Natural Inquirer

2021
Number 22

The *Natural Inquirer* Monograph Series: **FORESTS & AGRICULTURE**

TO HARVEST OR NOT TO HARVEST, THAT IS THE QUESTION

How Does Harvesting Impact Wild Plant Sustainability?

USDA FOREST SERVICE DEPARTMENT OF AGRICULTURE FIND OUTDOORS

Natural Inquirer

Monograph Series: Forests & Agriculture

To Harvest or Not to Harvest, That is the Question:

How Does Harvesting Impact Wild Plant Sustainability?

Produced by

Forest Service, an Agency of the U.S. Department of Agriculture (USDA)

FIND Outdoors

Production Staff

Jessica Nickelsen, *FIND Outdoors*

Brian Cooke, *FIND Outdoors*

Babs McDonald, Forest Service Volunteer

Michelle Andrews, *University of Georgia*

Nissa McKinney, *FIND Outdoors*

Bradi McDonald, *FIND Outdoors*

Leslie Shaw, *Leslie Shaw Design*

Stephanie Pfeiffer, *SMP Illustration*

Liz Sisk, *Illustrator*

Carey Burda, *Cartographer*

Forest Service Scientists Highlighted in the Journal

James Chamberlain, *Southern Research Station*

Collaborating Scientists

Christine Small, *Radford University*

Forest Service

Randy Moore, *Chief*

Alex L. Friend, *Deputy Chief, Research and Development*

Jaelith Hall-Rivera, *Deputy Chief, State and Private Forestry*

Tracy Hancock, *Staff Director, Knowledge Management & Communications*

Sharon Parker, *Program Manager Science Synthesis, Knowledge Management & Communications*

Tinelle Bustam, *Staff Director, Conservation Education*

Iris Velez, *National Symbols Program Manager*

Mason Edwards, *Education Specialist, Conservation Education*

Rachel Bayer, *Education Specialist, Conservation Education*

Wendy Zirngibl, *Senior Policy Advisor, Ecosystem Management & Coordination*

FIND Outdoors

Harry R. "Tad" Fogel, *Chairperson*

Natalie Britt, *President/CEO*

Adam DeWitte, *Vice President of Development & Communications*

With thanks to

Jim Kahler, *4-H National Headquarters, USDA National Institute of Food and Agriculture*

Project Learning Tree, http://www.plt.org/

Kelsi Eccles, *The Conservation Fund*

Cover photos: Background photo by emer1940, via https://www.istockphoto.com and inset photo by Giorez, via https://www.istockphoto.com.

2021 | Number 22

CONTENTS

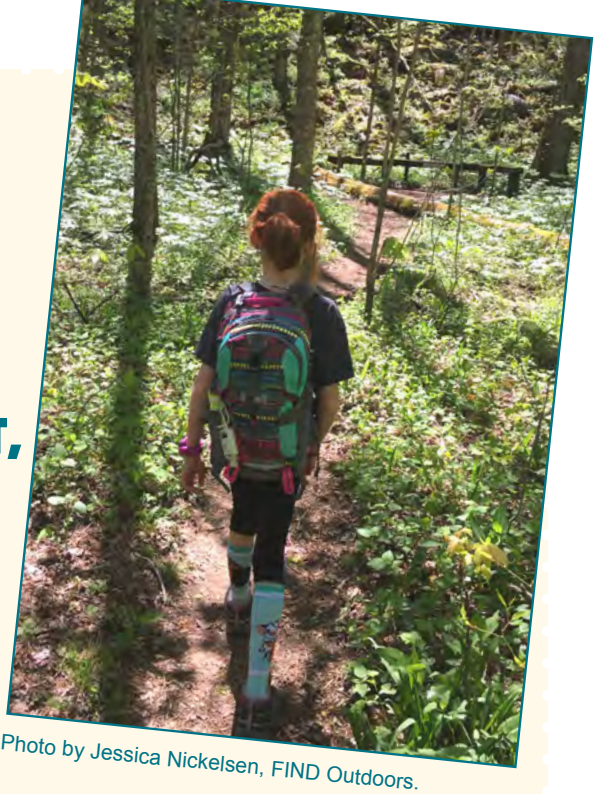


Photo by Jessica Nickelsen, FIND Outdoors.

Page 17
FEATURE:
TO HARVEST OR NOT TO HARVEST, THAT IS THE QUESTION:
How Does Harvesting Impact Wild Plant Sustainability?

Join us in being green!

The following Educator Resources are now available exclusively on the *Natural Inquirer* website at **http://www.naturalinquirer.org.**

These resources can be found with the "*Natural Inquirer* Monograph Series—Forests and Agriculture" journal and on the "For Educators" pages.

- **Note to Educators**
- **Lesson Plan**
- **Reflection Section Answer Guide**
- **National Education Standards**

Editorial Review Board Hard at Work

Ms. Moore's 7th Grade Life Science
Chamblee Middle School • Georgia

Photo by Julie Linsley, used with permission.

"That the ecosystem is a gift and it is our duty to protect it."

"I learned how and why experiments are conducted."

"I learned why it is important to know how to sustainably harvest black cohosh/ medicinal plants."

"I learned that over-harvesting could lead to a lack of certain nutrients for an organism, which can lead to lack of nutrients for multiple organisms in an ecosystem."

"Go a little bit more in depth in some areas and include some jokes with the questions."

"I would add more examples that can relate to the readers day to day life."

"It would be nice if students around the country can read this and other research on the topic. "

"Definitions for words should not only be in the glossary, but also as footnotes."

"The most important thing I learned was that there was a decline in the population of black cohosh as a result of harvesting the plant."

About *Natural Inquirer* Monographs!

Scientists report their research in a variety of special books, called journals. Although journals have been produced in hard copy, they are increasingly also produced online. Journals usually contain between four and seven scientific papers. Journals enable scientists to share their research with one another. A monograph is a type of journal about research that focuses on a single scientific paper.

This monograph of a *Natural Inquirer* article was created to give scientists the opportunity to share their research with you and other students. The monograph presents scientific research conducted by Forest Service scientists and other scientists. If you want to learn more about the Forest Service, you can read about it on the inside back cover of this monograph, or you can visit the *Natural Inquirer* website at http://www.naturalinquirer.org.

All of the research in this *Natural Inquirer* monograph is concerned with the natural environment, such as trees, forests, soils, animals, insects, outdoor activities, and water. First, you will "meet the scientists" who conducted the research. Then you will read about one of the many interesting aspects of science and about the natural environment. You will also read about a specific research project. The research article is written in the format that scientists use when they publish research in scientific journals. Then YOU become the scientist as you go through the FACTivity associated with the article. Don't forget to look at the glossary and the special sections highlighted in the article. These sections give you extra information that is educational and interesting.

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 will help you think like a scientist. They will help you think about how research is conducted. Your teacher may use these questions in a class discussion, or you may discuss these questions in a small group.

Each *Natural Inquirer* monograph will help you explore the exciting world of science and prepare you to become a young scientist. You will learn about the scientific process, how to conduct scientific research, and how to share your own research with others.

Visit http://www.naturalinquirer.org for more information, articles, and resources.

Be sure to try the Harvest or Not to Harvest Word Scramble and eyeChallenge on pages 36 and 37!

Who Are Scientists?

Scientists collect and evaluate information about a wide range of topics. Some scientists study the natural environment.

To be a successful scientist, you must:

Be curious:
Are you interested in learning?

Photo courtesy of Barb Beasley, USDA Forest Service.

Photo courtesy of Nora Gamino, USDA Forest Service.

Be enthusiastic:
Are you excited about a particular topic?

Photo courtesy of Ge Sun, USDA Forest Service.

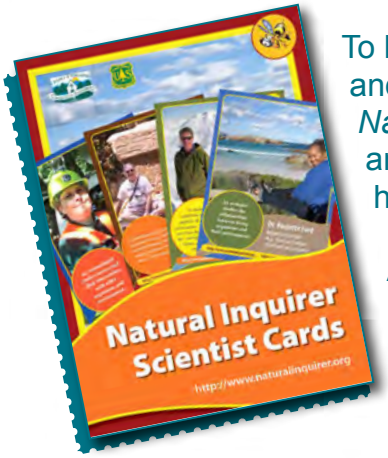
Be careful:
Are you accurate in everything you do?

Photo courtesy of Robert Develice, USDA Forest Service

Be open-minded:
Are you willing to listen to new ideas?

Photo courtesy of Sharon Hood, USDA Forest Service.

Question everything:
Do you think about what you read and observe?



To learn more about scientists and their work, you can find *Natural Inquirer* scientist cards and posters online at http://www.naturalinquirer.org.

At this website, you can also view a series of scientist videos to help you plan, design, and conduct your science fair project.

Photo by Kateryna_Mostova, via https://www.istockphoto.com.

Welcome to the *Natural Inquirer* Monograph Series— FORESTS & AGRICULTURE!

Glossary words are in **bold** and are defined on page 31.

Agriculture is the science and practice of preparing the soil, producing crops, and raising livestock. Agriculture is the process through which humans get food and many other resources.

Societies have practiced agriculture for thousands of years. Experts have difficulty pinpointing the exact start of agriculture, but estimates range from 10,000 to 25,000 years ago. Agriculture has taken many forms over its long history. Today, it is practiced on scales from very small, such as growing tomatoes in a pot (figure 1a), to very large, such as raising bison on ranches (figure 1b). You may find a wide variety of agricultural techniques in both urban areas and rural areas.

Historically, many people practiced agriculture on a small scale at their homes or in their communities. Over time, however, fewer and fewer people practiced agriculture at home. New techniques and technologies have become so efficient that agriculture has been able to support larger populations with fewer people farming

To learn more about monographs, read "About *Natural Inquirer* Monographs!" on page 5.

Figure 1a. For people not living on a farm, plants can be grown in a pot, like this tomato plant. Photo courtesy of coramueller, iStock.

Figure 1b. Agricultural areas include land used to raise animals, such as cows, horses, pigs, goats, sheep, and the bison pictured here. Animals can be used on the farm to complete tasks, and they can also be raised for products, such as meat or fiber. Photo courtesy of Ryan Hagerty, U.S. Fish and Wildlife Service.

(figure 2). Farmers can grow enough food for themselves and their communities, to sell at grocery stores, and even trade with people across the globe.

Supporting the 7 1/2 billion people on Earth requires a large amount of land to be used in agriculture. According to the United Nations Food and Agriculture Organization, approximately 11 percent of land

Figure 2. New technologies, like the modern tractor, have enabled farmers to produce more food and products.

Photo courtesy of Phyllis Cooper, U.S. Fish and Wildlife Service.

worldwide is used for agriculture. Scientists expect Earth's population to continue to grow. With population growth, scientists expect increased productivity on agriculture lands as a result of improved technologies and practices.

In the United States, large amounts of agricultural land are located in the Midwest (figure 3). The scientists in this study found that 43 percent of midwestern land is used to grow corn and soybeans.

The scientists in this study were interested in determining the impact of harvesting wild plants on the long-term health of plant populations. As you read this article, take a moment to think about agriculture in your life. How are the items that you use daily connected to agriculture?

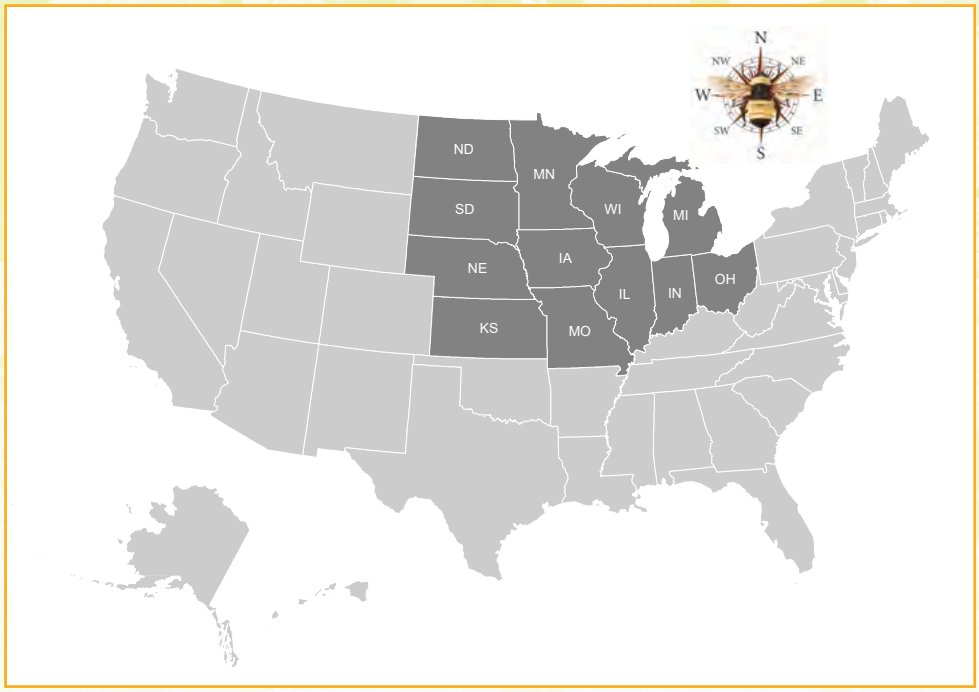


Figure 3. The Midwest is a region of the United States.

Map by Carey Burda and Stephanie Pfeiffer.

WHAT IS AGROFORESTRY?

This monograph is the second in the Forests & Agriculture Series and focuses on agroforestry. You may be wondering what the word agroforestry means. “Agro” comes from the Greek word “agros,” which means field. Forestry refers to the science or practice of planting, managing, and caring for forests.

Agroforestry is the practice of mixing trees, shrubs, crops, or animal production systems together. The purpose of mixing trees and shrubs with crops or animal production is to create environmental, economic, and social benefits. Five practices are used in agroforestry. The five practices are: windbreaks, **riparian** forest buffers, **silvopasture** systems, alley cropping, and forest farming.

Windbreaks are plantings of single or multiple rows of trees, shrubs, or grass that protect crops, livestock, people, and wildlife from wind (figure 4). Some of the benefits of windbreaks include creating healthier crops and livestock, storing carbon, and creating a better aesthetic. Storing carbon by planting trees or managing overgrown forests is important because it helps rebalance the global carbon cycle (figure 5). Too much carbon in the atmosphere can contribute to climate change.

Riparian forest buffers are trees, shrubs, grass, and other plants growing close to rivers, streams, lakes, and other bodies of water (figure 6).

Figure 4. A windbreak protects these vegetables, enabling them to grow more successfully.

Photo courtesy of USDA Natural Resources Conservation Service.

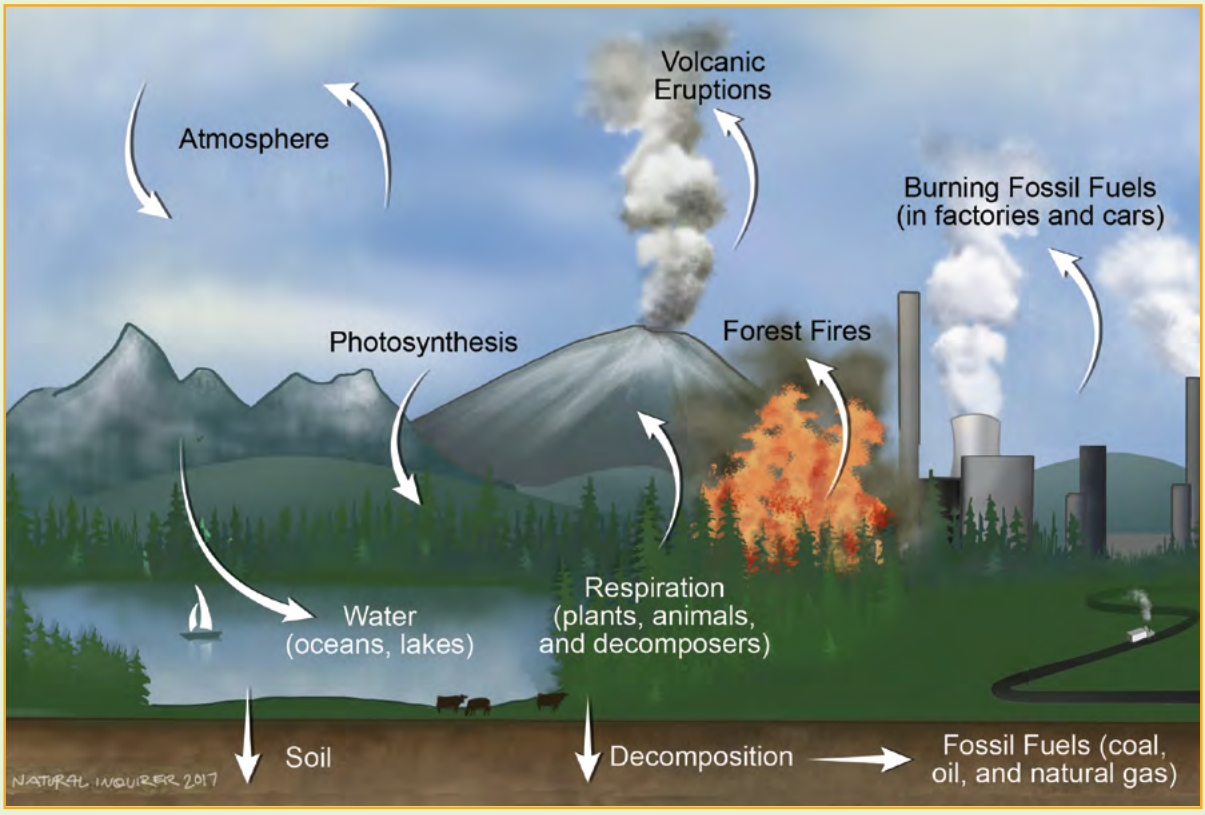


Figure 5. Carbon moves through Earth and its atmosphere in a cycle.
Illustration by Stephanie Pfeiffer.

These buffers protect water from potential harmful byproducts that may be caught in aboveground and belowground surface runoff. Other benefits of riparian forest buffers include stream bank stability, reduced flood damage, increased wildlife habitat, and improved aesthetic appeal.

Figure 6. Riparian forest buffers are maintained near bodies of water to protect water quality. They also provide food and habitat for plants and animals.
Photo courtesy of USDA Natural Resources Conservation Service.

Silvopasture is a practice where trees, livestock, and feeding areas for animals are managed as one system (figure 7). The trees provide shade and improved habitat for the livestock as they grow. The plant and habitat diversity in silvopasture systems attracts many wildlife species such as wild turkey, quail, deer, and songbirds. Silvopasture systems have other benefits, including increased biological diversity, water quality protection, and reduced soil erosion.

Figure 7. Livestock, such as cows, enjoy the shade provided by trees in a silvopasture system.

Photo courtesy of USDA Natural Resources Conservation Service.

Alley cropping is when agricultural crops like corn are grown in widely spaced rows of woody plants like trees and shrubs (figure 8). Alley cropping has several benefits, including improved soil and crop health and providing another type of income-producing plants. For example, if fruit-bearing trees are planted, then the farmer has both the agriculture crop and fruit from the trees to sell, rather than just the crops alone.

Forest farming is managing the forested land so that there can be small-scale gardening or farming as well. A variety of fruit, herbs, nuts, and other items can be grown and harvested (figure 9). Sometimes people use this method as an extra source of income. However, many people engage in forest farming because they enjoy growing or collecting nontimber forest products, like mushrooms or herbs, as a recreational

Figure 8. Alley cropping helps improve soil and crop health.
Photo courtesy of National Agroforestry Lab Center by Shibu Jose.

activity or as part of a family or cultural tradition. For more information on forest farming, see “What is a Food Forest?” on page 14.

These agroforestry practices provide many benefits to plants, animals, and the surrounding environment. In this monograph, we highlight one particular case of agroforestry involving black cohosh and forest farming. Learn more about agroforestry at the USDA National Agroforestry Center https://www.fs.usda.gov/nac/ or https://www.usda.gov/topics/forestry/agroforestry.

Figure 9. Some people like to grow and harvest forest medicinal herbs such as black cohosh, pictured here in the center of the photo.
Photo by Jessica Nickelsen, FIND Outdoors.

WHAT IS A FOOD FOREST?

Figure 10. A food forest consists mostly of forested space but can also contain community gardens and orchards. Community gardens are found in the middle of Browns Mill Food Forest. These community gardens provide space for vegetables to grow. Photo courtesy of The Conservation Fund.

Residents of the Browns Mill neighborhood in Atlanta, Georgia, along with the USDA Forest Service and other partners, are creating a "food forest." It will be Atlanta's first food forest and one of the Nation's largest.

A food forest looks like a regular forest, but its plants also provide fresh fruits, nuts, mushrooms, herbs, and vegetables (figure 10). The Browns Mill Food Forest is a 7.1-acre piece of land that used to be a small family farm. The land was abandoned and neglected for many years. Now, through the hard work of many partners, the food forest contains an **orchard**, community gardens, a walking trail, a picnic area, and more (figures 11 and 12).

The Browns Mill Food Forest is important because it is located in a "food desert." A food desert is a community that has limited access to affordable and healthy food. Thirty-six percent of Atlanta is considered a food desert, including the Browns Mill neighborhood. The Browns Mill Food Forest helps address the lack of access to healthy and affordable foods.

Figure 11. These kids are learning how they can help with the community gardens. Photo courtesy of The Conservation Fund.

Figure 12. These volunteers are planting trees for the orchard.
Photo courtesy of The Conservation Fund.

The food forest provides numerous environmental, economic, and social benefits. For example, the space provides habitat for many plants and animals. In particular, it provides pollinator habitat (figure 13). Pollinators are responsible for helping over 80 percent of the world's flowering plants reproduce. Some pollinators include bees, bats, hummingbirds, moths, and butterflies.

Figure 13. The Browns Mill Food Forest has bee pods that provide a home for pollinators. Local students get to learn about the bees and the role bees play in the food forest.
Photo courtesy of the United States Geological Survey.

The Browns Mill Food Forest also provides economic benefits, like increasing the property values of nearby homes and businesses. One of the important social impacts includes opportunities for local people to learn about gardening and healthy eating (figure 14).

Food forests are a great way to bring communities together and closer to their environment. To learn more about the Browns Mill Food Forest, visit https://www.aglanta.org/urban-food-forest-at-browns-mill-1 or https://www.conservationfund.org/projects/food-forest-at-browns-mill.

Figure 14. The food forest provides space for outdoor recreation, like birdwatching.
Photo courtesy of The Conservation Fund.

TO HARVEST OR NOT TO HARVEST, THAT IS THE QUESTION:

How Does Harvesting Impact Wild Plant Sustainability?

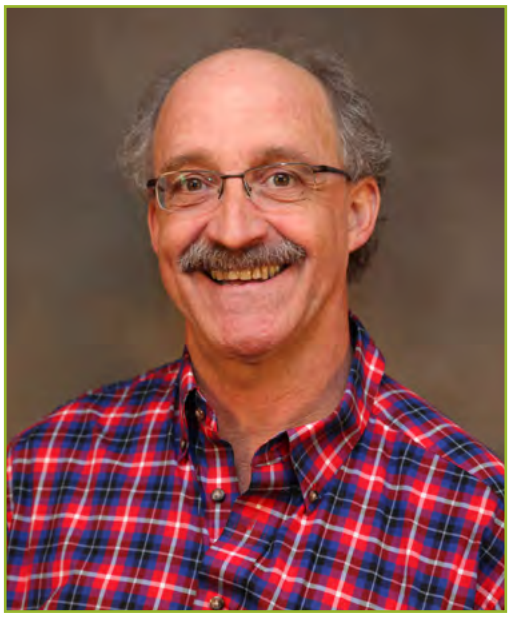
Photo by bkkm, via https://www.istockphoto.com.

MEET THE SCIENTISTS!

◀ CHRISTINE SMALL, Forest Ecologist

I am very lucky to be able to spend much of my working time outdoors, exploring nature, and sharing my excitement with others. My favorite science experiences have involved hiking, camping, or traveling to explore new habitats with students. Whether we are exploring underwater coral reefs in the tropics, cranberry bogs and herds of wild ponies in the mountains, or groups of trees just outside the classroom, spending time outdoors always leads to unexpected discoveries about nature and learning from one other.

Photo courtesy of Christine Small, used with permission.



◀ JAMES CHAMBERLAIN, Forest Products Technologist

A major part of this research was to provide field experience to young people to encourage them to pursue careers in science. On one field trip, we had students from five different universities. Some students had never camped or been in a forest. At the end of one trip, a young man came up to me and said, “This experience has changed my career vision and goals.” He went on to get an advanced degree in the study of ethnobotany—the study of how people interact with plants.

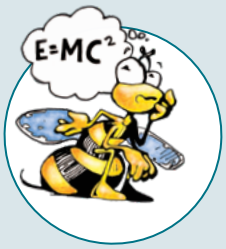
Photo courtesy of James Chamberlain, used with permission.

WHAT KIND OF SCIENTISTS DID THIS RESEARCH?

FOREST ECOLOGIST: This scientist studies the diversity of forest plants and their relationship with the surrounding environment including sunlight, moisture, soil nutrients, and effects of disturbances like invasive plants and insect pests.

FOREST PRODUCTS TECHNOLOGIST: This person studies forest management and the effects of management on products we use every day, like furniture, paper, building supplies, or medicinal ingredients.

Thinking About Science



Sometimes scientists study something that has already been studied. When scientists do this, they gather, read, and summarize all the research that has been completed. This process is often called a literature review. Scientists look at how other scientists researched the problem and then come up with their own research question and design an experiment to help answer their question.

However, there are times when scientists do not have access to much previous research. When that happens, scientists first look at what general information is known, as well as the research that has been conducted on similar topics. Using that information, the scientists come up with their own research question and design an experiment to help answer it. You will learn that the scientists in this research did not have much previous research to examine prior to beginning their research. Therefore, they created new questions similar to research conducted by other scientists.

Thinking About the Environment

Forests are filled with a variety of natural resources. Natural resources are parts of the natural environment that meet human needs such as wood for housing, plants for food and medicine, and water for drinking. Native and **naturalized** plants and fungi are collected from forests for medicinal, **edible**, decorative, or other reasons. Scientists estimate that 4,000–6,000 plant species worldwide are collected from forests for these purposes. Nearly 200 species are harvested from North American forests. Half of those species are in the forests of the southern Appalachian Mountains (figure 15). Some examples of medicinal plants are American ginseng (figure 16), goldenseal, slippery elm, and black cohosh. These are slow-growing, **perennial** forest herbs. The belowground material of these plants is the part mostly used for **medicinal** purposes.

Figure 15. The southern Appalachian Mountains, like these mountains in North Carolina, contain many plant species that are harvested and used by humans.

Photo by Babs McDonald, used with permission.

Figure 16. American ginseng is one commonly harvested medicinal plant from the southern Appalachian Mountains.

Photo courtesy of the Fish and Wildlife Service.

Introduction

Black cohosh is a forest plant that is harvested for its medicinal use (figure 17). Black cohosh is native to eastern **deciduous** forests and can be found as far south as Georgia, north to southern Ontario, and west to Missouri (figure 18). Black cohosh grows in a variety of conditions. Appalachian cove forests are an example of an area where black cohosh can be found. Appalachian cove forests are sheltered areas that have moist, fertile soil (figure 19).

Black cohosh is harvested, or collected, from the forest. Not much is known about how harvesting affects black cohosh populations. Some scientists, however, have observed a decline in black cohosh populations that may be a result of harvesting these plants.

Figure 17. Black cohosh is a perennial herb. It has long and toothed leaves. The plant blooms in late spring or early summer with a tall stem of clustered white flowers. Photo courtesy of Jessica Nickelsen, FIND Outdoors.

Figure 18. The range of black cohosh stretches across much of the Eastern United States and eastern Canada.

Map by Carey Burda and Stephanie Pfeiffer.

Figure 19. Appalachian cove forests have the right conditions for black cohosh to thrive.

Photo by Jessica Nickelsen, FIND Outdoors.

Scientists determined that harvest impacts could be particularly high for black cohosh because it is collected for its roots and **rhizomes** (figure 20). Roots and rhizomes are a part of the belowground plant material. Due to the increasing harvest and use of black cohosh, the scientists in the study wanted to examine the impacts of harvesting on black cohosh. In particular, the scientists wanted to determine what amount of harvesting would be **sustainable**.

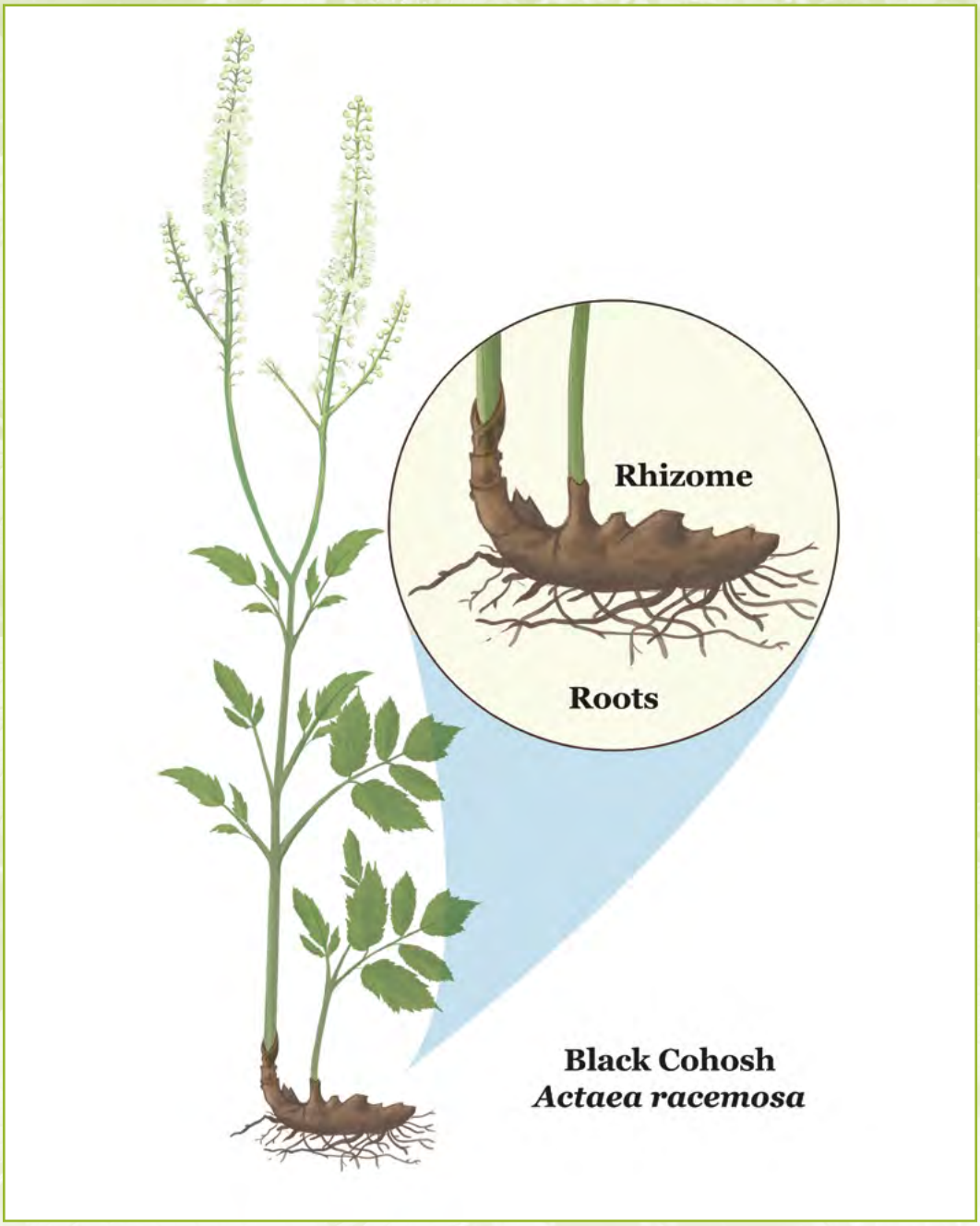


Figure 20. The roots and rhizomes of a plant are located underground. This is the part of black cohosh that is harvested for medicinal use. It is also important because it enables the plant to grow and reproduce. Illustration by Stephanie Pfeiffer.

did you know?

The word “cohosh” comes from an Algonquin (al **gän** kwē ən) Indian word meaning rough. Rough describes the dark, hard, knotted rhizomes of the plant that contain the plant’s medicinal properties.

In your own words and in the form of a question, what did the scientists want to study?

Why do you think it might be important to determine how to sustainably harvest black cohosh?

Methods

The research was conducted in parts of the George Washington and Jefferson National Forests (figure 21). This national forest encompasses approximately 1.8 million acres of land in Virginia, West Virginia, and Kentucky. The research site was in a Virginia portion of the national forest.

In June 2005, a 100-meter **transect** was established along the upper edge of the research site. The transect was located 3 meters from a Forest Service road (figure 22). This area was named Site 1. Thirty-six plots were created within Site 1 (figure 23). The plots were divided up by different harvesting treatments.

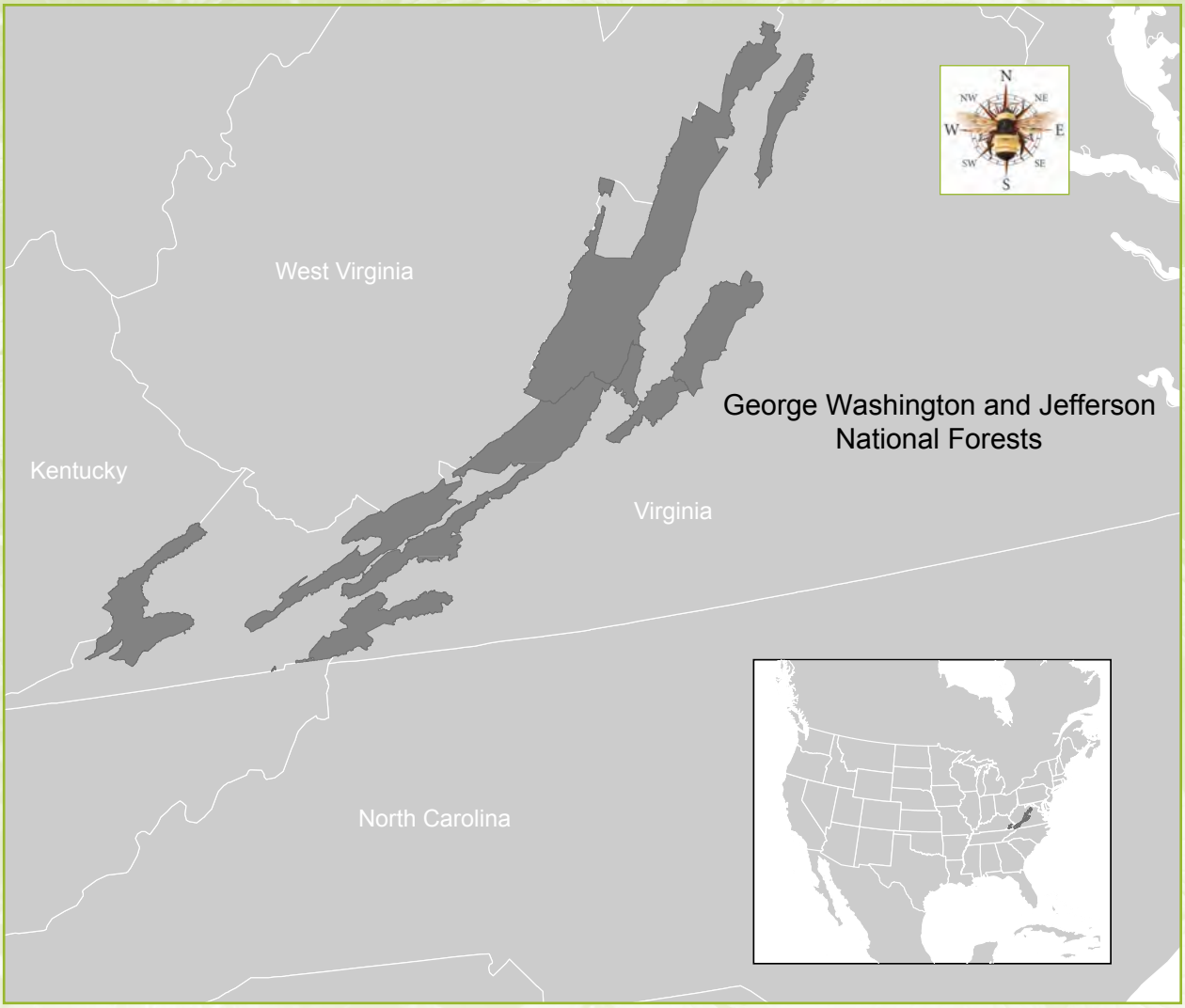


Figure 21. The George Washington and Jefferson National Forests encompass approximately 1.8 million acres of land across three States. Which two famous people is this national forest named after? What famous title did both of those people have?

Map by Carey Burda and Stephanie Pfeiffer.

The harvesting treatments were 0 percent harvest, 33 percent harvest, or 66 percent harvest (figure 24). The 0 percent harvest was used as a **control**. In June 2007 and June 2009, the scientists added new transects named Site 2 and Site 3. These sites were designed in the same way as Site 1.

Number Crunch

The scientists reported that the transect was located 3 meters from the Forest Service road. How many feet are in 3 meters? (Hint: 1 meter equals 3.28 feet)

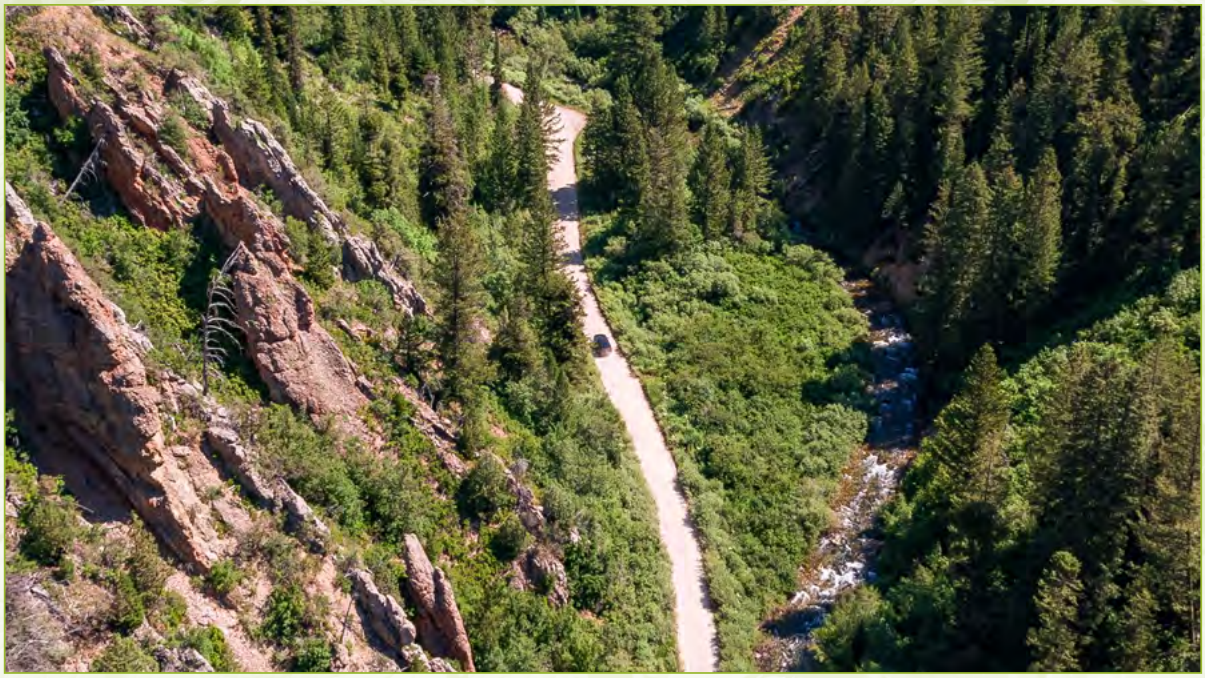


Figure 22. A Forest Service road is road built through a national forest. These roads are used by forest managers to reach areas within the forest and also to help manage wildland fires when needed.

Photo courtesy of U.S. Forest Service Flickr, Bridger-Teton National Forest. Photo by Pattiz Brothers.

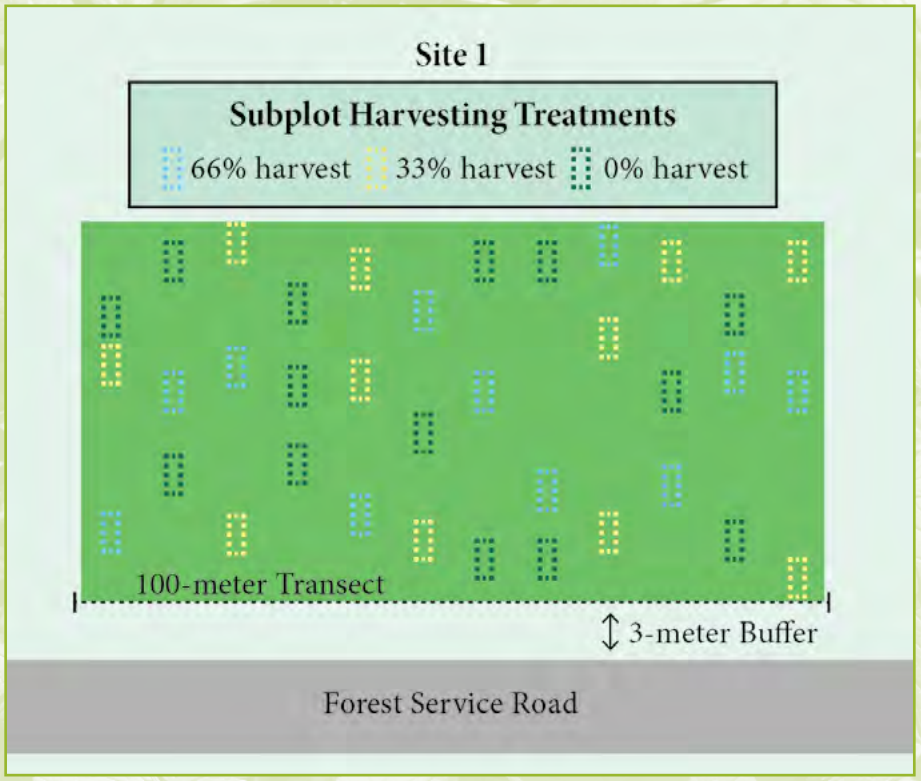


Figure 23. Site 1 consisted of 1 transect and 36 subplots. Each subplot was designated as either 0 percent harvest, 33 percent harvest, or 66 percent harvest.

Illustration by Stephanie Pfeiffer.

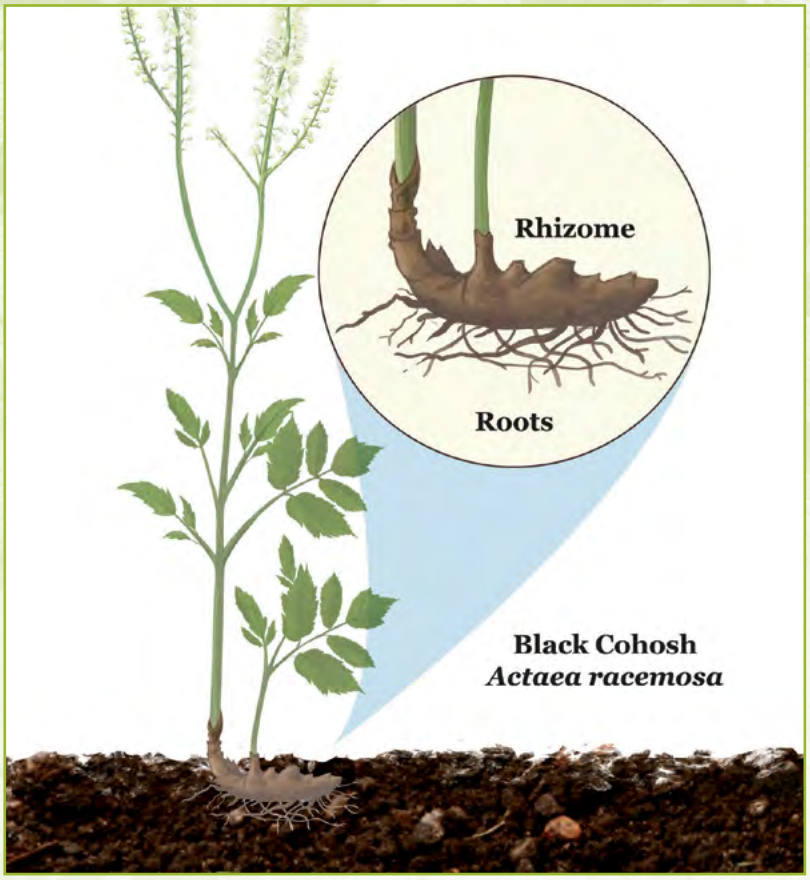


Figure 24. During each harvest, the scientists attempted to get all aboveground and belowground material from the black cohosh. It is possible that small pieces of the roots remained in the soil after the harvest.

Illustration by Stephanie Pfeiffer.

The scientists gathered a variety of growth measurements from each subplot, such as stem density, plant height, and **foliage** height and canopy dimensions (figure 25). In subplots which included harvesting, the scientists used techniques which mimic the way black cohosh has been harvested traditionally. All aboveground and belowground plant material were extracted as completely as possible. However, some rhizome fragments were likely left behind in the soil.

The growth measurements and harvests were conducted annually in June of each year beginning with the first year each site was established. The years that each site was studied were:

- Site 1: 2005–2007
- Site 2: 2007–2009
- Site 3: 2009–2011

During analysis of the results, the scientists removed any subplots that did not contain black cohosh.

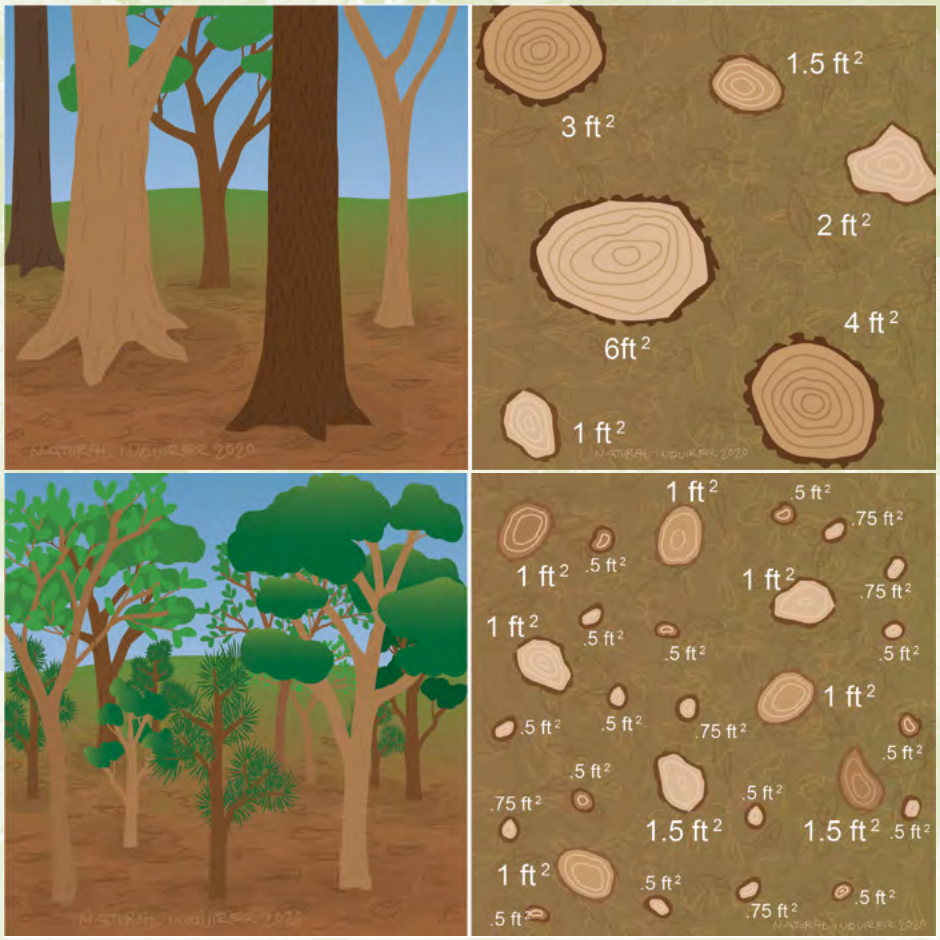


Figure 25. These illustrations show how the density of trees can vary depending on size and location of the trees.
Illustrations by Liz Sisk.

When the scientists harvested the black cohosh, they tried to remove as much of the aboveground and belowground plant material as possible. However, the scientists noted that some rhizome fragments were inevitably left behind in the soil. Why might this fact be important in the research?

The scientists ended up having three research sites. Do you think having multiple research sites is important? Why or why not?

Findings

The size and density of black cohosh plants were similar across the test subplots before harvesting. After 2–3 years of harvesting, most growth measurements for the black cohosh had declined (figure 26). After the last year of harvesting in the 66 percent harvest plots, black cohosh had 80–90 percent less foliage area and stem density. Black cohosh in the 33 percent harvest plots had 70–80 percent less foliage area and 65 percent less stem density.

The scientists also found differences between the treatment plots and the control plots for at least 2 years after harvests ended. When looking at all measurements, 3 years after harvesting ended at Site 1, there was no noticeable difference between the treatment plots and the control plots.

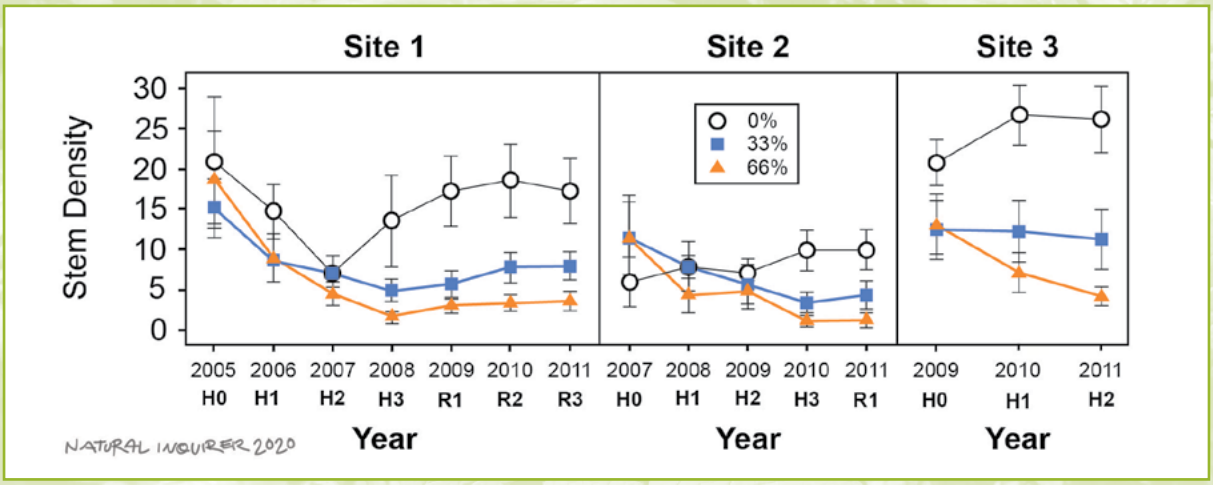
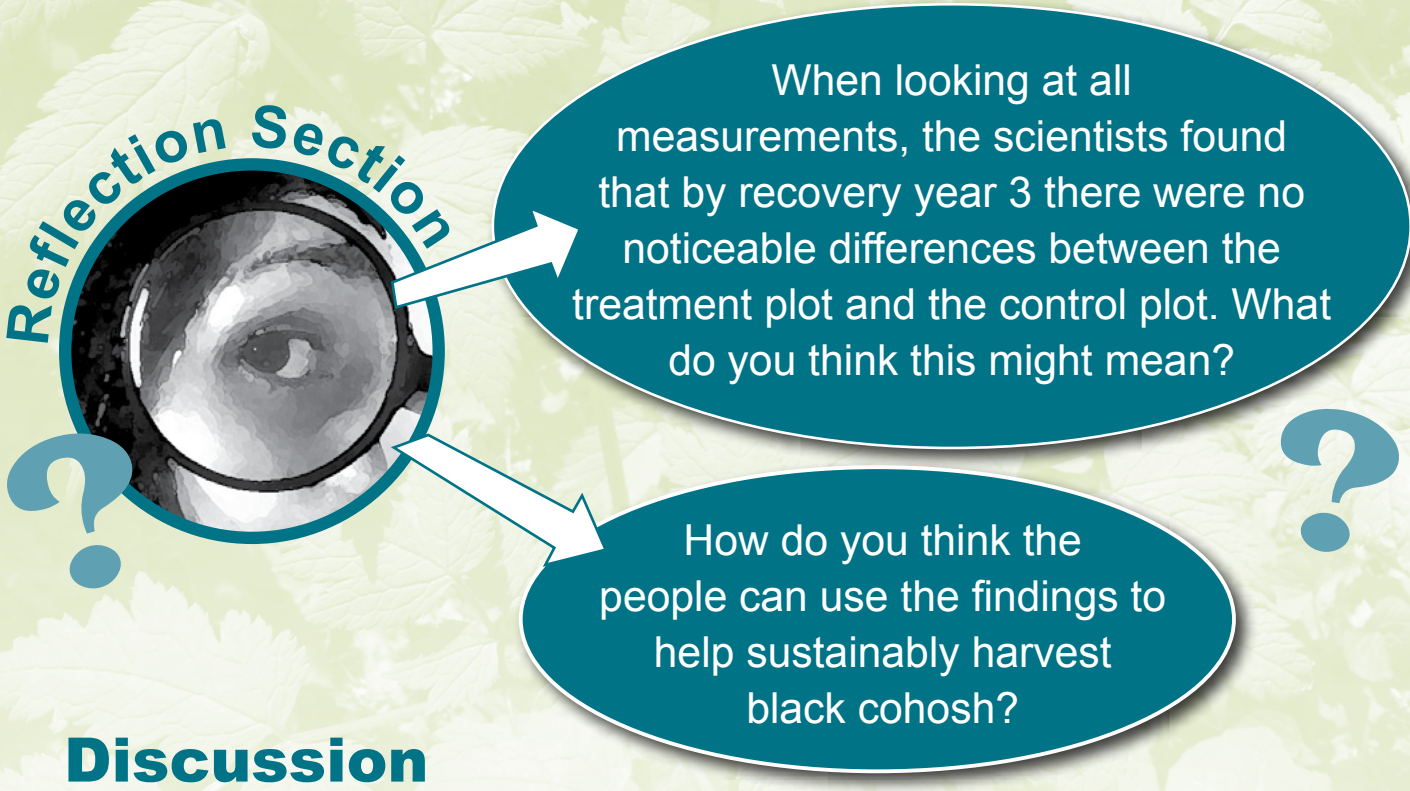


Figure 26. Examine the changes in stem density for black cohosh populations after 3 years of experimental harvest and the following regrowth. Stem density measurements were taken immediately before application of harvest treatments. H0 stands for preharvest year, H1 stands for harvest year 1, R1 stands for recovery year 1, and so forth. Illustration reproduced by Liz Sisk.



Discussion

Before this research, not much was known about the effect of harvesting on black cohosh. However, some research had been completed on a few other forest herbs. Results from this black cohosh research are similar to studies of some other forest herbs. At high harvest levels, plant recovery is slow or limited, especially when the roots or other belowground parts (like rhizomes) are collected for their medicinal properties.

The scientists noted that research on nontimber forest products like black cohosh have focused mostly on the population of a species. They determined that it is important for future research to also consider the effects of harvesting on **ecosystem services** and community structure. Community structure is the number of species in a natural community and their populations. Some studies have suggested that overharvesting of forest herbs like black cohosh could impact **nutrient cycling**, **invasive species**, and small mammal populations. Therefore, the scientists said that there is a need for improved understanding and management of native populations to support long-term sustainability of a population.

did you know?

Nontimber forest products are any products or services provided by the forest other than timber. They include things such as fruits, nuts, vegetables, fish, medicinal plants, and more.

In your own words, how would you explain the results of this study to a friend or family member?

What is one thing that you want to learn more about after reading this research on black cohosh?

Adapted from Small, C. and Chamberlain, J. 2018. Experimental harvest and regrowth in Appalachian black cohosh (Actaea racemosa, Ranunculaceae) populations: Implications for sustainable management of a medicinal forest herb. Journal of the Torrey Botanical Society. 14(2): 109-120. https://www.srs.fs.usda.gov/pubs/ja/2018/ja_2018_chamberlain_001.pdf.

GLOSSARY

agriculture (**a** gri **kəl** chər): The science or practice of preparing the soil, producing crops, and raising livestock.

control (kən **trōl**): A control is something used for comparison when checking the results of an experiment.

deciduous (di **si** jə wəs): Plants or trees that shed their leaves every year.

ecosystem services (**ē** kə **sis** təm **sər** vəs es): Environmental health benefits provided by a community of plant and animal species.

edible (e **də** bəl): Fit to be eaten.

invasive species (in **vā** siv **spē** shēz): Any plant, animal, or organism that is not native to the ecosystem it is in, and is likely to cause harm to the environment, the economy, or human health.

medicinal (mə **di** sə n əl): Being or acting like a medicine.

naturalize (**na** chə rə līz): To cause something, such as a plant, to become established as if native.

nutrient cycling (**nü** trē ənt **sīk** liŋ): The uptake, use, release, and storage of nutrients by plants and their environments.

orchard (**ȯr** chərd): Place where many tree selections are planted for the harvesting of their seeds and fruits.

perennial (pə **ren** ē əl): Present at all seasons of the year. The plant survives the winter season.

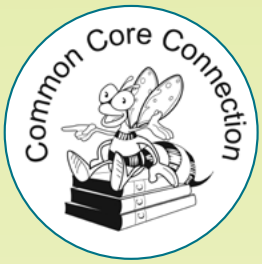
rhizome (**rī** zōm): A thick plant stem that grows underground and has shoots and roots growing from it.

sustainable (sə **stā** nə bəl): (1) The quality of surviving or being maintained over a specific time period; (2) Of, relating to, or being a method of using a resource so that the resource is not depleted or permanently damaged.

transect (tran(t) **sekt**): A sample area usually in the form of a long continuous strip.

Accented syllables are in **bold**. Marks and definitions are from https://www.merriam-webster.com. Definitions are limited to the word's meaning in the article.

FACTivity



Time Needed

One class period

Materials

- Harvest Recording Activity Sheet
- Writing utensil
- Large quantity of an item that students can count such as pretzel sticks or similar food items, paper clips, or strips of paper

FACTivity **Background**

In the research article presented in this monograph, you learned about how and why plants are harvested from forests, as well as how it can impact the plant's population size. In this FACTivity, you will learn what happens when something is overharvested and why sustainable harvesting is important.

The questions you will answer in this FACTivity are:

How many harvesting cycles does it take for the black cohosh population to drop below zero? What are some things that could have been done differently to keep the black cohosh population healthy, while still harvesting some of the plants?

FACTivity **Methods**

Your group will be provided with a copy of the Harvest Recording Activity Sheet, a writing utensil, and some pretzels (or other item that teacher provides). The pretzels or other item provided represent individual plants. As a group, assign someone to be the record keeper on the activity sheet, one to two people that will harvest plants, and one person to be a staff member from the local department of wildlife conservation.

You are starting with a black cohosh population of 100 plants. After each harvest, the staff member from the local department of wildlife conservation will add four new plants because they are trying to keep the plant population stable. Follow the directions each time you harvest.

After you have finished all of the harvests and completed the activity sheet as a group, answer the four followup questions.

Harvest 1: Your health food company just found this plant and is harvesting a few of the plants to see if consumers like it. Take 2 plants.

Harvest 2: Your health food company discovered that consumers like the plant for medicinal uses, so they double the amount they harvest. Take 4 plants.

Harvest 3: Other health food companies have found out about this plant. They start to harvest some plants. Take 8 plants.

Harvest 4: Demand from consumers stays stable. Take 8 plants.

Harvest 5: Consumer demand starts to grow for the plant because of a commercial about the plant's healthy benefits. Take 16 plants.

Harvest 6: Consumer demand stays high. Take 16 plants.

Harvest 7: New technology has provided your health food company with a way to harvest that increases the number of plants that can be taken at one time. Take 32 plants.

Harvest Recording Sheet

Names: _____

Number of Population Starting With	Number Added to the Population	Number Taken from the Population	Total Population
100	4	2	102
102			

1. How many harvests did it take before the population of black cohosh was gone?

_____

_____

2. What are some things that could have been done differently to help the black cohosh population become more stable? Brainstorm some ideas below.

_____

_____

3. What are some other examples of things that are overharvested or could be in danger of overharvesting?

_____

_____

4. What are some ways you could make people aware of harvesting sustainably?

_____

_____

_____

Natural Inquirer Connections

You may want to reference this *Natural Inquirer* article for additional information and FACTivities:

- For more information on carbon storage, read the *Natural Inquirer* Ecosystem Services edition, and
- For more information on harvesting wild foods, read the *Natural Inquirer* Morel of the Story monograph.

This article, along with others, can be found at: http://www.naturalinquirer.org/all-issues.html.

If you are a trained Project Learning Tree educator, you may use "We All Need Trees," "Pass the Plants, Please," and "A Forest of Many Uses" as additional resources.

WHAT'S IN A NAME?

"To be, or not to be, that is the question," is a famous quote by the character Prince Hamlet in William Shakespeare's play "Hamlet." The title of this article is a play on that famous quote by saying "To Harvest or Not to Harvest, that is the question."

WEB RESOURCES

George Washington and Jefferson National Forests
https://www.fs.usda.gov/gwj/

***Actaea racemosa* L. var. *Racemosa* –**
USDA Natural Resource Conservation Service
https://plants.usda.gov/core/profile?symbol=ACRAR

Black Cohosh – An Annotated Bibliography
https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs097.pdf

Are Black Cohosh Harvests Sustainable? – USDA Southern Research States CompassLIVE
https://www.srs.fs.usda.gov/compass/2013/04/18/are-black-cohosh-harvests-sustainable/

TO HARVEST OR NOT TO HARVEST

Word Scramble

Unscramble the words to create a sentence from this monograph!

The site portion national research Virginia was in forest a of the.

_____

_____

In harvesting, what the scientists wanted to **sustainable** determine particular amount of would be.

_____

_____

All extracted completely plant aboveground and belowground material were as possible.

_____

_____

At recovery harvest high limited levels, plant is slow or.

_____

_____

3 Sites 2 and Site designed the were in same Site way as 1.

_____

_____

TO HARVEST OR NOT TO HARVEST

eyeChallenge

Each of the following images represents something from the article. Explain what each of these images represents. You may write your explanation or hold a class discussion. If you write your explanation, use complete sentences, proper spelling and grammar, and appropriate punctuation.

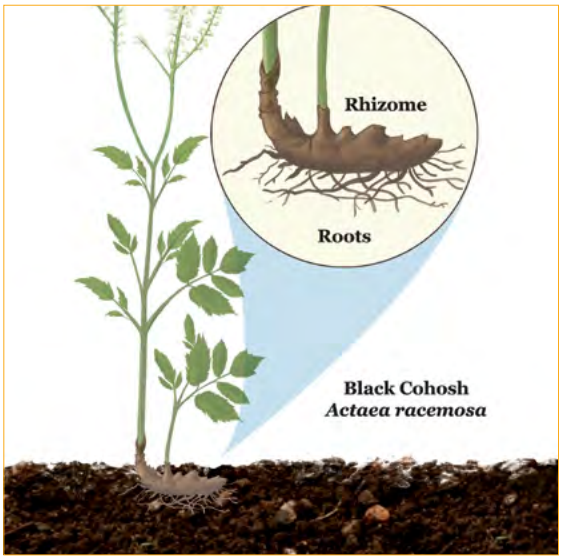
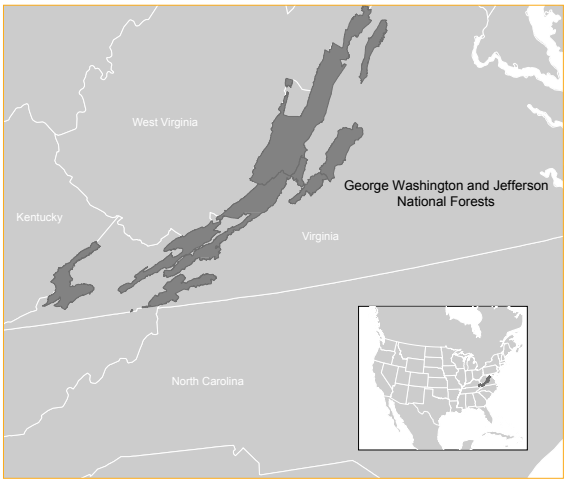


Photo courtesy of Randy Browning, U.S. Fish and Wildlife Service.



Map by Carey Burda and Stephanie Pfeiffer.

Photo courtesy of the United States Geological Survey.

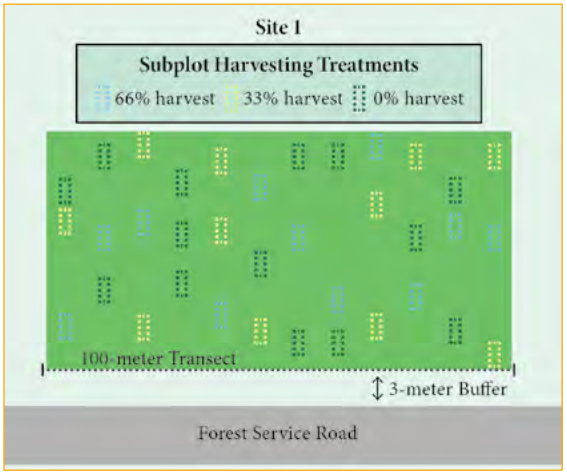


Illustration by Stephanie Pfeiffer.

Photo courtesy of USDA Natural Resources Conservation Service.

Photo courtesy of The Conservation Fund.

National Education Standards

For more detailed correlations of this *Natural Inquirer* Monograph to National Education Standards, visit the *Natural Inquirer* website (http://www.naturalinquirer.org).

National Science Education Standards Addressed In This Article

- Abilities Necessary to do Scientific Inquiry
- Understandings About Scientific Inquiry
- Structure and Function in Living Systems
- Reproduction and Heredity
- Regulation and Behavior
- Populations and Ecosystems
- Diversity and Adaptations of Organisms
- Populations, Resources, and Environments
- Science and Technology in Society
- Science as a Human Endeavor
- Nature of Science
- History of Science

Social Studies Education Standards Addressed In This Article

- People, Places, and Environments
- Individual Development and Identity
- Production, Distribution, and Consumption
- Science, Technology, and Society
- Global Connections

Common Core Education Standards Addressed in This Article

- Key Ideas and Details
  - CCSS.ELA-Literacy.RST.6-8.1
  - CCSS.ELA-Literacy.RST.6-8.2
  - CCSS.ELA-Literacy.RST.6-8.3
- Craft and Structure
  - CCSS.ELA-Literacy.RST.6-8.4
  - CCSS.ELA-Literacy.RST.6-8.5
  - CCSS.ELA-Literacy.RST.6-8.6
- Integration of Knowledge and Ideas
  - CCSS.ELA-Literacy.RST.6-8.7
  - CCSS.ELA-Literacy.RST.6-8.8
  - CCSS.ELA-Literacy.RST.6-8.9

Next Generation Science Standards Addressed In This Article

- Science and Engineering Practices
  - Asking Questions and Defining Problems
  - Planning and Carrying Out Investigations
  - Analyzing and Interpreting Data
  - Constructing Explanations and Designing Solutions
  - Engaging in Argument From Evidence
  - Obtaining, Evaluating, and Communicating Information
- Disciplinary Core Ideas
  - Physical Science: PS2.B Types of Interactions
  - Life Science: LS1.A Structure and Function; LS1.B Growth and Development of Organisms; LS2.A Interdependent Relationships in Ecosystems; LS2.C Ecosystem Dynamics, Functioning, and Resilience; LS4.B Natural Selection; LS4.C Adaptation; LS4.D Biodiversity and Humans
  - Earth and Space Science: ESS2.D Weather and Climate; ESS3.A Natural Resources; ESS3.B Natural Hazards; ESS3.C Human Impacts on Earth Systems
- Crosscutting Concepts
  - Patterns
  - Cause and Effect: Mechanism and Prediction
  - Scale, Proportion, and Quantity
  - Structure and Function
  - Stability and Change
  - Connections to Nature of Science
  - Connection to Engineering, Technology, and Applications of Science

Photo by Jessica Nickelsen, FIND Outdoors.

What Is the Forest Service?

The Forest Service is part of the United States Department of Agriculture (USDA). The Forest Service is made up of thousands of people who care for the Nation's forest land. The Forest Service manages 154 national forests and 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 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 Forest Service are scientists whose work is presented in the journal. 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.

For more information, visit https://www.fs.usda.gov.

Who Is FIND Outdoors?

Formerly the Cradle of Forestry in America Interpretive Association, FIND Outdoors is a reimagined 501(c)3 nonprofit organization based in Pisgah Forest, NC. We are the Southeast's leader in providing access to public lands, environmental education, recreation, and front country camping experiences. We maintain and operate 21 recreation, education, and camping facilities across western North Carolina, northern Georgia, and beyond—serving approximately 800,000 visitors each year with over 150 recreational and environmental education programs, special events, and tours.

Our story is rooted in education about the **forest**.

Our passion is to help people become **inspired**.

Our goal is to help people connect with **nature**.

Our drive is to help people learn through **discovery**.

We help people...FIND Outdoors

We are…FIND Outdoors

For more information, visit http://www.goFINDoutdoors.org.

What Is 4-H?

The 4-H Youth Development Program is the youth outreach program from the land-grant institutions' cooperative extension services and the U.S. Department of Agriculture. 4-H serves as a model program for the practice of positive youth development by creating positive learning experiences; positive relationships for and between youth and adults; positive, safe environments; and opportunities for positive risk taking.

For more information, visit https://nifa.usda.gov/program/4-h-positive-youth-development.

Student Editorial Review Board

Chamblee Middle School, Georgia

Ms. Moore's 7th Grade Life Sciences

Photo by Julie Linsley, used with permission.

Natural Inquirer
http://www.naturalinquirer.org

Forest Service Conservation Education
https://www.fs.usda.gov/conservationeducation

Follow us on
Twitter (@naturalinquirer)
and Facebook (https://www.facebook.com/NaturalInquirer)!

Photo by emer1940, via https://www.istockphoto.com

FS-1184
November 2021