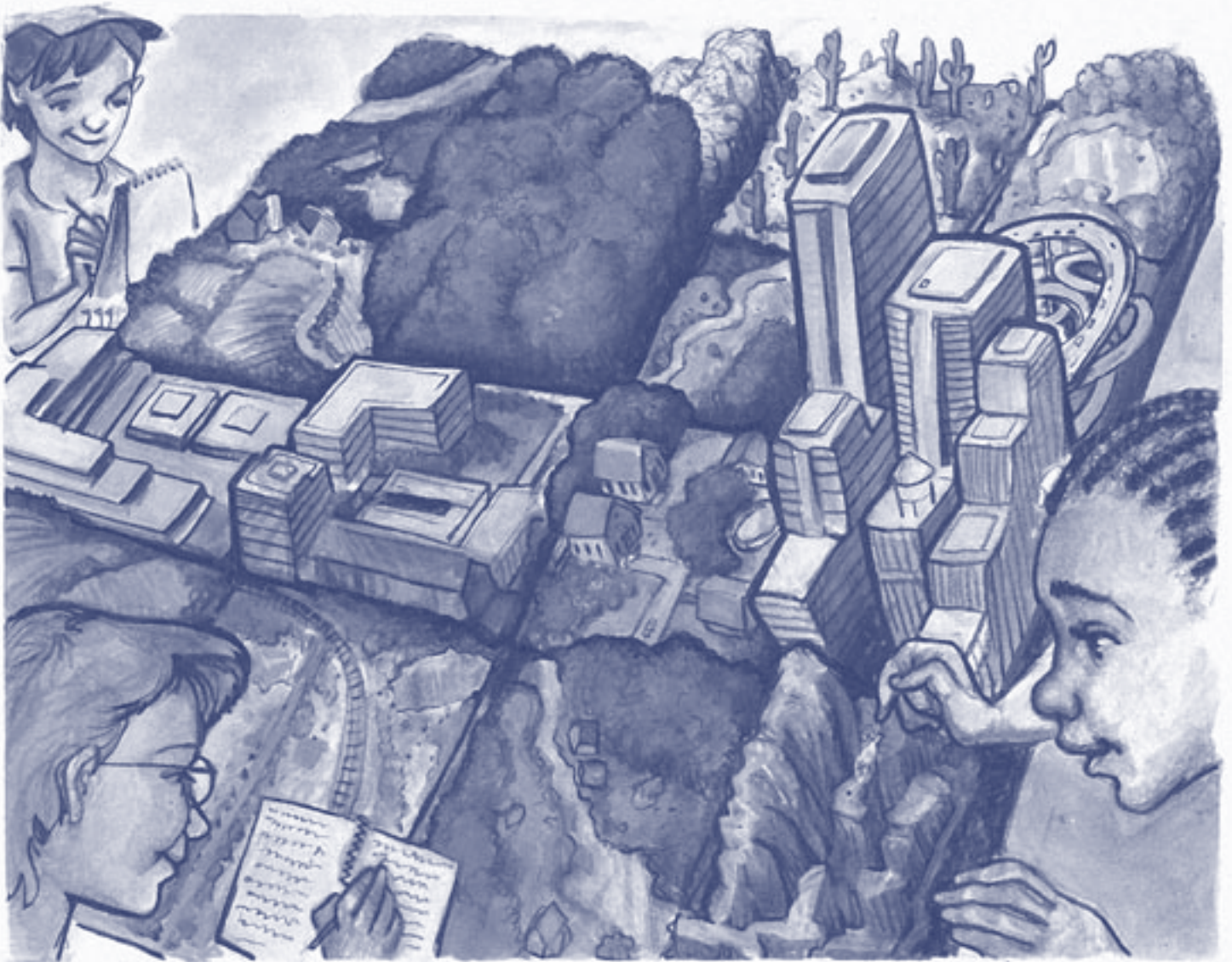
Identify the wildlife species that migrate in or through your area. The species will be different, depending on where you live. Discuss whether those migrating species could benefit from the creation of core areas and corridors. If so, try to identify some likely places in your community to place core areas and corridors.



If you are a Project Learning Tree-trained educator, you may use PLT Activity #88, "Life On the Edge" Part A and PLT Activity #45, "Web Of Life" as additional activity resources.

Wild and Free!

The Quality of Wildness in Wilderness in the United States



Meet the Scientists



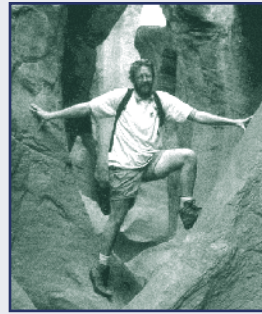
◀ **Dr. Aplet:** My favorite science experience was studying vegetation development on lava flows in Hawaii. It was fascinating to see how plants get started on bare rock, but the

coolest thing was just to stand among the tree ferns and rare native birds in fully developed rainforest on thousand-year-old lava.



◀ **Mr. Wilbert:** My favorite science experience was being the field technician for a research project where we investigated the fertilizer benefits and the environmental impact of irrigating young

forests with wastewater from a sewage treatment plant. I designed, built, and maintained irrigation systems, as well as a series of underground compartments, where we collected water samples.



◀ **Dr. Morton:** My favorite science experience was the summer I spent camping with Dr. Aplet in the Colorado mountains when we were doing some

research on wilderness. During the day, we collected information on the age and structure of ancient forests; while at night, we discussed science around the campfire.



Thinking About Science

Scientists are always learning about and using the latest technology that can help them to do a better job of discovering new information. In this study, the scientists used technology in the form of a computer-based mapping system, called a Geographic Information System (GIS). In a GIS, layers of information about a specific place are combined. The result is information about that place that includes the relationship of a number of features. In this study, the scientists combined six types of information for each of 16 million square kilometers of land and water in the United States (**figure 1**).

Thinking About the Environment



Imagine a small piece of land, about one-half kilometer square (or a little less than one-third of a mile on each side). That piece of land can have many characteristics that may be identified and measured. For example, you could measure the amount of ground within the square that is covered by trees. You could measure the length of any road within the square, or identify that there are no roads within the square. You could measure the length of any stream or river within the square. You could count the number of people living within the square. You could even count the number of middle school students living within the square!

The land has many characteristics, which include natural characteristics and human-related characteristics. Think about the land on which your school is located. Identify four natural characteristics that can be measured and four human-related characteristics that can be measured. You can see that a lot of information can be attached to a specific piece of land.

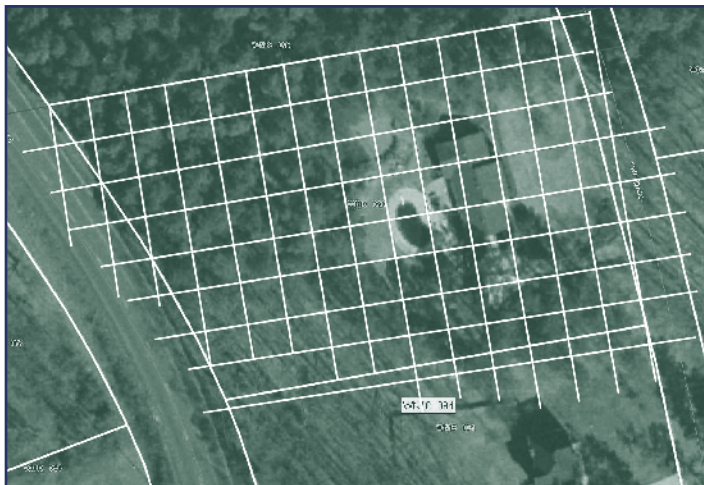


Figure 1. The top photo is an *aerial* photo of a house. You can see the roof and a swimming pool to the left of the house, with trees beyond towards the road. In the photo below, a grid has been placed on the photo. Although this is not at the same scale as the research done in this study, this grid shows how small squares of land can be identified and characteristics of land within each square can be described. (Photo courtesy of Barrow County, Georgia).

Glossary:



aerial (air e ul): Of or in the air.

speculate (spek u lat): To think about or make guesses.

hypothesis (hī paw thuh sis): An unproven idea that is accepted for the time being and is often tested during a scientific study.

composition (kām pō zish un): The act of combining parts or elements to form a whole.

components (kom pō nentz): Any of the main parts of a whole.

species (spe sez): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.

genetic diversity (juh neh tik dī vūr suh tē): Variation at the level of individual genes that makes variety possible.

plant community (plant ko mūn uh tē): A group of plant species that interact with each other and with their environment.

native (nat iv): Naturally occurring in an area.

satellite imagery (sat uh lit im ij rē): Photographs and other images of Earth taken from satellites orbiting Earth.

land cover (land ka vūr): Whatever is covering the land, such as trees, grasses, buildings, or roads.

indicator (in di ka tōr): Something that measures or shows something.

manage (man ij): To have charge of or direct the work of.

median (mē dē un): The number that is half-way between in a list of numbers.

The National Wilderness Preservation System is a system of land areas with special legal protection from human development. In the *Natural Inquirer*, the word wilderness always refers to lands that are a part of this national system and are under Federal protection. Other undeveloped lands are referred to as wild lands to distinguish them from lands within the National Wilderness Preservation System.



Superfund (**sup** ür fund): A U.S. Environmental Protection Agency (EPA) program to help clean up the environment. The areas that the EPA has identified as the most polluted sites in the United States are called Superfund sites.

national park (**nash** uh nul park): Federal land managed by the Department of the Interior National Park Service as a preserved natural area to be used for outdoor recreation and for learning about United States culture and history.

national forests (**nash** uh nul **fôr** est): Federal land managed by the USDA Forest Service to provide outdoor recreation opportunities, clean water, timber, habitat for wildlife, minerals, and for other uses.

national wildlife refuge (**nash** uh nul **wîld** lif **ref** uj): Federal land managed by the Department of the Interior U.S. Fish and Wildlife Service to provide habitat for wildlife.

national grassland (**nash** uh nul **gras** land): Federal area managed by the USDA Forest Service as a prairie.

reservoir (**rez** ür vwor): A place where something, especially water, is collected and stored for use.

Pronunciation Guide

a	as in ape
ä	as in car
e	as in me
i	as in ice
o	as in go
ô	as in for
u	as in use
ü	as in fur
oo	as in tool
ng	as in sing

Accented syllables are in **bold**.

Introduction

According to the scientists in this study, wildness is one of the central qualities of wilderness. To say that an area is wild in this sense, the scientists believed that it must have two qualities: (1) It must have the quality of naturalness, and (2) it must be free from the control of humans. **Figure 2** describes the relationship of different types of land to these two qualities. Using this figure, you can compare how different types of land, from wilderness to cities and towns, are related to the qualities of naturalness and freedom from the control of humans.

The scientists *speculated* that wilderness is more natural and freer from human control than other land in the United States. However, they did not know this for sure. Often, common sense or past learning tells us that something must be true. In science, this is sometimes called a *hypothesis*. Until scientific research is done to prove it, however, we cannot really say for sure. In this study, the scientists wanted to find out whether their belief that wilderness is more natural and freer from human control than other lands is really true.

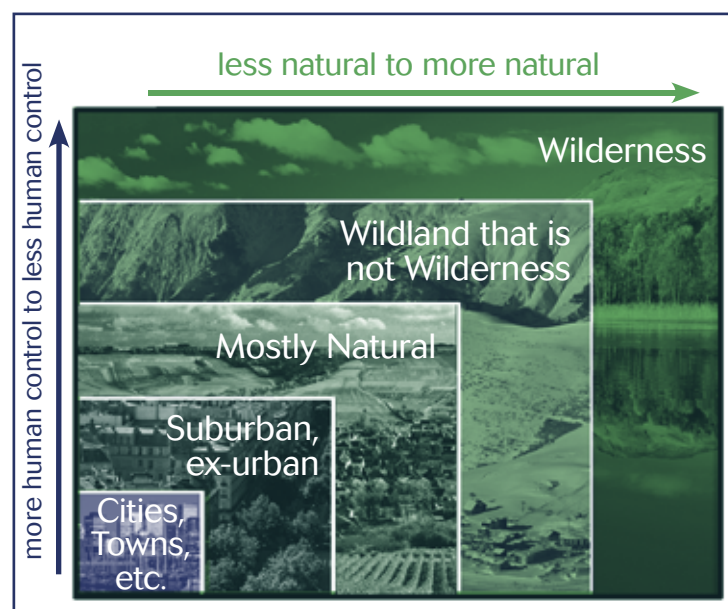


Figure 2. The wildness continuum.

Reflection Section



- ✿ Restate, in your own words, what the scientists in this study wanted to learn about wilderness as compared with other land in the United States.
- ✿ If you have not done so yet, read “Thinking About Science” and “Thinking About the Environment.” In those sections, you learned that the scientists used a GIS to collect their information. You also learned that in a GIS, information is connected to a specific place. For the land and water in each of the 16 million squares, what did the scientists want to know?

Method

The scientists had to find a more specific way to define what was meant by how natural the land was and how free it was from human control. The information that would be collected had to be the same across all 16-million-square kilometers of the United States. To do this, the scientists had to define what they meant by naturalness and freedom from human control. **Figure 3** shows how they defined these two qualities.

The scientists wanted to collect information on each of these six qualities for all 16-million-square kilometers of U.S. lands and waters. The scientists did not have the time or the money to collect their own information. Instead, they had to find existing sources of information. The existing information also had to be attached to a specific place in the United States, and it had to be measurable (**figure 4**). (You may want to refer back to “Thinking About the Environment.”) Ultimately, the scientists would combine the six pieces of information for each of the 16-million-square kilometers in the United States.

If an area has the quality of naturalness, it has:

Natural composition: The area has many natural *components*, such as different *species*, *genetic diversity* within species, and native *plant communities*.

Unaltered structure: The area’s natural components are like they were before European settlers came to North America.

Lack of pollution: The area has clean water, clean air, clean soil, and a lack of artificial lighting.

If an area has freedom from human control, it has:

Solitude: The area can provide an opportunity for humans to be alone or to not feel crowded.

Remoteness: The area is considered remote if it does not contain roads or is far from roads and people cannot use any mechanical forms of transportation while in the area.

Uncontrolled processes: The area is freer if it has free-flowing streams and rivers, native trees and other native plants, and native animals. All of these things must be able to continue as they would have before European settlers came to North America, such as naturally occurring wildfires and the uninterrupted movement of wildlife.

Figure 3. ▲ The definitions of naturalness and freedom from human control.

Figure 4. ► Sources of information for each of the six qualities, and the measurement assigned to each quality by the scientists, for each of the 16-million-square kilometers.

Quality	Source of information	The meaning of the assigned values from 1 to 5
Natural composition	<i>Satellite imagery</i> , land use maps, and <i>land cover</i> maps.	1=least natural, meaning that the square kilometer had the fewest natural components 5=most natural, meaning that the square kilometer had the most natural components
Unaltered structure	Maps of the location of cities, towns, highways, airports, dams, and agricultural land as an <i>indicator</i> of altered structure.	1=most altered, meaning that the square kilometer had the least similarity to the way it was before European settlers arrived and modified the land 5=least altered, meaning that the square kilometer had the most similarity to the way it was before European settlers arrived and modified the land
Lack of pollution	Maps of <i>Superfund</i> sites, nuclear reactor sites, and other sources of pollution. They also used a map showing city lights at night across the United States.	1=most polluted, meaning that the square kilometer had the dirtiest water, air, and soil; and had the most artificial lighting 5=least polluted, meaning that the square kilometer had the cleanest water, air, and soil; and had the least artificial lighting
Solitude	Maps showing the number of people living in each square kilometer.	1=lowest solitude, meaning that the square kilometer had the highest number of people living on it 5=highest solitude, meaning that the square kilometer had the lowest number of people living on it
Remoteness	Maps showing the distance of each square kilometer to a road.	1=low remoteness, meaning that the square kilometer had the highest number of roads or was closest to roads and had cars and other motorized vehicles 5=high remoteness, meaning that the square kilometer had the lowest number of roads or was farthest from roads and did not have cars or other motorized vehicles
Uncontrolled processes	Maps of locations of dams on waterways. They also used maps showing large areas of natural land with no human constructions, such as roads or buildings.	1=most controlled, meaning that the square kilometer had the highest number of dams and other barriers to the flow of natural elements across the landscape 5=least controlled, meaning that the square kilometer had the lowest number of dams and other barriers to the flow of natural elements across the landscape

Notice that for every square kilometer, the scientists assigned a value between 1 and 5 for each of the six qualities listed above. Then, the six values were summed. This gave one value for each of the 16-million-square kilometers of land and water in the United States (**figure 5**).

The scientists then applied the summed value to each of the 16-million-square kilometers. They ended up with a single value for each square kilometer in the United States. Since they were using a GIS, the next step was to create a map. For each of the final values, they assigned a color that would be applied to the square kilometer. Remember that each square kilometer was located somewhere unique in the United States. When the map was created by placing all of the square kilometers together, the scientists could see which areas of the United States were less wild and which were more wild.

Reflection Section

- ✦ For each square kilometer, the five values were summed. What was the range of values possible for each of the square kilometers? How many colors were possible across the entire map?
- ✦ What are some of the advantages of using a map to display scientific findings?

Findings

When they first looked at their map, the scientists were surprised at what they saw (**figure 6**). In the East, only small patches of land or water had high values of wildness. These lands were surrounded by large areas of land with a low wildness value. In the

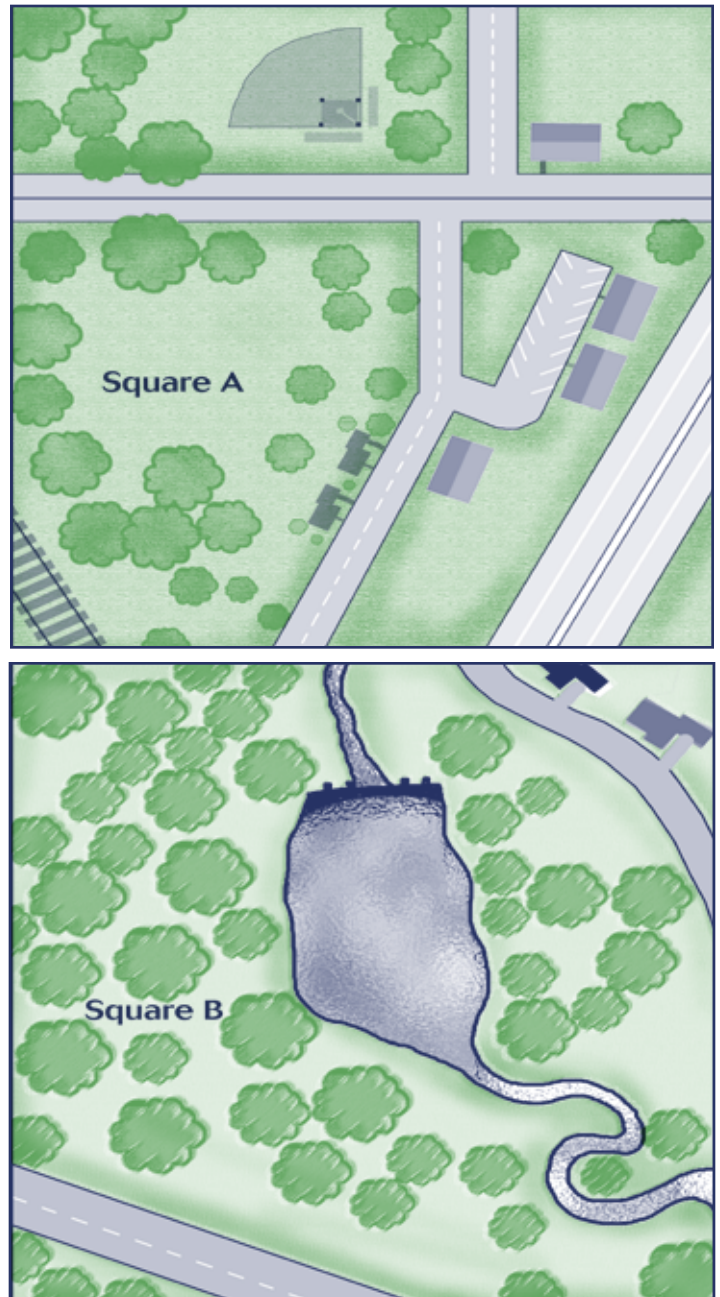
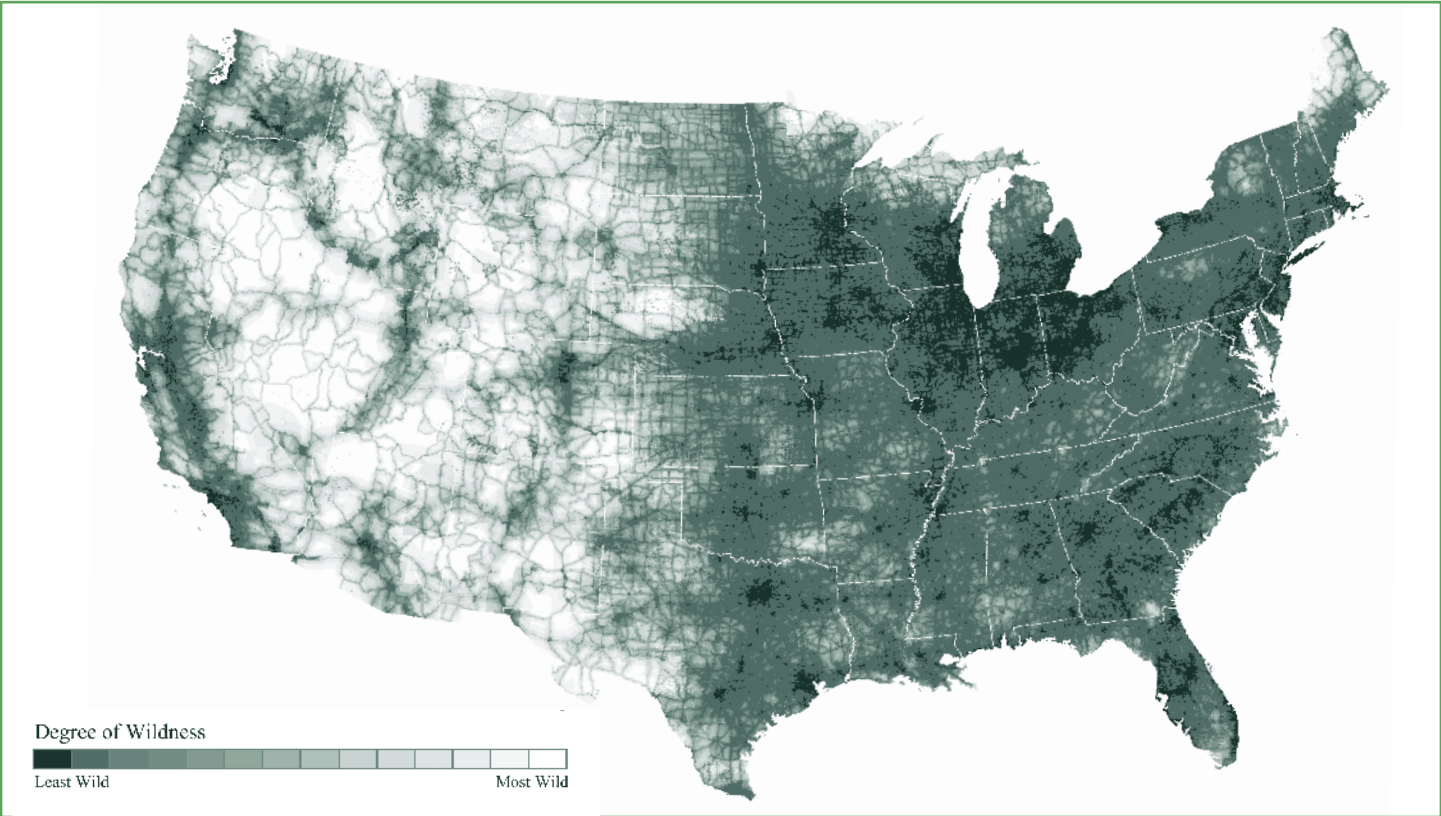


Figure 5. Here is an example of two different square kilometers of land. Square A shows a highway, a railroad track, a baseball diamond, a shopping center, houses, and a gas station. There is a lot of grass, some bare ground, and some trees. Square B shows a few houses and two roads, a lot of trees and grass, and a large man-made lake with a dam. Look at the rating guide in figure 4. Which square would get the highest overall rating? Remember, a higher rating indicates that the square kilometer would have higher wildness character.

West, the opposite was true. There were small patches of land with a low wildness value, surrounded by large areas with a high wildness value.

The scientists divided all of the Nation's land and water into three categories. These categories were: (1) Federal wilderness, (2) Federal nonwilderness, and (3) non-Federal land. Federal land is land owned by all of the citizens and *managed* for the citizens by the Federal Government. Federal wilderness is Federal land protected from human development. You can read more about wilderness on page 5. Federal nonwilderness is mostly large natural areas of undeveloped or lightly developed land. They include *national parks, national forests, national wildlife refuges, national grasslands,* and other natural land managed by the Federal Government. Non-Federal land

▼ **Figure 6.** National map showing wildness values.



is everything else, including cities, towns, houses, buildings, yards, roads, *reservoirs,* farms, State parks, and private forest land. The *median* summed value for each of these categories is given in **figure 7**.

The scientists found that while most wilderness has a high wildness value, some wilderness has values lower than they expected. These were the wildernesses located close to highly developed areas such as cities. Therefore, wilderness is not always

Figure 7. The median summed value representing wildness for three categories of land and water.

Land/water category	Median value
Federal wilderness	27
Federal nonwilderness	25
Non-Federal	17

the wildest area. It is also area that provides some degree of wildness, especially when it is located close to highly developed areas of the United States.

in general also have a high quality of wildness. Compared with non-Federal land, Federal land is more natural and freer from human control. Wilderness is the most natural of all lands and is the freest from human control.

Reflection Section



- Look at figure 6. Identify four of the wildest States, and four of the least wild States. Look at your own State and compare it with these other States. What can you say about the wildness of your State?
- In figure 7, compare the wildness values of Federal nonwilderness and Federal wilderness. Are the values close together or far apart? Why do you think Federal nonwilderness might have the value that it does?

Reflection Section



- Look again at figures 3 and 4. You know that Federal lands have a high wildness value. Pretend that you have been asked to describe Federal wilderness and Federal nonwilderness to a foreign visitor. How would you describe these lands?
- Why are Federal lands freer from human control than non-Federal lands, and why is Federal wilderness freer from human control than Federal nonwilderness? (Hint: This has something to do with being protected.)

Discussion

Wilderness has the highest wildness value of all lands in the United States. This shows that wilderness protects the quality of wildness, ensuring that some lands remain truly wild in the United States. Federal lands

From Aplet, G. H., Wilbert, M., and Morton, P. Wilderness attributes and the state of the National Wilderness Preservation System. In: Cordell, H. Ken, Bergstrom, John C., & Bowker, J.M. (2005). *The Multiple Values of Wilderness*. State College, PA: Venture Publishing.

Superfund Web site for kids: <http://www.epa.gov/superfund/kids/index.htm>



Wondering About Wilderness

Wild lands are an important part of America's past, present, and future. In 1964, America's leaders recognized the importance of these wild lands by passing a law called the Wilderness Act. This act allows Congress to name areas of wild land

as wilderness. Wilderness must be kept in a completely natural state. People can visit wilderness but cannot live there. When people visit wilderness, they can truly test their outdoor skills for they cannot take any mechanical equipment with them. Wilderness also

provides environmental benefits for people now and into the future. This edition of the *Natural Inquirer* introduces some of those benefits. For more information about wilderness, read page 5 in this journal or visit <http://www.wilderness.net>. ■

FACTivity



In this FACTivity, you will do a project that is similar to what the scientists did in this study. The method you will use follows.

You will need five crayons or colored pencils. Suggested colors are black, purple, medium blue, light blue, and light yellow. However, any five colors going from darkest to lightest can be used.

Using a copy machine, make a copy of the following graphic:

Each of the squares represents one square kilometer of land. You will now calculate a wildness value for each square kilometer, based on the table on page 46. The qualities listed along the top are the same qualities used by the scientists in this study. Refresh your memory by

looking again at figure 4. The numbers in each square represent the value assigned to that square kilometer for each quality. Once again, look at figure 4 to see what the numbers represent.

Now complete this table by adding each row across and placing the sum in the last column. The sums represent the total wildness value of each square kilometer of land. Now color each of the squares with a crayon using the following key:

Yellow = wildness value 6-10

Light blue = wildness value 11-15

Dark blue = wildness value 16-20

Purple = wildness value 21-25

Black = wildness value 26-30

A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P

If you did not use these colors, substitute your own colors. The darker colors should be used for the higher wildness values.

When you have finished, hold a class discussion about the relative wildness of these 16 square kilometers of land. You can see that north, east, west, and south, are marked. The 16 square kilometers are also divided into four quadrants. In which quadrant is wilderness most likely located? (Is it the northwest, northeast, southwest, or southeast quadrant?) In which quadrant is the city most likely located? Discuss what kind of

land might be found in squares B, F, K, and O. What kind of land might be found in G, L, and P? You can compare actual wildness values from the table below to get even more information about each square kilometer.

Now look again at the national map (**figure 6**). That map was created using 16 million squares representing 16-million-square kilometers of the United States. As a class, discuss how what you have just done is similar to what the scientists did in this study. How is it different?

QUALITIES ► SQUARES ▼	Natural composition	Unaltered structure	Lack of pollution	Solitude	Remote- ness	Uncon- trolled processes	Total wildness score
A	2	2	2	1	2	1	
B	3	3	2	2	3	5	
C	4	5	5	4	4	5	
D	5	5	5	5	5	5	
E	2	1	1	1	2	2	
F	3	3	2	3	3	3	
G	4	4	4	4	4	5	
H	5	5	5	4	4	5	
I	1	1	1	1	1	1	
J	2	2	2	2	1	1	
K	3	3	3	3	3	3	
L	3	3	4	4	4	5	
M	1	1	1	1	1	1	
N	1	1	1	1	1	1	
O	3	1	1	3	3	1	
P	4	4	3	4	4	4	



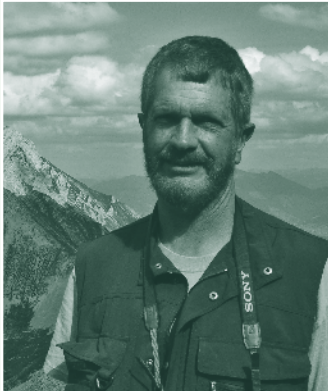
If you are a Project Learning Tree-trained educator, you may use PLT Activity #35, “Loving It Too Much,” as an additional activity resource.

Can You Hear Me Now?

Using the Telephone To Discover Peoples' Opinions About Wilderness



Meet the Scientists



▲ **Dr. Cordell:** It is always fun to discover a new idea or trend from a survey that we have done. Our surveys are about the importance of natural lands to people. We find that natural lands play an important role in everyone's life. I know that natural lands are important to me!



▲ **Dr. Tarrant:** My favorite science experience was swimming with dolphins and studying their habitat in the continental shelf at Kaikoura, New Zealand. This photograph shows the mountains of New Zealand, where I spend a lot of my time doing research.



▲ **Dr. Green:** My favorite science experience was playing with a chemistry set and accidentally blowing up a test tube when I was eight. I learned a lot from that experience! This photograph was taken in Hawaii.



Thinking About Science

In the United States, *Federal representatives* are elected to make decisions on behalf of the whole population. These representatives make up the *Congress*. To make decisions that are in the best interest of the *majority* of citizens, these representatives often make use of public opinion research, or polls. Scientists who conduct these polls contact a *random sample* of American citizens and ask them questions.

In this study, the scientists contacted a random sample of citizens and asked them questions about a special category of natural lands called wilderness. Elected representatives can use the results of polls like this to help them make decisions. Their decisions can then reflect how the majority of American citizens feel about wilderness.



Thinking About the Environment

People receive a variety of benefits from *publicly* owned land. When people use land or receive benefits directly from the land, they may value the land because they can use it. Scientists call these kind of benefits “use benefits.” Examples include using the land for recreation, such as for hiking and camping; mining for minerals; using trees for wood; harvesting food products; and using the land for scientific research.

People also receive benefits that do not necessarily come from their activities on the land. Examples include the *preservation* of land to protect water and air quality, to provide *habitat* for *wildlife*, and to ensure that future generations can also benefit from the land. Scientists call these kinds of benefits “non-use benefits.”

Introduction

In 1964, Congress passed a law that established the National Wilderness Preservation System or NWPS. This law identified areas of Federal land to be protected as much as possible from human activities. These lands are called wilderness and are allowed to exist without any machines or permanent *habitation* by humans (**figure 1**). People receive special benefits from these lands because they are kept completely natural. Wilderness is different from other publicly owned land because it does not have any roads, buildings, or other developments.

In this study, the *social scientists* wanted to know how U.S. citizens feel about wilderness. They wanted to know if people are aware that wilderness exists. They wanted to know what people value about wilderness. The scientists also wanted to know how peoples' opinions about wilderness might have changed in recent years.

Reflection Section



- What questions did the scientists want to answer in this study?
- Why would this information be of interest to Congress?

The National Wilderness Preservation System is a system of land areas with special legal protection from human development. In the *Natural Inquirer*, the word wilderness always refers to lands that are part of this national system and under Federal protection. Other undeveloped lands are referred to as wild lands to distinguish them from lands within the National Wilderness Preservation System.

Glossary:



Federal (**fed** ūr ul): A union of States having a central government.

representative (**rep** rē **zen** ta tiv): A person chosen to act for or speak for others.

Congress (**kon** gres): The group of elected officials in the United States that makes the laws. Congress is made up of the Senate and the House of Representatives.

majority (muh jōr uh tē): More than half.

random (**ran** dum): Selection purely by chance, with every element having an equal chance of being selected.

sample (**sam** pul): A part or piece that shows what the whole group or thing is like.

publicly (**pub** lik lē): By the government on behalf of all citizens.

preservation (**prez** ūr **va** shun): To protect from harm or damage; to save.

habitat (**hab** uh tat): Environment where a plant or animal normally grows and lives.

wildlife (**wild** lif): Animals that live in the wild.

habitation (**hab** uh **ta** shun): Living in a place.

social scientist (**so** shul **si** en tist): A scientist who studies individual humans, groups, and their actions or relationships.

endangered species (n **dan** jŭrd **spe** shez) Wild plants or animals with so few individual survivors that the species could become extinct in the area where it naturally lives.

ecosystem (**e** kō **sis** tem): Community of plant and animal species interacting with one another and with the nonliving environment.

Pronunciation Guide

a	as in ape	ô	as in for
ä	as in car	u	as in use
e	as in me	ü	as in fur
i	as in ice	oo	as in tool
o	as in go	ng	as in sing

Accented syllables are in **bold**.



Figure 1. Okefenokee Wilderness is located in south Georgia in the Southeastern United States. It is a part of Okefenokee National Wildlife Refuge (ref uj). Okefenokee Wilderness is a large freshwater swamp.

Method

The scientists called people on the telephone in 1995 and again in 2000 and asked them questions about the NWPS. (What does NWPS stand for? Reread the first sentence of the “Introduction” to find out.) The scientists picked a random sample of American citizens by having a computer generate phone numbers for telephone area codes and exchanges across the country. An exchange is the first 3 digits of a 7 digit phone number. (What is your telephone exchange number?) Generating a random telephone number is like rolling a dice four times and using the number that comes up on each roll. Because of Federal laws, the scientists could only ask questions of people 16 years old or older.

The scientist told the person on the phone a little bit about the NWPS. They told the person how many acres of wilderness are in the United States. They asked the person if they were aware of the NWPS. Then they asked the person if the amount of land in the NWPS was too little, about right, or too much. They then read a list of

13 possible benefits that could be received from wilderness (**figure 2**). For each of the 13 benefits, the person on the phone told the scientists how important that benefit was to them.

The scientists compared what people said in 1995 with what they said in 2000.

Figure 2. Possible benefits of wilderness.

Protecting water quality
Protecting wildlife habitat
Protecting air quality
Having wilderness for future generations
Protecting <i>endangered</i> species
Preserving <i>ecosystems</i>
Providing scenic beauty
Having the chance to visit a wilderness in the future
Just knowing that wilderness exists
Using wilderness for scientific study
Using wilderness for recreation
Providing spiritual inspiration
Providing income for the tourism business

Reflection Section



- ✿ The scientists did this study in 2000. Since the year 2000, many more people have cell phones. Do you think that scientists could do this study again in 2008 and contact people with cell phones? Why or why not?
- ✿ Look at the list of benefits in figure 2. Which three benefits do you think are the most important? Why?

Findings

In 2000, more people said that they were aware of the NWPS than in 1995. In 1995, 44 percent of American citizens were aware of the NWPS. In 2000, that percentage was 57. Compared with the percentage of responses in 1995, a smaller percentage of people in 2000 said that the size of the NWPS is not large enough. However, in both 1995 and 2000, the percentage of

people saying that the NWPS is not large enough was over 50 percent (table 1). Of the 13 benefits, only one was not rated as important by more than 50 percent of the people. This was the last benefit listed in figure 2. What is that benefit? Compared with 1995, the percentage of people saying that wilderness benefits were very important or extremely important increased (table 2).

Table 1. How Americans age 16 and older responded to the telephone survey.

Description of those who responded to the survey	Percentage aware of the NWPS		Percentage saying that the size of the NWPS is not enough	
	1995	2000	1995	2000
Place of residence				
Metro	44	58	57	54
Rural	45	58	52	44
Eastern or Western United States				
Eastern resident	43	56	56	53
Western resident	50	61	54	48
Age				
16-30	32	39	64	57
31-55	48	61	57	55
Over 55	57	70	38	39
Race				
White	46	61	56	52
Non-White	38	38	51	48
All Americans over age 16	44	58	56	52

Table 2. The percentage of people in 2000 saying that wilderness benefits are very or extremely important, and the percentage increase between 1995 and 2000 in people saying that wilderness benefits are very important or extremely important.

Wilderness benefit	Percentage saying that the benefit is very or extremely important	Percentage increase between 1995 and 2000
Protecting water quality	93	14
Protecting air quality	92	14
Protecting wildlife habitat	88	9
Having wilderness for future generations	87	10
Protecting endangered species	83	9
Preserving ecosystems	80	14
Having the chance to visit a wilderness in the future	75	16
Just knowing that wilderness exists	75	19
Providing scenic beauty	74	14
Using wilderness for recreation	65	16
Using wilderness for scientific study	58	11
Providing spiritual inspiration	57	13
Providing income for the tourism business	30	7

Reflection Section



- ✿ Overall, would you say that the benefits of wilderness are important to the American public? Explain your answer using the information in table 2.
- ✿ Reread “Thinking About the Environment.” Looking at the information in table 2, would you say that more Americans place a high value on the “use benefits” or “non-use benefits” that they receive from wilderness? Explain your answer.

These benefits have to do with human health by protecting air and water quality. They also have to do with environmental health by protecting endangered species and ecosystems. Information such as this can help our elected representatives make decisions about wilderness that are in the interest of the majority of American citizens.

Reflection Section



- ✿ In what ways can wilderness help protect human health?

Discussion

In 2000, a higher percentage of people said that “non-use benefits” from wilderness were more important than “use benefits.”

From Cordell, H. K., Tarrant, M. A., and Green, G. T. (2003). Is the public viewpoint of Wilderness shifting? *International Journal of Wilderness*, 9(2), pp. 27-32.

FACTivity



Directions:

For this FACTivity, you will conduct your own survey like the scientists in this article. You will actually ask people some of the same questions that the scientists in this study asked. The questions on your survey come from a larger survey called the National Survey on Recreation and the Environment or NSRE, for short. To look at more questions from the survey, go to this Web site: <http://www.srs.fs.usda.gov/trends/Nsre/nsre2.html>.

1. Copy the survey and the chart (on p. 54-55) to record the responses.
2. Ask at least five people the questions on this survey and record their responses on the response chart. These people can be classmates, other students, family, and

friends, but don't ask the same person twice. Remember, do not ask people for names because their responses should be anonymous.

3. Bring the answers to class with you.
4. Have the class compile all of their responses.
5. Hold a class discussion about the responses. What did you find about what people know about wilderness? Are there any areas where a majority of the people responded the same way? Do you think this could be important? Why or why not? Do any of your findings support what the scientists found? If so, how? If not, what are the differences?

Wilderness Survey

1. Were you aware that Congress established the National Wilderness Preservation System?

1. Yes
2. No
3. Don't know
4. Refused to answer

2. Do you think the amount of land Congress has designated as wilderness is not enough, about the right amount, or too much?

1. Not enough
2. About the right amount
3. Too much
4. Don't know

3. Do you plan to visit a wilderness within the next year?

1. Yes
2. No
3. Don't know
4. Refused to answer

4. Even if you do not plan on visiting a wilderness within the next year, would you want to visit one sometime in the future?

1. Yes
2. No
3. Don't know
4. Refused to answer

Please tell me whether you strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree with the following statements about wilderness.

5. I enjoy reading about and viewing pictures, videos, TV shows, and movies featuring wilderness.

1. Strongly agree
2. Somewhat agree
3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

6. I enjoy knowing that other people are currently able to visit wilderness.

1. Strongly agree
2. Somewhat agree
3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

7. I enjoy knowing that future generations will be able to visit and experience wilderness.

1. Strongly agree
2. Somewhat agree
3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

8. Wilderness is important to protect because it contributes to better local, national, and global air and water quality.

1. Strongly agree
2. Somewhat agree
3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

9. Wilderness is important because it helps to preserve plant and animal species that could have important scientific or human health value, such as sources of new medicines.

1. Strongly agree
2. Somewhat agree
3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

10. I support protecting wilderness just so it will always exist in its natural condition, even if no one were to ever visit or otherwise benefit from it.

1. Strongly agree
2. Somewhat agree

3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

11. I believe the trees, wildlife, free flowing water, rock formations, and meadows that wilderness protects have value themselves, whether or not humans benefit from them.

1. Strongly agree
2. Somewhat agree
3. Neither agree nor disagree
4. Somewhat disagree
5. Strongly disagree
6. Don't know
7. Refused to answer

Survey Response Chart. Record the responses on this sheet for each person who answers the questions. Place the number that matches the person's answer by each question.

Question	Respondent (Example)	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5
1	1 (Yes)					
2	2 (About the right amount)					
3	3 (don't know)					
4	Etc.					
5						
6						
7						
8						
9						
10						
11						

Question	Respondent 6	Respondent 7	Respondent 8	Respondent 9	Respondent 10	Respondent 11
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

Alternate FACtivity



Using the Internet, visit <http://www.wilderness.net>. Click on “Search map of wilderness areas,” which is located in the left hand column titled “General Wilderness Information.” You will see a map of the United States with wildernesses identified on the map. Working in pairs, select a State. Click on that State and do research on the

wilderness within that State. If you select a State with many wildernesses, you might want to focus your research on just two or three of them. Present your findings to the class. You may want to draw maps and pictures to use in your presentation. After the presentations, hold a discussion about the similarities and differences in wildernesses that were presented.



If you are a Project Learning Tree-trained educator, you may use PLT Activity #19, “Values On the Line” and PLT Activity #91, “Good Ol’ Days” as additional activity resources.

Speak-o-logical:

***Defining and Measuring the Ecological
Value of Wilderness***



Meet the Scientists



▲ **Dr. Cordell:**
One of my favorite science experiences happened when I was a young scientist. Like all scientists, I spent a lot of time reading articles in scientific journals that were written by other scientists. The first time one of my articles was published in a scientific journal was exciting. It is really fun to finally see your name in print in a scientific journal!



▲ **Ms. Murphy:**
My favorite science experiment was going out on a boat to collect little bugs that live in the water called zooplankton. We wanted to see if the bugs would eat harmful algae that was killing fish and act as a biological control. The bugs did eat the algae and experiments are still being done to see if they can be used for this purpose.

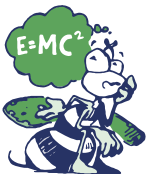


▲ **Dr. Riitters:**
My favorite science experience was the discovery of a new computer method to measure forest *fragmentation* from global *satellite imagery*. Can you identify the character on my T-shirt? You can find the answer at http://en.wikipedia.org/wiki/The_Lorax.



▲ **Mr. Harvard:**
My favorite science experience was visiting and doing research in Iceland. You can see me here floating on a small iceberg in front of part of the Myrdalsjokull glacier in Iceland. Iceland has a variety of geological, geographical, and biological mysteries to experience and study. These include glaciers, volcanoes, geysers, waterfalls, hot springs, tectonic plates and earthquakes, Viking ruins, wild blueberries, Icelandic horses, and Icelandic sheep.

Thinking About Science



To answer a question or solve a problem, scientists must clearly define what they are going to study. In this research, the scientists were interested in exploring a possible difference between wilderness and lands that are not wilderness. Wilderness is *legally designated*

land that is protected from most human activities. The scientists wanted to know if wilderness has greater *ecological* value than nonwilderness. To answer their research question, the scientists had to find a way to define what is meant by the ecological value of a natural area.

Glossary



fragmentation (frag men **ta** shun): The act or process of breaking apart or detaching.

satellite imagery (sa tel lit im uh jre): Photographs and other images of Earth taken from satellites orbiting Earth.

legally (le guh **le**): Of or pertaining to law.

designate (dez ig **nat**): To choose or appoint; to give a name to.

ecological (e ko **law** juh kul): Having to do with ecology. Ecology is the study of organisms and their relationship to their environment.

speculate (spek u **lat**): To think about or make guesses.

sustain (suh **stan**): To keep up or maintain.

concept (kän **sept**): A general idea of what a thing or a class of things is.

represent (rep **re zent**): To be an example of.

reservoir (rez ür vwor): A place where something, especially water, is collected and stored for use.

shrub (shrub): A woody plant that is smaller than a tree, usually with many stems. A bush.

barren (bear en): Not producing crops, fruit, or many trees.

microclimate (mī kro **kli** met): The climate of a small, specific place within a larger area.

Pronunciation Guide

a	as in ape
ä	as in car
e	as in me
i	as in ice
o	as in go
ô	as in for
u	as in use
ü	as in fur
oo	as in tool
ng	as in sing

Accented syllables are in **bold**.

Thinking About the Environment



The scientists in this study decided that the ecological value of an area is related to two things. Those things are how natural the area is and the area's ability to support life. Think about the word "natural." What does that word mean to you? Think about a parking lot, a soccer field, and a path through a forest. Which seems the most natural to you? What makes one area more natural than the other? What makes one area less natural than the other? Which of these areas can best support life? Which one is least able to support life?

Introduction

When a society decides to set aside areas of land as wilderness, it makes a choice about the value of those lands. In the United States, people have decided that some lands are more valuable without human development. Wilderness is an example of this type of area. Unlike many other natural areas, wilderness is protected from almost all human activities and development. People cannot take machines into wilderness. They cannot change the natural character of wilderness (**figures 1 and 2**).



Figure 1. Camping in a wilderness. The platforms are necessary because this wilderness is a large freshwater swamp.



Figure 2. Camping in a developed camp site.

One of the values of wilderness is its ecological value. The scientists in this study speculated that wilderness has a greater ecological value than other natural lands and than lands with roads, buildings, and other types of development. The scientists decided to compare wilderness with other lands. They wanted to know whether wilderness has greater ecological value than all other types of land.

Reflection Section



- ❖ What do you think is meant by the term “ecological value”? A value is the quality of a thing that makes people want to have it. Think about the values, or desirable qualities, that you might find in a natural area. You may also want to reread “Thinking About the Environment.”
- ❖ To compare the ecological value of wilderness and nonwilderness lands, the scientists had to be able to measure the different areas’ ecological value. They needed to use numbers to make their comparison. Think about your answer to the first reflection question. Can you think of a way to measure ecological value, or desirable qualities, using your definition? How would you do that?

Method

The scientists began their study by doing research in the library and on the World Wide Web. They wanted to find out how others had defined the term “ecological value.” They found that many scientists had defined ecological value by how well an area could naturally *sustain* itself. The scientists decided to use the concept of naturalness as their measure of the ecological value of an area. The more natural an area was found to be, the greater its ecological value, and the greater its ability to support both human and nonhuman life.

The scientists’ next step was to define what they meant by the term “natural.” If you read “Thinking About the Environment,” you have already thought about what is meant by the term “natural.” The scientists used four *concepts* that could be measured and that when taken together, would *represent* the naturalness of an area. In this article, two of the concepts used will be presented (**figure 3**).

After deciding to use these concepts, the scientists did more library research. They looked for sources of information that had measured at least one of these concepts. They collected this information for wilderness and nonwilderness lands. Finally, they put all of the information together.

Reflection Section



- ❖ Do you think that the naturalness of an area is a good measure of its ecological value? Why or why not? Remember that naturalness was defined by the two concepts in figure 3.
- ❖ Have you ever done any research in which you used some of the same methods as these scientists? If so, describe what you did.

Concept	Description	Measurement
Natural land cover	All land that is not developed, meaning all land that is not urban or being used for buildings, roads, or agriculture.	Examination of a national map showing land cover. Land cover is a description of what is on the land. Examples include forests, natural lakes, <i>reservoirs</i> , houses, roads, agricultural land, etc. The scientists identified each type of land cover as natural or developed (covered with man-made development). The percentage of wilderness and nonwilderness with natural land cover was calculated.
Distance from roads	How much land area is a certain distance from a road (figure 4).	Examination of a national map showing land cover and a road map showing all roads in the United States. The scientists calculated how much land in wildernesses and nonwildernesses was within 127 meters, 382 meters, and 5,000 meters of a road. (Multiply the number of meters by 1.09 to calculate the number of yards.)

Figure 3. Two concepts that represent the naturalness of an area.

Findings

Land Cover

In all areas of the United States except the West, over 95 percent of wilderness is in natural land cover. In the West, over 90 percent of wilderness is in natural cover. The actual percentage of natural cover in the West might be higher than 90 percent. However, because much of the land in the West is desert and *shrub* land, the scientists could not say for sure if the land was naturally barren, or *barren* because of human activity. Scientists will usually be more cautious when they cannot be sure of their findings. **Figures 5a and 5b** summarize the percentage of wilderness land and all land with either natural land cover



Figure 4. Example of wilderness and nonwilderness that is at least 127 meters and at least 382 meters from a road.

or developed land (land covered with man-made development).

Distance From Roads

When a road is located beside a natural area, it can disrupt the natural area up to hundreds of meters into the area. Roads can disrupt wildlife, pollute water, change the *microclimate*, and raise noise levels. The scientists found that across the United States, 97 percent of wilderness land area is at least 127 meters from a road. In comparison, 80 percent of all land in the United States is at least 127 meters from a road.

Number Crunches

How many feet is 127 meters?
Multiply 127 by 3.27 to find out.

When the scientists looked at the percentage of land area at least 382 meters from a road, their results were different. East of the Mississippi River, 90 percent of wilderness is at least 382 meters from a road. West of the Mississippi River, 95 percent

of wilderness is at least 382 meters from a road (**table 1**). In comparison, only about 50 percent of all land in the United States is at least 382 meters from a road.

Number Crunches

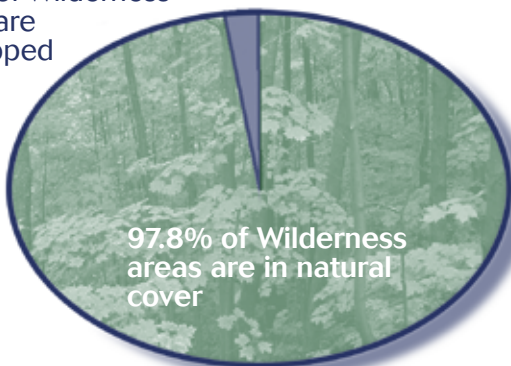
How many feet is 382 meters?

When the scientists looked at the percentage of land area at least 5,000 meters from a road, they found something different again. In the East, 47 percent of wilderness is at least 5,000 meters from a road. In the West, 60 percent of wilderness is at least that far from a road. In comparison, only 3 percent of all land in the United States is at least 5,000 meters from a road (**table 2**).

Number Crunches

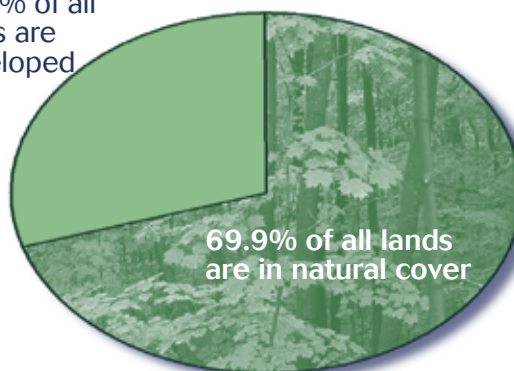
How many feet is 5,000 meters? Once you have that figure, divide it by 5,280 to find out how many miles this is.

2.2% of Wilderness areas are developed



97.8% of Wilderness areas are in natural cover

30.1% of all lands are developed



69.9% of all lands are in natural cover

Figures 5a and 5b. Percentage of land in natural cover and in developed land for wilderness and for all land in the United States. The pie chart on the left shows the percentage of natural and developed land within wilderness. The pie chart on the right shows the percentage of natural and developed land for all lands in the United States.

Table 1. Percentages of wilderness in the East and West and of all lands across the United States that are at least 382 meters from a road.

Location of land			
	Wilderness east of Mississippi River	Wilderness west of Mississippi River	All land in the United States
Percent of land at least 382 meters from a road	90	95	50

Table 2. Percentages of wilderness in the East and West and of all lands across the United States that are at least 5,000 meters from a road.

Location of land			
	Wilderness east of Mississippi River	Wilderness west of Mississippi River	All land in the United States
Percent of land at least 5,000 meters from a road	47	60	3

Reflection Section



- Now that you have read the “Findings,” would you say that wilderness is more natural than land that is not wilderness? Why or why not?
- The scientists assumed that the more natural an area is, the greater its ecological value. This is because the more natural an area is, the greater is its ability to support human and nonhuman life. Would you agree that taken together, wilderness has greater ecological value than land that is not wilderness? Why or why not?

Discussion

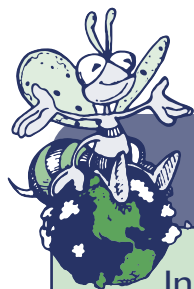
The scientists decided that using four measures of naturalness was the best way to determine the ecological value of wilderness. In this article, two of those concepts were presented. The scientists used existing information to discover that wilderness has more natural cover than other lands in the United States. Wilderness is also less affected by roads than other lands. The scientists concluded that wilderness has a greater ability than nonwilderness to support both human and nonhuman life.

Reflection Section



- Reread the last sentence in “Discussion.” Do you agree that wilderness has a greater ability than nonwilderness to support both human and nonhuman life? Why or why not?

From: Cordell, H. K, Murphy, D., Riitters, K., and Harvard, J. (2005). The natural ecological value of Wilderness. In: Cordell, H. Ken, Bergstrom, John C., and Bowker, J.M. (2005). *The Multiple Values of Wilderness*. State College, PA: Venture Publishing.



Wondering about Wilderness

In the United States, there are 677 wildernesses. The smallest is a 5-acre wilderness in Florida, and the largest is in Alaska, with 9 million acres. The largest combined area of wildernesses is also in Alaska. This includes Noatak Wilderness and Gates of the Arctic National Park and Preserve, which is introduced in this journal on page 6 ("It's Elemental, My Dear!"). In the lower

48 States, the largest combined area of wilderness is Gospel-Hump Wilderness and Frank Church - River of No Return Wilderness. You can read about a scientific study done in Frank Church - River of No Return Wilderness on page 25 ("As the Frog Hops"). For more information about wilderness, read page 5 in this journal or visit <http://www.wilderness.net>.

FACTivity

One of the measures of naturalness used by the scientists is distance from roads. In this FACTivity, you will use your experience and imagination to explore whether you agree with the scientists' conclusion (To refresh your memory, reread the last sentence in "Discussion" on page 63). You will write a story about going home from the viewpoint of an animal who makes his or her home in the forest.

First, select an animal from this list or come up with your own animal. Your story will be told from this animal's point of view.

Frog



Skunk



Deer



Snake



Rabbit



Your story will be four paragraphs long. Each of the paragraphs will describe a part of the animal's journey home. Use the four photographs on page 65 as a guide, one for each paragraph. In each paragraph, consider the following:

1. Is there a difference between the number and size of trees your animal finds and its closeness to the road? What is the difference?
2. Is there a difference between the amount of traffic noise and closeness to the road? Do you think that the traffic and traffic noise is disruptive to your animal? Why or why not? Describe how your animal feels as he or she travels across the road and into the forest.
3. Is there a difference between the types of ground cover your animal crosses and closeness to the road? If so, what is the difference? Are areas away from the road more natural, less natural, or about the same? Describe your animal's journey across the

FACTivity

land, paying attention to the surface. How does the surface feel, sound, and smell?

4. Is there a difference between the number and type of other animals that your animal met as he or she traveled away from the road toward home? Did he or she find more or fewer animals or evidence of animals farther from the road? If there are differences, what are they?
5. Is there a difference in the number and types of plants that your animal found as she or he traveled home? What is the difference? Does the difference have anything to do with the distance from the road?

As a class, share your stories and pictures. Based on your stories, do you agree that the farther away from a road one travels, the more natural the area is? Based on your stories, do you agree with the scientists that wilderness has a greater ability to support human and nonhuman life? Why or why not?



If you are a Project Learning Tree-trained educator, you may use PLT Activity #88, "Life On the Edge," as an additional activity resource.

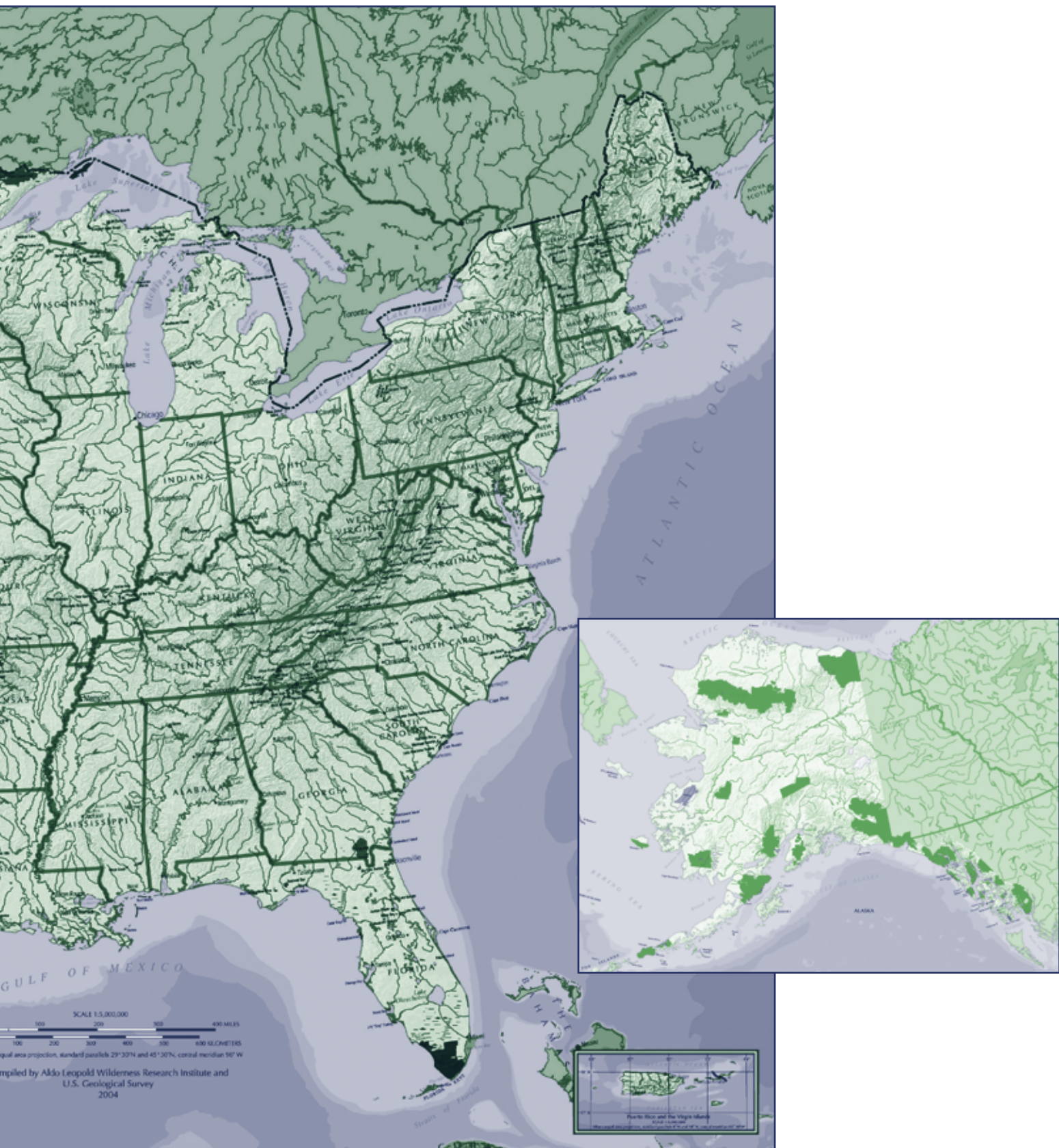
You may also draw pictures to help tell your animal's story.





Original map prepared by the National Atlas of the United States of America ® (August 2004). This is a map that was prepared in 2004 on the 40th anniversary of the Wilderness Act (In what year was the Wilderness Act signed?).

Key: On this map, wilderness areas are indicated in dark green. Look closely at the Eastern United States. You will see small areas of dark green that represent wilderness areas. What do you notice about wilderness areas in the Eastern United States compared with the Western United States?



Reflection Section Answer Guide

It's Elemental, My Dear!

Introduction:

- **Think about what it would be like to be in an area as remote as Gates of the Arctic National Park and Preserve. Think of three things that you would expect to see, do, or feel if you were in an area that far away from cars, phones, buildings, or other people. Remember that in a wilderness, you cannot use any motorized vehicles or equipment. Share your ideas with your class. Discuss the benefits and disadvantages of visiting such a remote place.** *These are personal questions. Examples of responses to what I might expect to see include: I would expect to see bears and wolves. I would expect to see mountains and clean rivers. I would not expect to see airplanes. Examples of what I might do include: I might hike up a mountain trail, pitch a tent, drink hot chocolate, canoe in a cold river. Examples of what I might feel include: I might feel cold, or inspired by the beauty. I might feel challenged, or afraid, or lonely. I might feel awed by how large and beautiful the area is. Some benefits the class may mention are: Having some time either alone or with just a few people; seeing bears, caribou, and other wildlife; not hearing any machines; challenging myself to do something new or difficult. Some disadvantages the class may mention are: Having to walk everywhere, not having a phone or computer, not having TV, or not having a shower.*
- **If you were the scientist, how would you find out what some of the elements of experience are for people visiting Gates of the Arctic National Park and Preserve?** *Some ideas include: Ask people who are visiting the area what stands out in their experience. Send out a questionnaire to people who have visited*

the area in the past. Social scientists often use questionnaires to collect information from people.

Method:

- **Why do you think that the scientists audio-recorded the conversations?** *Because they could never keep track of 94 conversations. To have accurate information, scientists must record everything, whether it is by writing, using computers, audio-recording, photography, or sketching.*
- **Do you think that the scientists received responses from all 242 people who were sent the questionnaire? Why or why not?** *Probably not. This is because not everyone who received a questionnaire either had time to or cared about filling it out and sending it back in. Some of the people might have moved and would have never received the questionnaire.*

Findings:

- **Look at figure 7 and table 1. Each of the comments in figure 7 should fit somewhere in table 1. See if you can place each item from figure 7 under one of the five elements in table 1. This can be done individually or as a group. The important thing is for students to be able to give a logical reason for placing each item in figure 7 under an element in table 1. This will be difficult to do for a few of the comments. Allow your students to debate and finally decide where to place each of the comments.**
- **Which of the elements in table 1 do you think that wilderness managers can change? Discuss why or how managers might or might not be able to change each of these elements with your classmates. This will help you to introduce the concept of management. For**

example, while managers cannot change the wildlife, they can manage the land so that wildlife populations are protected and sustained. They can manage so that visitors do not feel overburdened by rules and regulations, even if those rules and regulations exist. They could improve the way visitors get information about wilderness. An example of something they cannot change is uncertainty regarding the weather.

Discussion:

- **Look at table 1, element 2 (Free-Roaming Wildlife). Name one way that managers might measure this element.** *Managers could keep an inventory of different kinds of wildlife seen in wilderness. They could then identify whether visitors are seeing more, less, or the same amount of animals over the years.*
- **Why do you think that managers will have to measure any of the elements that they decide to use?** *Because if you do not keep track of something by measuring it, it is hard to judge whether you are making any difference in the future.*

Wilderness Makes Cents!

Introduction:

- **Reread the first paragraph under “Introduction,” above. What are some of the benefits you might receive from buying one shirt instead of another?** *The benefits might be fashion-related, such that one shirt is more in style and will bring more admiration from peers. The benefits might be comfort-related, in that one shirt will be more comfortable to wear. Another benefit might be that one shirt will be more versatile, and will “go with” more of the person’s clothes. Your students may come up with a*

variety of other benefits. You may want to discuss the idea of benefit in relation to price; for example, the number or type of benefits may increase as the price increases.

- **Restate what the scientists wanted to discover by doing this research.**

The scientists wanted to discover how much the recreation use benefits and passive use benefits of wilderness are worth to the entire American public.

Method:

- **Look at figure 3. Explain in your own words what each of the dollar values represents.** *On the average, an individual is willing to pay \$68 more than they have to pay to go on a wilderness recreation trip. On the average, an individual is willing to pay \$67 more every year to protect wilderness because they want the option of visiting them in the future, they want their children to be able to enjoy wilderness, or they just want to know that wilderness exists.*
- **Reread the last sentence in the “Methods” section. What might be one advantage of knowing the dollar amount of benefit per acre for each of the two types of benefits?** *By placing both of the benefits on a per-acre basis, it is easier to compare them. Whenever you can compare two numbers using the same unit of measurement, it is a better and easier way to understand their relationship.*

Findings:

- **Look at figures 4 and 5. Compare the amounts in each column. Would you say that recreation use benefits or passive use benefits have greater value to the American public? Why?** *Passive use benefits have greater value because the number representing those benefits in column 2 is much higher than the number representing recreation use benefits in column 1.*

- **Think about what the numbers in figures 4 and 5 represent. If you need to refresh your memory, reread “Thinking About the Environment” at the beginning of this article. What would you conclude about the benefits people receive from wilderness?** *This is an individual question, but some answers might be: 1. Wilderness is important to Americans. 2. Non-use benefits of wilderness are much more important than recreation use benefits to Americans. 3. People think that wilderness is important, even if they never plan to visit wilderness. 4. People want wilderness to be there in the future, either for themselves or for their children. 5. Passive use benefits are over eight times greater than recreation use benefits. Your students may come up with other conclusions as well.*
- **The last paragraph in the “Introduction” describes three things that the scientists wanted to discover. Restate these three things as questions.** *1. What types of habitats are needed by Columbia spotted frogs at different times of the year? 2. How far will Columbia spotted frogs migrate to reach these different habitats? 3. What routes do Columbia spotted frogs take when they migrate from habitat to habitat?*

Method:

- **The scientists marked the toes of each frog that was found. Can you think of one reason why the scientists would want to identify the frogs that had been caught?** *The scientists needed to have a way to identify which frogs had been measured, weighed, and identified as to which sex they were. Otherwise, the scientists might catch the same frog more than once. If they did this, they would not have an accurate count of the frogs.*
- **The scientists were careful not to harm the frogs during their research. Do you think that scientists should take care not to harm the animals that they study? Why or why not?** *This question must be answered individually by each student, however, the student should be able to give a reason for his or her answer. This question provides an opportunity to discuss ethics in animal-based science. Scientists are bound by ethics (and law) to protect animals from pain and suffering when they conduct their studies.*

Discussion:

- **Recreation use benefits and passive use benefits are not the only benefits of having wilderness. Name at least one other benefit of having wilderness.** *Wilderness provides clean water and places for wildlife to live, it helps to slow soil erosion, it helps to clean the air, it protects plant and animal species, and it provides a place for scientists to do research. Your students may come up with many other benefits to having wilderness.*

As the Frog Hops:

Introduction:

- **Do you think that a nonnative species of animal should be allowed to harm the population of a native species? Why or why not?** *This question must be answered personally. Each student should be able to back up his or her answer with logically constructed reasons.*

Findings:

- **The scientists found that the female frogs migrated farther than males. They also found that larger frogs migrated farther than smaller frogs. What does this tell you about the size**

of male and female frogs? *Female frogs must be generally larger than male frogs.*

- **If you were a natural resource manager and you wanted to protect the Columbia spotted frog, would you only focus your attention on the lakes, ponds, and streams where frogs breed, forage, and spend the winter? Why or why not?** *No, because this study has shown that the dry areas between lakes, ponds, and streams are used by female frogs for migration. Although frogs need watery habitat to breed, forage, and hibernate, they also need the spaces in between these water bodies.*

Discussion:

- **What new thing did the scientists learn about the migration of Columbia spotted frogs?** *That the frogs sometimes migrate from water body to water body by generally traveling in a straight line, even if that means traveling across dry areas that have no water.*
- **Why do you think the scientists suggest protecting dry land areas within one kilometer of a water body?** *Because the female frogs migrated up to 1,033 meters from a water body, which is just over one kilometer. Most of the female frogs did not migrate that far. So by protecting the land up to one kilometer, most of the land being used by frogs for migration will be protected.*
- **Do you think that the scientists could have done this study in an area that was not a wilderness? You might want to reread “Thinking About Science” before you answer this question.** *The scientists could have done this study in an area that is not wilderness. However, it would be harder to find a nonwilderness area that would not be disturbed by humans or development over the time span of a year.*

Wild and Free!

Introduction:

- **Restate, in your own words, what the scientists in this study wanted to learn about wilderness as compared with other land in the United States.** *They wanted to know whether wilderness has a greater quality of wildness than other lands. This means they wanted to know if wilderness is more natural and freer from human control than other lands.*
- **If you have not done so yet, read “Thinking About Science” and “Thinking About the Environment.”** *In those sections, you learned that the scientists used a GIS to collect their information. You also learned that in a GIS, information is connected to a specific place. For the land and water in each of the 16 million squares, what did the scientists want to know? They wanted to know how natural the land was and how free it was from human control. In other words, they wanted to know how “wild” it was.*

Method:

- **For each square kilometer, the five values were summed. What was the range of values possible for each of the square kilometers? How many colors were possible across the entire map?** *The lowest value is 1, so the lowest value for the six qualities together is 6 (6 qualities times a value of 1). The highest value is 5, so the highest value for the six qualities is 30 (6 qualities times a value of 5). Therefore, the range in value for each square kilometer is 6-30. The possible number of colors is 30-6 (+1), or 25. The lower the score, the less wild the square kilometer is thought to be. The higher the score, the wilder the square kilometer is thought to be.*

- **What are some of the advantages of using a map to display scientific findings?** *This should be answered individually, and the class should be encouraged to identify at least three advantages. Examples include being able to easily see relationships between different areas of land and water; being able to present a combination of land- or water-based qualities as one quality; showing the information as a picture rather than as numbers, which is easier for some people to understand; being able to see patterns across an area of land and water; and being able to look at different size areas of land and water. Your students may come up with different advantages.*

Findings:

- **Look at figure 6. Identify four of the wildest States, and four of the least wild States. Look at your own State and compare it with these other States. What can you say about the wildness of your State?** *Most wild: Nevada, Montana, Wyoming, Utah, New Mexico. Least wild: Illinois, Indiana, Ohio, Michigan, New Jersey. The students should develop their own observations regarding their own State in comparison with these other eight States.*
- **In figure 7, compare the wildness values of Federal nonwilderness and Federal wilderness. Are the values close together or far apart? Why do you think Federal nonwilderness might have the value that it does?** *Students will have to have some experience with or knowledge of national parks, national forests, national wildlife refuges, or other Federal land to answer this question. Federal nonwilderness lands are typically large tracts of undeveloped or minimally developed land and water. They have a*

lower value than Federal wilderness because they have some roads, buildings, and other development. Compared with non-Federal land, they can be considered to have a high quality of wildness.

Discussion:

- **Look again at figures 3 and 4. You know that Federal lands have a high wildness value. Pretend that you have been asked to describe Federal wilderness and Federal nonwilderness to a foreign visitor. How would you describe these lands?** *The student should mention the qualities given in these two figures. He or she should point out that wilderness lands have a higher wildness rating than nonwilderness lands, but that all Federal lands have these qualities. The student should point out some of the characteristics mentioned in these two figures.*
- **Why are Federal lands freer from human control than non-Federal lands, and why is Federal wilderness freer from human control than Federal nonwilderness? (Hint: This has something to do with being protected.)** *You may need to help your students figure this out. Federal lands are freer from human control because as a society we have enacted laws to protect them from certain kinds of development. Wilderness is the freest of Federal lands because it is protected under a stricter law (The Wilderness Act of 1964).*

Can You Hear Me Now?

Introduction:

- **What questions did the scientists want to answer in this study?** *They wanted to know if people know that wilderness*

exists, how people feel about wilderness, and whether people's attitudes about wilderness have changed in recent years.

- **Why would this information be of interest to Congress?** *As the body of people who make decisions about lands like wilderness, Congress wants to know how the majority of American citizens feel about wilderness. Congress makes decisions on behalf of the people they represent. Information about how people value wilderness will help them to make decisions in the best interests of the majority of American citizens.*

Method:

- **The scientists did this study in 2000. Since the year 2000, many more people have cell phones. Do you think that scientists could do this study again in 2008 and contact people with cell phones? Why or why not?** *Because the 4-digit phone numbers are randomly generated, the scientists could add the cell phone exchanges and contact people on cell phones as well.*
- **Look at the list of benefits in figure 2. Which three benefits do you think are the most important? Why?** *This is a personal question. Each student should, however, be able to state the reasons he or she selected his or her top three benefits.*

Findings:

- **Overall, would you say that the benefits of wilderness are important to the American public? Explain your answer using the information in table 2.** *Yes, because a majority of American citizens said that 12 of the 13 values were either very important or extremely important.*
- **Reread "Thinking About the Environment." Looking at the information in table 2, would you say**

that more Americans place a high value on the "use benefits" or "non-use benefits" that they receive from wilderness? Explain your answer.

People place a higher value on non-use benefits because a higher percentage of them rated non-use benefits as very important or extremely important.

Discussion:

- **In what ways can wilderness help protect human health?** *By protecting air quality and water quality, wilderness can help protect people from diseases caused by dirty air and polluted water. Wilderness also protects the overall environment and protects plant species that might be useful as medicines in the future. Wilderness may help to slow flooding. Students may come up with other ways that wilderness works to protect human health.*

Speak-o-logical

Introduction:

- **What do you think is meant by the term "ecological value"? A value is the quality of a thing that makes people want to have it. Think about the values, or desirable qualities, that you might find in a natural area. You may also want to reread "Thinking About the Environment." This is an individual question and could be answered in many different ways. Students should be able to provide a rationale for their answer. An area's ecology is its diversity of natural processes, including the relationship of organisms to each other and to the whole area. Qualities might include providing habitat for animals, providing clean water, providing a quiet place to camp or hike, protecting the area for the future, etc.**

- **To compare the ecological value of wilderness and nonwilderness lands, the scientists had to be able to measure the different areas' ecological value. They needed to use numbers to make their comparison. Think about your answer to the first reflection question. Can you think of a way to measure ecological value, or desirable qualities, using your definition? How would you do that?** *This question must be answered individually. The student should be able to provide a rationale for his or her answer. This could include counting the number of plant and animal species in wilderness and nonwilderness, testing the water quality and comparing it with nonwilderness lands, identifying how many opportunities exist for quiet types of recreation, or identifying how likely it will be that the wilderness and nonwilderness will be undisturbed in the future.*

Method:

- **Do you think that the naturalness of an area is a good measure of its ecological value? Why or why not? Remember that naturalness was defined by the two concepts in figure 3.** *This is an individual question and must be answered individually. However, students should be able to provide a rationale for their answer.*
- **Have you ever done any research in which you used some of the same methods as these scientists? If so, describe what you did.** *Students should have done previous research projects where they used the library and the Internet to collect information on a topic. They should have also had to define the topic that they were studying. Hold a class discussion on how their research was similar to and different from this study.*

Findings:

- **Now that you have read the "Findings," would you say that**

wilderness is more natural than land that is not wilderness? Why or why not? *Students should conclude that wilderness is more natural than nonwilderness. The reasons they should give are that a greater percentage of wilderness than nonwilderness is in natural cover and a greater percentage of wilderness is farther from roads than nonwilderness.*

- **The scientists assumed that the more natural an area is, the greater its ecological value. This is because the more natural an area is, the greater is its ability to support human and nonhuman life. Would you agree that taken together, wilderness has greater ecological value than land that is not wilderness? Why or why not?** *If the scientists' assumption is accepted, then wilderness has greater ecological value. This is because wilderness has more areas covered by forests, water, wetlands, prairies, etc., which support more life than do areas covered by pavement, roads, buildings, etc. Students can reason through the "Findings" to determine whether wilderness is better able to support human and nonhuman life.*

Discussion:

- **Re-read the last sentence in "Discussion." Do you agree that wilderness has a greater ability than nonwilderness to support both human and nonhuman life? Why or why not?** *This question could be used for a class discussion. Students should think about how agricultural lands support human life, and how roads and buildings also support human life. Then, students should compare this with the types of support offered by wilderness, including the qualities identified in the first reflection question under "Introduction."*

Wilderness Lesson Plan

Day 1 – 2

1. Ask students to brainstorm for a couple of minutes about what they think wilderness means and where they might find wilderness.
2. Ask students to share their thoughts. Then provide students with a brief overview of wilderness from page 5 of the *Natural Inquirer* Wilderness Benefits Edition. After talking about the definition, find out if any of the students have visited wilderness lands.
3. Provide students with some pictures of wilderness. A good resource is <http://www.wilderness.net> or you can visit <http://www.naturalinquirer.usda.gov> and download the wilderness PowerPoint slideshow under Education Resources.
4. Have students break into pairs or groups and read the article “Speak-o-logical.”
5. With a partner or in groups, students should discuss the way scientists defined the ecological value of wilderness.
6. After students have finished reading the article and discussed the article in their groups, discuss the article as a whole class.

Day 3 - 4

1. Refresh the students’ memories about the article “Speak-o-logical” by having a few students summarize the different findings in the article and the class discussion.
2. Have students read in pairs or groups “It’s Elemental, My Dear!” Ask students to think about the two concepts that represent naturalness in the “Speak-o-logical” article: natural land cover and distance from roads. Ask students to reflect on whether these two naturalness concepts influenced peoples’ experiences at Gates of the Arctic National Park and Preserve.































3. In order to have students synthesize and integrate the information from the two articles, hold a class discussion about the concepts of naturalness and peoples’ experiences in Gates of the Arctic. Here are some questions to start the discussion:

- a. Do you think natural land cover and/or distance from roads are important to visitors at Gates of the Arctic National Park and Preserve? Why or why not?
- b. How might the experience at Gates of the Arctic be different from going to a local park or State park? How might they be similar? Would natural land cover and distance from roads differ among these areas? If so, how?

Day 5

1. Ask students to reflect on their study of wilderness by writing Haiku poems.
2. In order to create a Haiku poem, the students should pick a topic for the poem that has something to do with nature and wilderness. A Haiku is typically three lines, with the first line having five syllables, the second line having seven syllables, and the third line having five syllables. Words in a Haiku do not have to rhyme.
3. Once students have created their Haiku poems, they can “publish” their poems on a PowerPoint® slide and use a picture from wilderness as a background image for their Haiku. The wilderness.net Web site has a nice collection of images. Students can also draw their own wilderness scene or use magazine pictures or create a collage of wilderness photos on which to display their Haiku. Additionally, students can submit their Haiku poems to the *Natural Inquirer* and the *Natural Inquirer* staff will post them on our Web site.

Which National Science Education Standards* Can Be Addressed by the *Natural Inquirer*?

	It's Ele- mental, My Dear!	Wilder- ness Makes Cents!	As The Frog Hops	Wild & Free!	Can You Hear Me Now?	Speak-o- logical
Science as Inquiry						
Abilities Necessary To Do Scientific Inquiry						
Understandings About Scientific Inquiry						
Life Science						
Regulation and Behavior						
Populations and Ecosystems						
Diversity and Adaptations of Organisms						
Science and Technology						
Understandings About Science and Technology						
Science in Personal and Social Perspectives						
Natural Hazards						
Risks and Benefits						
Science and Technology in Society						
History and Nature of Science						
Science as a Human Endeavor						
Nature of Science						

* National Research Council, Content Standards, Grades 5-8

PLEASE COPY THIS FORM BEFORE COMPLETING.

STUDENTS—Tell Us What You Think About The *Natural Inquirer*

1. The article I read was entitled: _____

Circle the answer that best describes how you feel about the article you just read.

2. The article was: Easy to understand Hard to understand Very hard to understand

3. The article was: Very interesting Somewhat interesting Not interesting

4. Did you learn something from reading the article? Yes No

5. Did you try to answer the Reflection Questions? Yes No Some of them
If you read and tried to answer any of the reflection questions, did they help you to think about the article? Yes No

6. Would you like to read another article? Yes No

7. How old are you? 9 10 11 12 13 Other age: _____

8. What grade are you in? 4th 5th 6th 7th 8th 9th

9. Are you a girl or a boy? Girl Boy

Now write in your answer:

10. What did you learn from reading the article? _____

11. What is your favorite subject in school? _____

Along with your class or by yourself, please send this form to:
Dr. Barbara McDonald • Forest Service • 320 Green St. • Athens, GA 30602-2044

Thank You!

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The Natural Inquirer Teacher's Evaluation

For each article that you read, please answer the following:

Name of Article: _____

1. Would this article help you meet any of the required statewide science curriculum standards?

Yes No

2. How close to the appropriate reading and comprehension level for your students is this article written?

Very close Somewhat close Not close

3. If the article is somewhat close or not close to the appropriate reading and comprehension level, is it:

Too hard Too easy

4. Would or did you use this article in your classroom as an educational resource?

Yes No

Why or why not? _____

5. Please rate the article sections on a scale of 1 to 5. One means the section was not useful at all, five means the section was very useful.

	Not useful		Very useful		
Glossary	1	2	3	4	5
Introduction	1	2	3	4	5
Methods	1	2	3	4	5
Findings	1	2	3	4	5
Discussion	1	2	3	4	5
Graphs, figures, photos	1	2	3	4	5
Reflection Questions	1	2	3	4	5
FACTivity	1	2	3	4	5

For any of the sections you rated with either a "one" or a "two" in question 5, please indicate why the section was not useful or how it can be improved:

Glossary _____

Introduction _____

Methods _____

Findings _____

Discussion _____

Graphs, figures, photos _____

Reflection Questions _____

FACTivity _____

6. Was the "Note to Educators" useful to you?
Yes No Somewhat

7. What grade(s) do you teach? _____

8. What subject(s) do you teach? _____

9. Other comments or suggestions: _____

Please send this evaluation, along with your students' evaluations, to
Dr. Barbara McDonald
Forest Service
320 Green St.
Athens, GA 30602-2044

Thank you! Your evaluations will help us to continually improve the *Natural Inquirer*.

Directions: Your job is to use this **READING GUIDE** to better understand any article in the *Natural Inquirer* edition.

Before you read the entire article, S.C.A.N it!

Survey the section by reading the “Reflection Section” questions, and skim over the “Thinking About Science” section.

What do you think this article is going to be about?

Capture the visuals. Look at the pictures and diagrams. What information can you learn from them?

Attack the vocabulary. Read the words in the glossary section and make sure you know what they mean before you read the article.

Note what you know. Make a short list of the topics, ideas, and terms you see in the article that you are already familiar with.

Now that you’ve “scanned” the article, you’re ready to **R.U.N** with it.

Read for Meaning. As you read, think about what each section is about. Write down one sentence that describes what the section is about.



The “Thinking about Science” section is all about...



The “Thinking about the Environment” section is all about...



The most important piece of information in the “Introduction” section is...



The “Method” section explains...



The “Findings” section is important because...



The “Implications” section is important because...

Understand What You Read. Without looking back at what you just read, can you explain it? If so, create three sentences that summarize the entire article. If not, go back to the article and re-read the areas that were confusing.

In my own words, I think this article is about...

Notes for later – Take a look at the notes you’ve collected so far. Based on the notes you’ve taken so far, answer these questions. Do you have your main ideas written down? Do you have your definitions written down for any words you did not know? Do you have a good understanding of what the article is about? If not, go back to the article and find the information you need.

This S.C.A.N and R.U.N activity was compiled by Todd R. Nickelsen and is a modification of Salembier’s (1999) S.C.A.N and R.U.N. Salembier, G.B. (1999, February). S.C.A.N and R.U.N: A reading comprehension strategy that works. *Journal of Adolescent & Adult Literacy*, 42(5), 386-394.



What Is the USDA Forest Service?

The Forest Service is a part of the U.S. Department of Agriculture (USDA). It is made up of thousands of people who care for the Nation's forest land. The USDA Forest Service manages over 150 national forests and almost 20 national grasslands. These are large areas of trees, streams, and grasslands. National forests are similar in some ways to national parks. Both are public lands, meaning that they are owned by the public and managed for the public's use and benefit. Both national forests and national parks provide clean water, homes for the animals that live in the wild, and places for people to do fun things in the outdoors. National forests also provide resources for people to use, such as trees for lumber, minerals, and plants used for medicines. Some people in the USDA Forest Service are scientists, whose work is presented in this journal. USDA Forest Service scientists work to solve problems and provide new information about natural resources so that we can make sure our natural environment is healthy, now and into the future.



CAMPAIGN
for AMERICA'S WILDERNESS

What Is the Campaign for America's Wilderness?

The Campaign for America's Wilderness is a national organization that works to preserve, protect, and raise awareness of wilderness. The organization works with State coalitions and citizen groups to ensure the preservation of wilderness. Additionally, the organization works with partners to identify wild lands and help to preserve them as a part of the National Wilderness Preservation System.



What Is the Wilderness Research Alliance?

The University of Georgia and the USDA Forest Service work together to study wilderness and the benefits of natural resources. These scientists study topics such as the value of natural lands and resources, recreational use of wildlands, and people's experience of natural lands.

Visit these Web sites for more information:

USDA Forest Service:

<http://www.fs.fed.us>

The Natural Inquirer:

<http://www.naturalinquirer.usda.gov>

Conservation Education:

<http://na.fs.fed.us/spfo/ce>

USDA Kid's Page:

<http://www.usda.gov/news/usdakids/>

Agriculture in the Classroom:

<http://www.agclassroom.org>

Wilderness Information

<http://www.wilderness.net>

NatureWatch

<http://www.fs.fed.us/outdoors/naturewatch/>



Woodsy Owl:

<http://www.fs.fed.us/spf/woodsy>

Smokey Bear:

<http://www.smokeybear.com>

Project Learning Tree

<http://www.plt.org/>

Interactive Map of the Wilderness Preservation System:

<http://www.wilderness.net/index.cfm?fuse=NWPS>

National Forests by Map:

<http://www.fs.fed.us/recreation/map/finder.shtml>

National Forests by State:

http://www.fs.fed.us/recreation/map/state_list.shtml



United States
Department
of Agriculture



Forest Service

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Visit these Web Sites for More Information About Wilderness:

Campaign for America's Wilderness
<http://www.leaveitwild.org/>

Experiencing Wilderness
http://www2.nature.nps.gov/synthesis/views/index_wilderness.htm

Wilderness Information
<http://www.wilderness.net>

Arthur Carhart National Wilderness
Training Center
<http://carhart.wilderness.net/>

Aldo Leopold Wilderness Research
Institute
<http://leopold.wilderness.net/>

The Wilderness Society
<http://www.wilderness.org/>



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