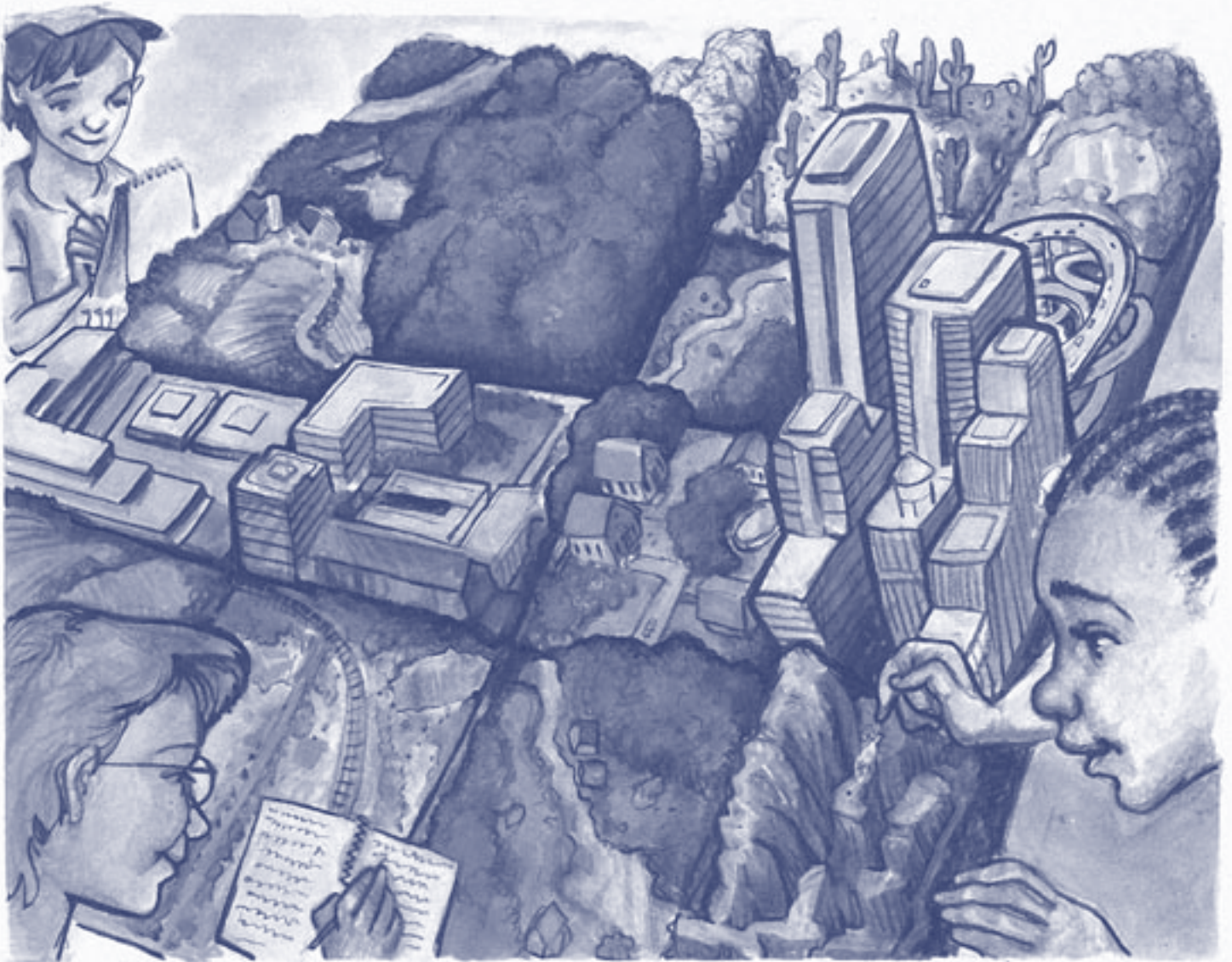


# ***Wild and Free!***

## ***The Quality of Wildness in Wilderness in the United States***



## Meet the Scientists



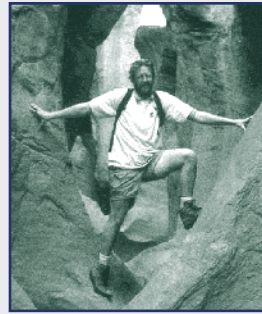
◀ **Dr. Aplet:** My favorite science experience was studying vegetation development on lava flows in Hawaii. It was fascinating to see how plants get started on bare rock, but the

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**).

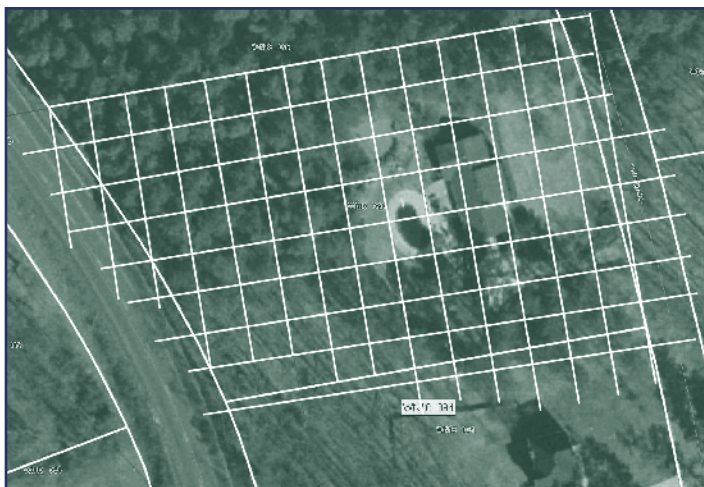
### Thinking About the Environment



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

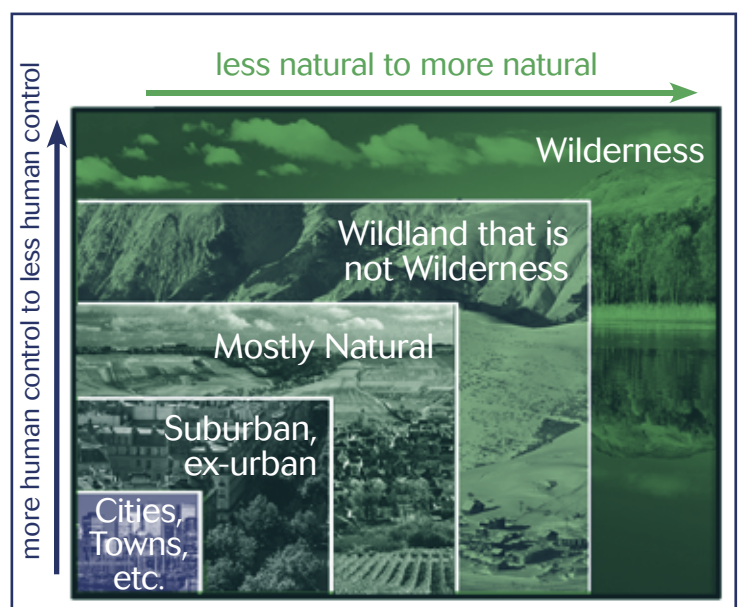
<u>a</u>	as in ape
<u>ä</u>	as in car
<u>e</u>	as in me
<u>i</u>	as in ice
<u>o</u>	as in go
<u>ô</u>	as in for
<u>u</u>	as in use
<u>ü</u>	as in fur
<u>oo</u>	as in tool
<b>ng</b>	as in sing

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**).

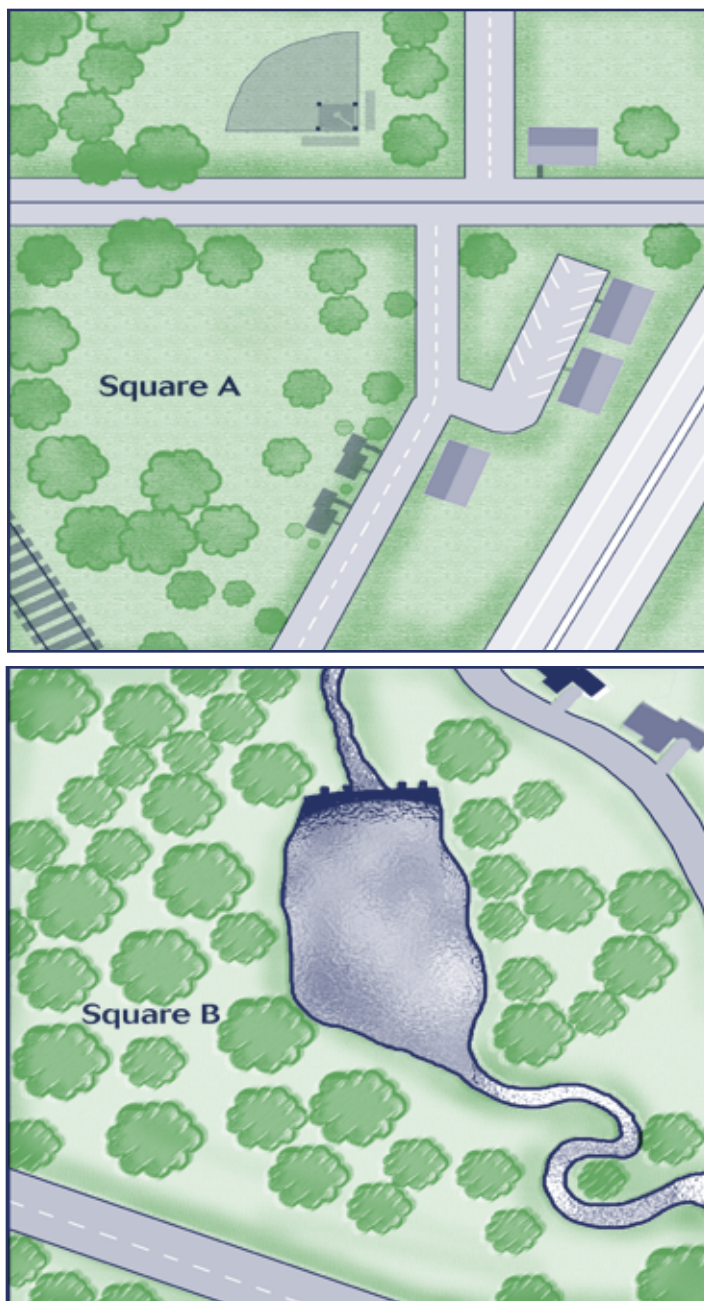
The scientists then applied the summed value to each of the 16-million-square kilometers. They ended up with a single value for each square kilometer in the United States. Since they were using a GIS, the next step was to create a map. For each of the final values, they assigned a color that would be 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



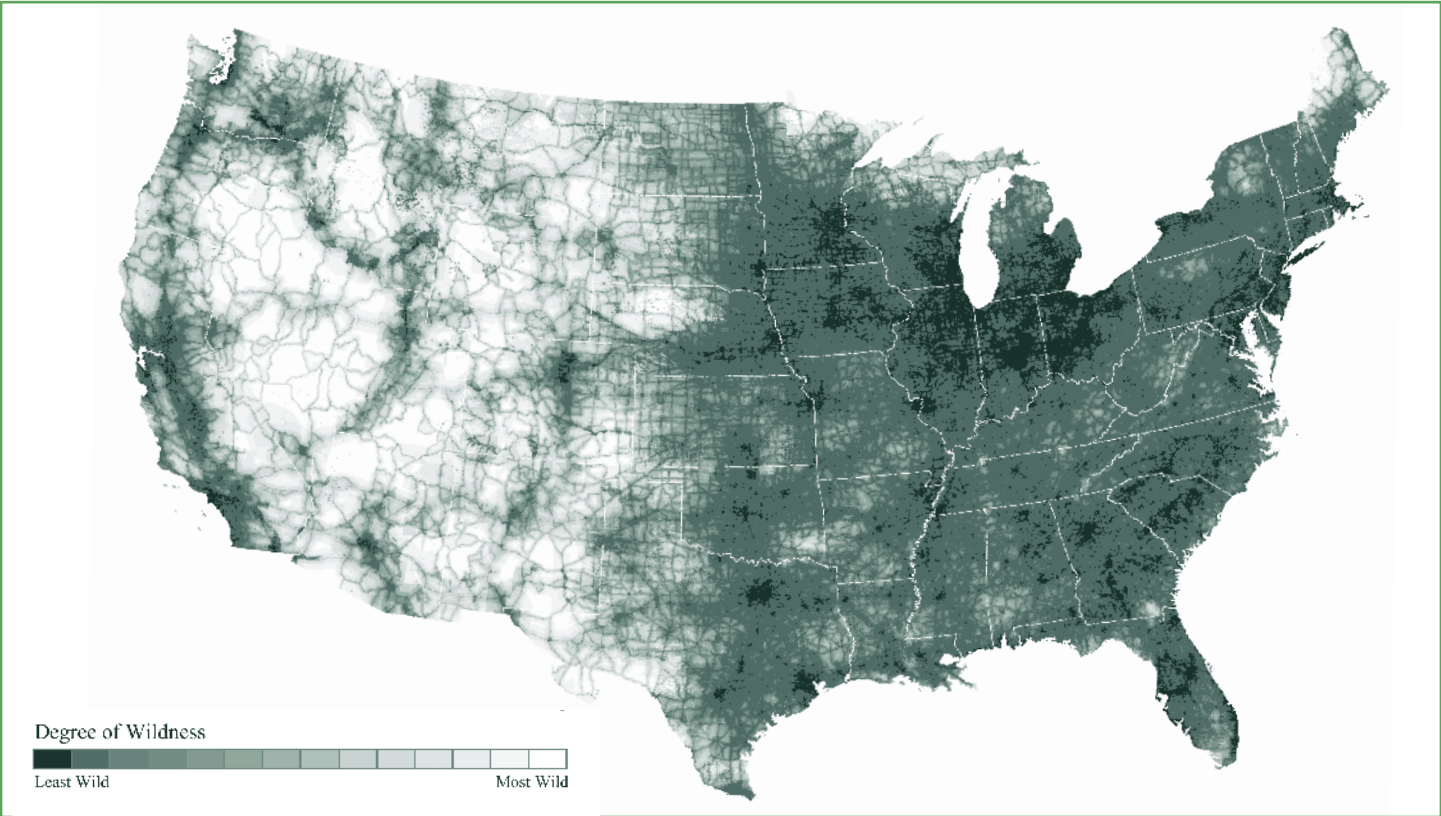
**Figure 5.** Here is an example of two different square kilometers of land. Square A shows a highway, a railroad track, a baseball diamond, a shopping center, houses, and a gas station. There is a lot of grass, some bare ground, and some trees. Square B shows a few houses and two roads, a lot of trees 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.