

2019  
Number 19

# Natural Inquirer

The *Natural Inquirer* Monograph Series: **WILDFIRE PREVENTION EDITION**



## A BURNING QUESTION

Is an Ounce of Prevention  
Worth a Pound of Cure?





# Natural Inquirer

Monograph Series: Wildlife Prevention Edition

## A Burning Question: Is an Ounce of Prevention Worth a Pound of Cure?

### Produced by

U.S. Department of Agriculture, Forest Service  
Cradle of Forestry in America Interpretive Association

### Production Staff

Babs McDonald, *Forest Service*  
Jessica Nickelsen, *Cradle of Forestry in America Interpretive Association*  
Michelle Andrews, *University of Georgia*  
Bradi McDonald, *Cradle of Forestry in America Interpretive Association*  
Leslie Shaw, *Leslie Shaw Design*  
Stephanie Pfeiffer, *SMP Illustration*  
Carey Burda, *Cartographer*  
Lane Eskew, *Technical Editor*

### Forest Service Scientists Highlighted in the Journal

Karen Abt, *Southern Research Station*  
Jeffrey Prestemon, *Southern Research Station*

### Collaborating Scientists

Samuel Scranton, *U.S. Department of the Interior, Bureau of Indian Affairs*  
David Butry, *National Institute of Standards and Technology*

### Forest Service

Victoria Christiansen, *Chief*  
Alex L. Friend, *Deputy Chief, Research and Development*  
Patricia Hiram, *Acting Deputy Chief, State and Private Forestry*  
Tracy Hancock, *Staff Director, Knowledge Management & Communications*

Tinelle Bustam, *Acting Director, Conservation Education*  
Rob Doudrick, *Director, Southern Research Station*  
Shawna Legarza, *Director, Fire and Aviation Management*  
Michiko Martin, *Director, Recreation, Heritage & Volunteer Resources*

### Cradle of Forestry in America Interpretive Association

Susan Moore, *Chairperson*  
Carlton Murrey, *Executive Director*  
Adam DeWitte, *Director of Education*

### With Thanks to

Heidi McAllister, *Assistant Director, Conservation Education*  
Deb Bruyere, *Symbols Cache Assistant Manager, Northeast Interagency Support Cache*  
Linda Hecker, *Interpretive Planner, Rocky Mountain Regional Office*  
Gwen Beavans, *National Fire Prevention Program Manager, State and Private Forestry*  
Jaelith Hall-Rivera, *Associate Deputy Chief, State and Private Forestry*  
Project Learning Tree, <https://www.plt.org/>

*Natural Inquirer* is reproduced on recycled paper with soy-based inks. Please pass this journal along or recycle it when you have finished using it.

Cover photos: Background photo courtesy of the National Interagency Fire Center; inset photo courtesy of USDA Forest Service, Pacific Southwest Region.





# CONTENTS

Page 11

FEATURE:

## A BURNING QUESTION:

Is an Ounce of Prevention Worth a Pound of Cure?

- 4 Editorial Review Board
- 5 About *Natural Inquirer* Monographs!
- 6 Who Are Scientists?
- 7 Welcome to the *Natural Inquirer* Monograph—Wildfire Prevention Edition!
- 11 **FEATURE**  
A Burning Question:  
Is an Ounce of Prevention Worth a Pound of Cure?
- 27 A Burning Question Glossary
- 28 FACTivity
- 34 A Burning Question eyeChallenge
- 38 National Education Standards

### Inside back cover

- What Is the Forest Service?
- What Is the Southern Research Station?
- What Is the Cradle of Forestry in America Interpretive Association?

### Back cover

- Websites



Illustration courtesy of USDA Forest Service.



## Join us in being green!

The following educator resources are now available exclusively on the *Natural Inquirer* website at <http://www.naturalinquirer.org>.

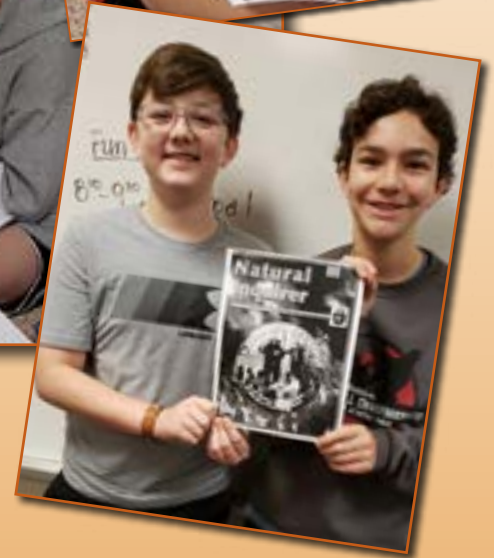
These resources can be found with the “*Natural Inquirer* Monograph Series: Wildfire Prevention Edition” and on the “For Educators” pages.

- **Note to Educators**
- **Lesson Plan**
- **Reflection Section**
- **Answer Guide**
- **National Education Standards (specific to each article), including:**
  - National Science Education Standards
  - National Curriculum Standards for Social Studies
  - Common Core State Standards
  - Next Generation Science Standards

# Natural Inquirer

## Editorial Review Board Hard at Work

Amy Cartlidge's 7th grade science class  
East Jackson Middle School  
Commerce, GA



**"The most important thing I learned was what to do when a wildfire starts and what could cause a wildfire."**

**"Maybe shorten Wildfire Prevention Education Program to WPEP."**

**"Maybe shorten it and try not to use so much word repetition."**

**"Great layout. Pictures were good. Smokey is cool."**

**"The most important thing I learned was don't play with fire."**

# 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, especially people and wildfires. 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

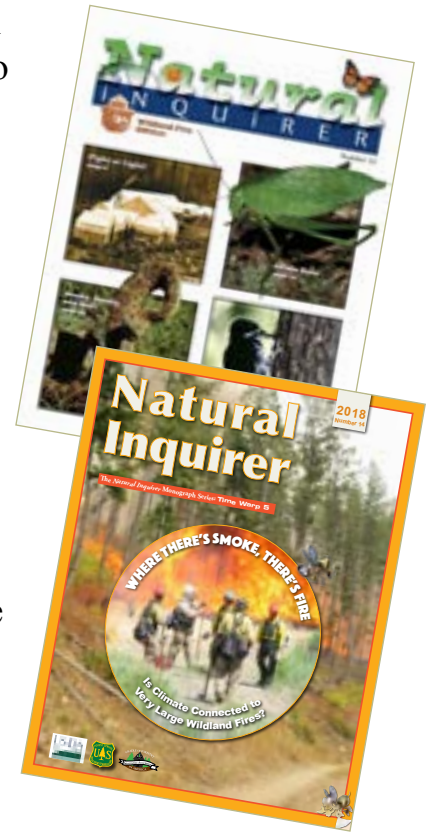
sections highlighted in the article. These sections give you extra information that is educational and interesting.

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 “A Burning Question eyeChallenge” on page 34!





# 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?

**Be enthusiastic:**  
Are you excited about a particular topic?

**Be careful:**  
Are you accurate in everything you do?

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

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



Photo courtesy of Shyh-Chin Chen, USDA Forest Service.



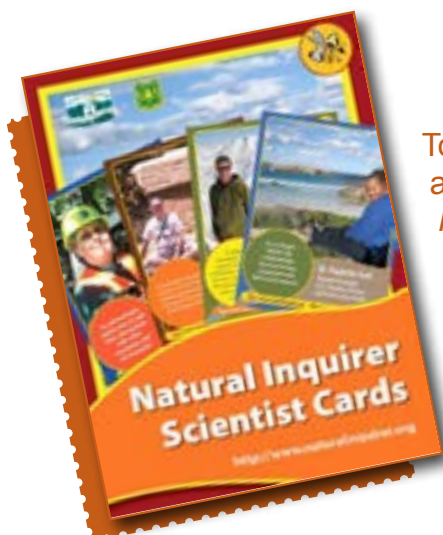
Photo courtesy of Johnny Boggs, USDA Forest Service.



Photo courtesy of Sara McAllister, USDA Forest Service.



Photo courtesy of Cassandra Johnson Gaither, USDA Forest Service



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

Welcome to the  
*Natural Inquirer* Monographs—  
**WILDFIRE  
PREVENTION  
EDITION!**



Illustration courtesy of USDA Forest Service.

Glossary words are in **bold** and are defined on page 27.

Welcome to the *Natural Inquirer* Monographs—Wildfire Prevention Edition!

Wildfires are a particular type of wildland fire. A wildland fire is a fire that burns in forests, on prairies, or over other large natural areas. The Forest Service defines wildfires as unplanned ignitions (ig **ni** shənz). An ignition occurs when a fire is started. Wildfires can be started naturally, by lightning or volcanoes, or they can

be started by human action. Humans start wildfires accidentally and on purpose. The researchers in this study were interested in evaluating wildfire prevention education programs as a way to reduce accidentally caused wildfires.

The Forest Service is one of many Agencies and organizations that provide wildfire prevention education to individuals and communities.

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





Photo courtesy of USDA Forest Service, Northern Region.

## WHICH ORGANIZATIONS PROVIDE WILDFIRE PREVENTION EDUCATION PROGRAMS?

Wildfire prevention education programs are provided by many different Federal, State, and local agencies. Federal examples include the USDA Forest Service, the U.S. Bureau of Land Management, the Bureau of Indian Affairs, and the National Park Service. State examples include the Kentucky

Division of Forestry and the Montana Department of Natural Resources and Conservation. Cities and counties also provide wildfire prevention education programs as do organizations such as the Keep Oregon Green Association, Inc., and The Lands Council.

One of the most effective wildfire prevention education programs has been the Smokey Bear campaign. Smokey Bear has taught people about wildfires since 1944.

Smokey Bear was adopted as a **fictional** symbol for wildfire prevention in 1944 (figure 1). At the time, no one knew that Smokey would soon be represented by a real bear.

In 1950, in the Capitan Mountains of New Mexico, a wildfire began to burn. The firefighters soon heard of a lone bear cub near the fire. The firefighters

hoped that the cub's mother would come for him. The mother bear did not return, and the cub climbed a charred tree to escape the fire.

The cub survived, but his front and back paws were badly burned. A New Mexico game warden, Ray Bell, helped to get the cub on a plane to Santa Fe. The cub's paws were treated and bandaged (figure 2).

News of the cub spread across the United States. The New Mexico game warden offered to transfer the cub to the National Zoo, as long as the





**Figure 1.** In 1945, the first Smokey Bear poster was created. Artist Albert Staehle was asked to paint the first poster of Smokey Bear.

(Staehle, Albert. 1945.) "Smokey Says—Care Will Prevent 9 out of 10 Forest Fires!"

Illustration courtesy of Special Collections, USDA National Agricultural Library.



**Figure 2.** Dr. Edwin J. Smith bandages the cub's burned paws.

Photo courtesy of Special Collections, USDA National Agricultural Library.



Illustration courtesy of Special Collections, USDA National Agricultural Library

bear would be dedicated to a conservation and wildfire prevention education program. The cub, now known as Smokey Bear, was transferred to the National Zoo in Washington, DC.

Smokey received so many gifts and letters he had to be given his own ZIP Code. Smokey remained at the National Zoo until his death in 1976. Smokey was buried at the Smokey Bear Historical Park in Capitan, New Mexico. Smokey Bear remains a symbol for wildfire prevention. Almost everybody knows Smokey Bear!

In this monograph, you will learn whether science shows that wildfire prevention education programs are successful at reducing the number of accidental wildfires occurring on **Tribal** lands. As you read this research, think about whether Smokey Bear's message has been successful.

## EDUCATORS!

**A... B... C!** This monograph's **FACTivity** is a spelling bee. Have students close their monograph after you have completed the article if you plan to proceed with the spelling bee.

## DID YOU KNOW?



The U.S. President and Smokey Bear are the only two individuals with their own ZIP Code. If you want to write to Smokey, his address is Smokey Bear, Wildfire Prevention Specialist, Washington, DC 20252.



# A BURNING QUESTION:

## Is an Ounce of Prevention Worth a Pound of Cure?

### MEET THE SCIENTISTS!



Photo courtesy of Karen Abt, USDA Forest Service.

#### ◀ KAREN ABT, Forest Economist

My favorite science experience has been working on fire-related questions. There is so much we don't know about wildfire and its role in our forests and, in particular, its role in our National Forests. What would happen if we let wildfires burn rather than putting them out? How would this affect the people who live next to or in the forest? And will letting fires burn make

putting them out cheaper in the future? How do we return the forest to its normal rhythms of fire and recovery when smoke and fire harm people? Will a changing climate make all of our efforts to reintroduce and control wildfires **irrelevant** by permanently changing the forest regardless of what we do?



Photo courtesy of David Butry, National Institute of Standards and Technology.

## ◀ DAVID BUTRY, Economist

My favorite science experience was calculating the cost effectiveness of fire sprinklers in homes. This required determining how much it costs to install and maintain fire sprinklers. It also required **modeling** the improvements to human safety, in terms of lives saved and injuries avoided, due to sprinkler use. This research is used by State and local governments to decide whether or not to adopt building codes requiring fire sprinklers in new construction.

## JEFF PRESTEMON, ▶ Forest Economist

My favorite science experience has been uncovering evidence that some wildfire **arsonists** set many wildfires over a few days in bursts of fire setting. I also learned that arsonists likely repeat this behavior throughout a fire season and possibly over several years, until they are caught. This evidence has allowed us to better predict where and when future arson wildfires might be **ignited**.



Photo courtesy of Jeff Prestemon, USDA Forest Service.





Photo courtesy of Samuel Scranton, U.S. Department of the Interior, Bureau of Indian Affairs.

## ◀ **SAMUEL SCRANTON,** **Forester**

My favorite science experience is when I get to go back to places I worked a long time ago as a forester. When I go back to these places, I am able to see what the work I did back then looks like now. An example would be going back to an area where I was part of a timber sale. The timber sale was designed to promote forest health. After a number of years have gone by, I get to see if what we did in the past actually produced the results we wanted.

### What Kind of Scientists Did This Research?

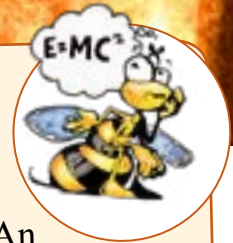
**Economist:** This scientist studies economics. Economics is a social science that addresses the production, distribution, and use of goods and services. Goods and services include purchased items and services, such as clothes and car repair. Goods and services also include those that are difficult, if not impossible, to buy and sell, such as clean water, clean air, and pollination.

**Forester:** A scientist who studies forests or is skilled in planting, managing, or caring for trees. Foresters also manage forests for wildland fire.

**Forest Economist:** A scientist who studies the economics of forest lands. Economics is the study of the way goods, services, and wealth are measured, produced, distributed, and used.

Glossary words are in **bold** and are defined on page 27.

## Thinking About Science



To do experiments, scientists rely on assumptions (ə səm(p) shəns). An assumption is a statement assumed to be true. In our everyday lives, we all make assumptions. For example, you probably assume that you will have clean water to drink every day. Name at least one more assumption that you make every day. Assumptions help scientists to identify hypotheses. Hypotheses are assumptions put to a scientific test. In other words, a hypothesis is an assumption stated in such a way that scientists may determine whether evidence exists to support their assumption.

In this research, the scientists wanted to learn whether wildfire prevention activities were related to the number of wildfires occurring in particular communities. One set of activities the scientists studied was wildfire prevention education programs. In this research, the scientists assumed, and then hypothesized, that wildfire prevention education programs were related to the number of wildfires occurring in a community. The scientists also hypothesized that community characteristics were related to the number of wildfires. All of these hypotheses were based on assumptions made by the scientists. In science, assumptions are based on previous evidence, usually in the form of earlier research.



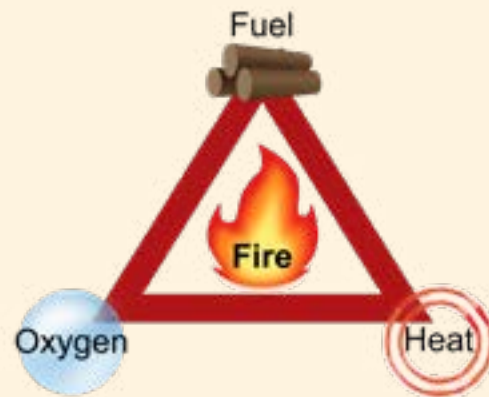
# Thinking About the Environment



A wildfire is a type of wildland fire. It is an unplanned ignition that started naturally or by careless human action, either accidentally or intentionally. An ignition occurs when a fire is started.

Three conditions must be present for a fire to burn. Fire experts call the presence of these three conditions the fire triangle. The fire triangle includes the presence of fuel, oxygen, and a heat source (figure 3). Fuel is any flammable or burnable material. In the case of wildfires, fuel includes trees, grasses, brush, and even houses. More fuel causes a more intense fire, and dry fuels help the fire to spread (figure 4). Air provides the oxygen that a fire needs to burn. Heat sources help spark the wildfire and bring fuel to temperatures hot enough to ignite. Lightning, burning campfires, or cigarettes—and even the sun—can provide sufficient heat to spark a wildfire.

While wildfires can have undesirable effects, they are a natural process needed by most forests to remain healthy. Foresters sometimes set fires on purpose and manage them safely. These **prescribed fires** are used to keep ecosystems healthy and to reduce the amount of fuel available for a future wildfire.



**Figure 3.** Three conditions must be present for a fire to burn.

Illustration by Stephanie Pfeiffer.



**Figure 4.** Forest fuels are found on the forest floor and may also include tree boles and tree crowns. Tree boles are tree trunks, and crowns are the leafy tops of trees.

Photo by Babs McDonald, used with permission.

# Introduction

Wildfire prevention education programs include those programs that teach people about wildfires and how to prevent them (figure 5). These programs are focused on wildfires caused by human actions. Humans may cause wildfires accidentally or on purpose. Accidentally caused wildfires include those caused by children at play, uncontrolled brush fires, unattended campfires, faulty

power lines and electrical equipment, smoking materials, cars dragging chains or other metal, and railroads. Sparks from cars or trains can ignite the brush alongside a railroad track or road. Even parking on tall, dry grass may cause a wildfire to ignite. In contrast to accidentally caused wildfires, people may also cause wildfires on purpose.



**Figure 5.** Fire prevention education programs may include posters, such as this Smokey Bear poster.

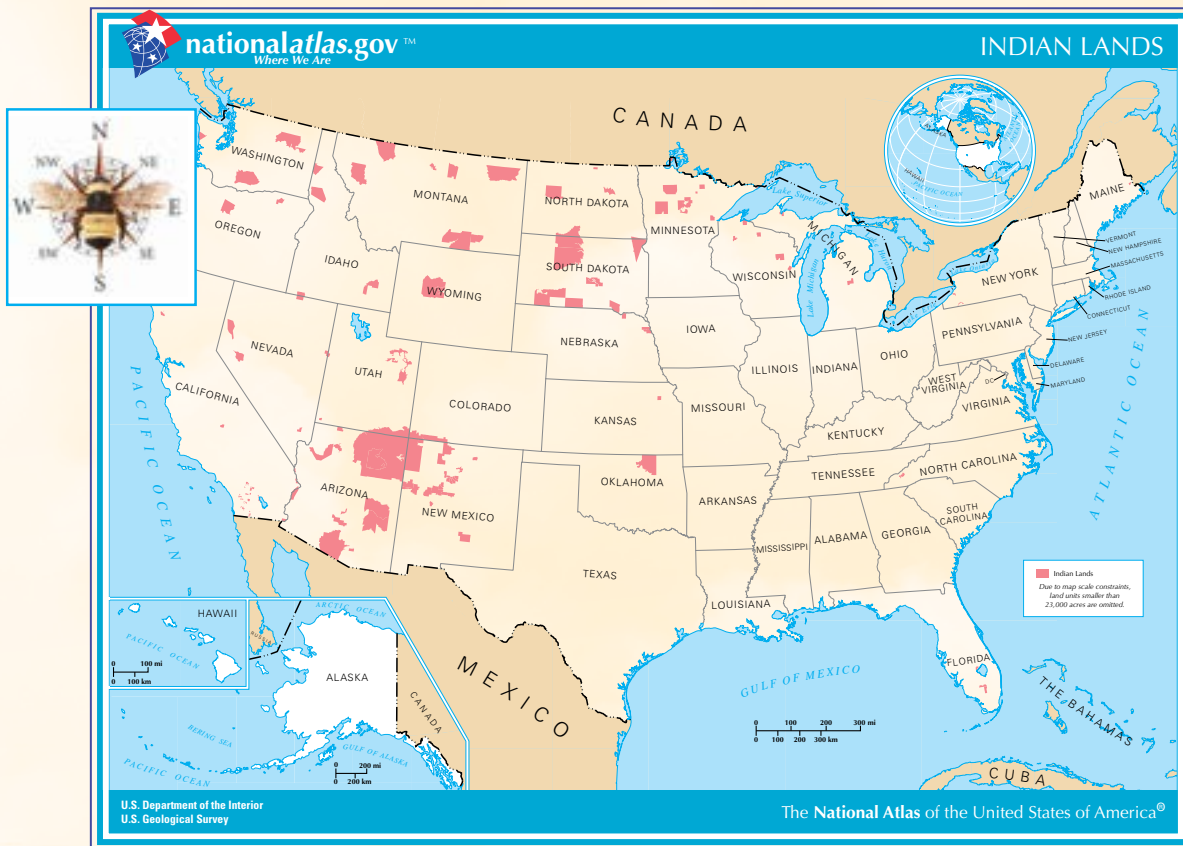
Illustration courtesy of Special Collections, USDA National Agricultural Library.



Scientists have found that wildfire prevention education programs may reduce the number of accidentally caused wildfires. Although wildfire prevention education programs cost money, research has shown that wildfire prevention activities may cost less than it costs to **suppress** a wildland fire.

The scientists in this research were interested in wildfire prevention education programs occurring on a

special set of U.S. lands. These lands are Tribal lands across the United States (figure 6). The scientists were interested in learning whether wildfire prevention education programs conducted over a period of time were effective at reducing the number of accidentally caused wildfires on Tribal lands. The scientists also wanted to test for evidence as to whether the cost of suppressing wildfires was greater or less than the cost of wildfire prevention programs on Tribal lands.



**Figure 6.** U.S. Tribal lands are under the **governance** of American Indian Tribes and Native Alaskans. The United States Bureau of Indian Affairs, a Government bureau, works with American Indian Tribes and Native Alaskans to enhance their quality of life and to promote economic opportunity on Tribal lands.

Map courtesy of the National Atlas, U.S. Department of the Interior and U.S. Geological Survey.



From Smokey's Wildfire Prevention Detectives Skills Test, <https://smokeybear.com/education/smokey-poster.pdf>.

## WHAT ARE WILDFIRE PREVENTION EDUCATION PROGRAMS?

Wildfire prevention education programs include activities and games, posters and booklets, social media, billboards, and other resources. These resources provide information and challenge people to learn about and become more responsible for wildfire prevention.

One example of a wildfire prevention education program is “Smokey’s Wildfire Prevention Detectives.” In this activity, students investigate the cause of a wildfire.

You can learn about wildfire prevention and test your knowledge by visiting <https://www.smokeybear.com/en>.

### Reflection Section



Explain in your own words what the scientists wanted to learn.

Children at play may accidentally cause a wildfire. As a class, discuss how children at play might accidentally cause a wildfire. Discuss ways to prevent these kinds of wildfires.



# Methods

The scientists made a number of assumptions to conduct their research. (Read “Thinking About Science” to learn about assumptions in science.)

First, the scientists made assumptions about what might cause or prevent accidental wildfires. The scientists assumed that three broad possible things cause or prevent accidental wildfires. These things included environmental conditions, social conditions, and wildfire prevention education programs.

Under each of these assumptions, the scientists identified **variables** to

describe each of the things that might cause or prevent accidental wildfires (table 1).

The scientists used weather information that had been collected by others. This information included air temperature, wind speed, and measures of drought (draut) and the likelihood of wildfire. A drought is a long period of dryness. Because natural areas may be severely impacted in a wildfire, the amount of available fuel was difficult to estimate. The scientists, therefore, used the amount of natural area burned previously as a measure of available fuels.

THINGS THAT CAUSE OR PREVENT WILDFIRES	Environmental conditions	Social conditions	Wildfire prevention education programs
VARIABLES	Weather	Opportunity to visit wildlands	<b>Duration</b> of the education program in months
	Fuels	Community well-being	

**Table 1.** The scientists identified variables that described each of the things assumed to be related to accidentally caused wildfire.

To identify a community's opportunity to visit wildlands, the scientists measured the number of roads, trails, and campgrounds in and near the communities they studied (figure 7). The scientists assumed that easier access to wildlands would be related to more accidental wildfire occurrences. The scientists collected information about income and unemployment rates in the communities. The scientists assumed that lower income and higher unemployment rates would result in

more community dissatisfaction. This dissatisfaction might result in less care while in wildland environments and more accidentally caused wildfires. Communities with higher dissatisfaction were assumed to have a lower sense of well-being.

The scientists asked people working with the Tribes for information about wildfire prevention education programs (figure 8). Seventeen Tribes responded with information about programs



**Figure 7.** Roads, trails, and campgrounds provide opportunities for people to visit wildlands.

Photo by Babs McDonald, used with permission.





**Figure 8.** Wildfire prevention education programs include information provided at fairs and festivals.

Photo courtesy of USDA Forest Service, Northern Region.

started and conducted between 1996 and 2011. The scientists identified the months when wildfire prevention education programs were conducted. The scientists also collected

information about how much each prevention program cost per year.

The scientists identified and counted the accidental causes of wildfires on the 17 Tribal lands (table 2).

General cause	Specific cause	Percentage of all wildfires
Campfire	Cooking or warming fires	2
Smoking	Smoking	2
Fire use	Trash burning, field burning, land clearing, slash burning, natural resource management	16
Equipment	Aircraft, vehicle, exhaust, brakes, power lines	6
Children at play	Fireworks, ignition devices	14

**Table 2.** The causes of accidentally occurring wildfires by percentage of all wildfires on the 17 Tribal lands. Note that the percentage of all accidentally caused wildfires does not equal 100 percent. Other categories of wildfire causes, not included in this table, include arson and wildfires caused by natural events, such as lightning and volcanoes.

## Reflection Section



Describe the three things the scientists assumed were related to wildfires on the 17 Tribal lands.

Examine table 2.

What stands out about the numbers in table 2?



## Number Crunches

What percentage of all wildfires was accidentally caused in the 17 Tribes?

What percentage of all wildfires was caused by arson or natural events?



## Findings

The number of wildfire prevention education programs was most related to the number of wildfires caused by fire use and by children at play. Wildfire prevention programs were also related to the number of equipment-caused wildfires. Generally, as the number of education programs increased, the number of accidentally caused wildfires decreased. The scientists found that the number of wildfires started from smoking cigarettes was not related to the prevention education programs. When the weather variables described dry and windy conditions, wildfires were more likely to occur.

According to the scientists' calculations, wildfire prevention education programs were related to the number of accidentally caused wildfires on the 17 Tribal lands (table 3). Based on their research, the scientists were able to estimate how many wildfires were avoided on Tribal lands with wildfire prevention education programs.

The scientists compared the costs of wildfire prevention programs with the average cost of suppressing a wildfire. The scientists found that yearly prevention education program costs were less than the costs of suppressing wildfires.

Cause of wildland fire	Number of wildfires on Tribal lands with prevention programs	Number of wildfires avoided on Tribal lands with prevention programs
Campfires	925	488
Smoking	434	0
Fire use	6,442	6,588
Children at play	6,134	2,925
Equipment	1,858	762
Total	15,793	10,763

**Table 3.** The scientists estimated the number of wildfires avoided on Tribal lands with wildfire prevention education programs.

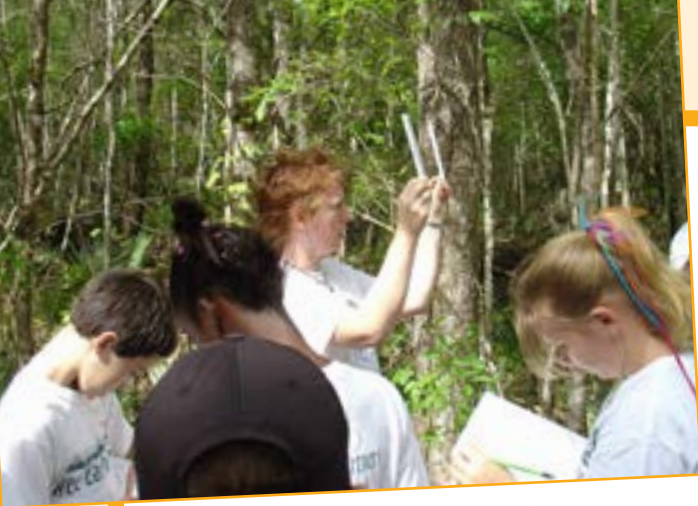


Photo courtesy of the SEWEE Center.

## WHAT IS THE DIFFERENCE BETWEEN RELATIONSHIP AND CAUSATION?

When scientists compare variables, they look for relationships between the variables. Relationships might be positive or negative. A positive relationship is

one in which the variables change in the same direction. For example, in this study, as the recorded air temperature rose, the number of wildfires also rose. A negative relationship is one in which the variables change in different directions. In this study, for example, as the number of education programs rose, the number of accidentally caused wildfires fell.

Scientists look for relationships but rarely feel certain that one condition caused another. That kind of certainty takes many research studies to establish.

### Reflection Section



Why do you think prevention programs had no effect on smoking-caused wildfires?

The title of this monograph is “A Burning Question: Is an Ounce of Prevention Worth a Pound of Cure?”

After reading this monograph, how would you answer that question?





## Discussion

This research indicates that wildfire prevention education programs may reduce the number of accidentally caused wildfires. The scientists believe, however, that more research is needed to better understand the effects of wildland fire prevention programs conducted over longer periods of time.

Smokey Bear has been working to prevent wildfires since 1944 (read “Welcome to the Wildfire Prevention Edition!” on page 7). The Smokey Bear Wildfire Prevention campaign is the longest-running public service advertising campaign in U.S. history. This campaign has been educating generations of Americans about their role in preventing wildfires.



## Number Crunch

How many years has Smokey Bear's wildfire campaign been running?

## Reflection Section



If Smokey Bear's campaign did not exist, do you think there would be FEWER or MORE wildfires? Why?

Based on your own experience, do you think programs aimed at changing behavior are more effective if they are conducted over months rather than weeks? Why or why not?

Did you know about Smokey Bear and his message before you read this monograph? Do you think the Smokey Bear campaign has been successful? Why or why not?

Adapted from Abt, K.L.; Butry, D.T.; Prestemon, J.P.; Scranton, S. 2015. Effect of fire prevention programs on accidental and incendiary wildfires on Tribal lands in the United States. *International Journal of Wildland Fire*. 24(6): 749-762. <http://dx.doi.org/10.1071/WF14168>.



# A BURNING QUESTION

## GLOSSARY

**arson** (är sən): The deliberate burning of property.

**arsonist** (är sə nist): One who commits arson.

**duration** (du rā shən): The time during which something exists or lasts.

**fictional** (fik shə nəl): (1) Characterized by the imagination; (2) made up.

**governance** (gə vər nən(t)s): Government. The exercise of control.

**hypothesize** (hī path ə sīz): (1) To propose an explanation in light of known facts; (2) to make an assumption to test its logical consequences.

**ignite** (ig nīt): To cause to burn.

**irrelevant** (i re lə vənt): Not having to do with the matter at hand.

**model** (mä dəl): To make a simplified copy or representation of something to help human understanding.

**prescribed fire** (pri skrībed fir): (1) The controlled application of fire to wildland fuels under certain weather conditions as a forest management tool; (2) human

application of fire to wildland vegetation under certain weather conditions as a forest management tool.

**suppress** (sə pres): To put down by authority or force.

**tribal** (trī bəl): Of, relating to, or characteristic of a Tribe. This article is about American Indian Tribes.

**variable** (ver ē ə bəl): (1) Something that is able or apt to vary; (2) thing that can vary in number or amount.

**wildland fire** (wīld land fir): Fires that burn in forests, on prairies, or over other large natural areas.

Marks and definitions are from <https://www.merriam-webster.com>. Accented syllables are in **bold**. Definitions are limited to the definition used in the article.

# FACTivity



## Time Needed

One class period

## Materials

- List of spelling bee words from “A Burning Question” FACTivity
- Additional spelling bee words are available online at:  
<http://naturalinquirer.org>

## FACTivity Methods

Before students turn to this FACTivity, have them close their monographs so the words cannot be seen.

The following 70 words can be used for a spelling bee in your classroom. Each of these 70 words (or phrases) was used in the “A Burning Question” monograph. You may conduct your spelling bee in the usual way; when a student misspells a word, he or she is eliminated from the bee. Alternatively, you may also continue without elimination by simply keeping score of right and wrong spellings.

The format for spelling bees is as follows: The reader will say, for example: “Drought. *Flowers wilted as the drought continued.* Drought.” The reader should speak clearly and carefully. The speller returns with: “Drought. D-R-O-U-G-H-T. Drought.” A student may be recruited to be the reader. Another student may be recruited to write each correctly spelled word on the white board.



# FACTivity

## A BURNING QUESTION SPELLING BEE

1. **Aircraft.** *The aircraft roared across the sky, making us all look up.*
2. **Alaskan.** *The visitors marveled at the Alaskan glaciers.*
3. **Application.** *Tanya filled out an application for a weekend job.*
4. **Arson.** *From the charred remains, the detectives suspected arson in the woods behind the new house.*
5. **Assumption.** *Making an assumption before knowing the facts may not be the best idea.*
6. **Authority.** *Teachers have authority over students in the classroom.*
7. **Billboard.** *Seeing the billboard reminded Lee to buy orange juice on his way home.*
8. **Bole.** *The tree trunk, or bole, had begun to rot on the forest floor.*
9. **Bureau.** *Chris's mother worked for an organization called the Bureau of Land Management.*
10. **Calculating.** *The shopper began calculating the total cost of all of her items.*
11. **Campaigns.** *Some election campaigns include heated debate, while others seem relatively quiet.*
12. **Campfire.** *The campers liked to sing around the campfire.*
13. **Category.** *When organizing his clothes, Pablo liked to include color as a category.*
14. **Causation.** *Scientists are unlikely to point to causation as a reason for change between two variables.*
15. **Characteristics.** *The students were asked to list the characteristics of good study habits.*
16. **Commission.** *His father was a popular member of the city commission.*
17. **Community.** *Sports provide a community for young athletes.*
18. **Condition.** *What is the condition of the car following the fender bender?*
19. **Controlled.** *To keep from having any fights, dogs should be controlled at the dog park.*

20. **Curious.** *Everyone was curious after hearing a strange noise in the hallway.*
21. **Detective.** *The detective collected clues following the latest burglary.*
22. **Dissatisfaction.** *Some of the citizens expressed dissatisfaction with the county's decision.*
23. **Drought.** *Flowers wilted as the drought continued.*
24. **Duration.** *A test of long duration may contribute to low test scores.*
25. **Economist.** *The economist predicted a healthy shopping season.*
26. **Effect.** *The snow's effect on driving conditions was immediate.*
27. **Effective.** *To be effective, do your best.*
28. **Enthusiastic.** *The kids were enthusiastic about going to the movie.*
29. **Escape.** *Renee's puppy tried unsuccessfully to escape her enclosure.*
30. **Evidence.** *It is usually best to base our decisions on clear evidence.*
31. **Exhaust.** *The old car's exhaust was a menacing dark color.*
32. **Exist.** *Do you wonder if unicorns exist?*
33. **Experiment.** *The experiment went well until the last 5 minutes.*
34. **Faulty.** *A faulty tablet can cause a student a lot of headaches.*
35. **Federal.** *Federal and State authorities were involved in the investigation.*
36. **Fictional.** *Almost everybody has at least one fictional friend.*
37. **Fire setting.** *Fire setting is the act of starting a fire.*
38. **Fuel.** *LaRon's mother stopped for fuel before setting off on her road trip.*
39. **Hypothesize.** *Scientists hypothesize as a part of the experimental process.*
40. **Ignite.** *Be careful not to ignite a fire.*
41. **Individual.** *Each individual student left the building.*
42. **Journal.** *Keeping a daily journal is a good idea.*
43. **Lightning.** *The lightning was so bright that the nighttime looked like noon.*
44. **Likelihood.** *The likelihood of getting lost between your home and your school is minimal.*
45. **Monograph.** *The monograph presented one research article on fire prevention.*
46. **New Mexico.** *New Mexico is located in the Southwestern United States.*



47. **Occurrence.** *The occurrence of flooding has been rising.*
48. **Opportunity.** *Avona welcomed the opportunity to perform in the school play.*
49. **Organization.** *The school band was known as an organization full of fun-loving students.*
50. **Ounce.** *An ounce of prevention is worth a pound of cure.*
51. **Oxygen.** *Oxygen is one-third of the fire triangle.*
52. **Particular.** *The toddler wanted just one particular toy.*
53. **Positive.** *It is a good idea to stay positive when faced with a challenge.*
54. **Prescribed fire.** *The forester set a prescribed fire to reduce the amount of brush in the area.*
55. **Recorded.** *Ms. Samman recorded everyone's test scores into her computer.*
56. **Relationships.** *The students looked for relationships between plant health and rainfall amounts.*
57. **Smokey Bear.** *Smokey Bear reminds us to be careful with wildfire.*
58. **Suppress.** *Gavin wanted to suppress a smile when he saw his sister trip.*
59. **Symbol.** *The bald eagle is a symbol of the United States.*
60. **Taught.** *The older sister taught her younger brother to ride a bike.*
61. **Temperature.** *The air temperature seems to be higher every summer.*
62. **Timber.** *Timber is a renewable resource and therefore makes a good material for building.*
63. **Tribal.** *This article described fire prevention programs on Tribal lands.*
64. **Undesirable.** *Being the last person in line is often undesirable.*
65. **Unemployment.** *Unemployment numbers are often used to describe how many people are out of work.*
66. **Variable.** *The scientist compared one variable with another variable.*
67. **Vehicle.** *A large vehicle is needed to carry a soccer team.*
68. **Volcano.** *A volcano eruption is a natural event.*
69. **Wildland fire.** *Wildland fire has become an important concern in California.*
70. **Benjamin Franklin.** *Benjamin Franklin was an early American inventor.*

## Natural Inquirer Connections

You may want to reference these *Natural Inquirer* articles for additional information:

- For more information on wildland fire, read the *Wildland Fire* and *Wildland Fire 2* editions of *Natural Inquirer*.
- For information about predicting future wildland fire, read “Fire and Water” in the *Natural IQ* edition. See <http://www.naturalinquirer.org> and search products for *Natural IQ* edition.
- For more information about education programs, read “What Is the Impact of the Impact Monster?” in the Olympic Winter Games edition.
- For more information on very large wildland fires and climate, read the “Where There’s Smoke, There’s Fire” *Natural Inquirer* monograph.



These resources, 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 “Then and Now,” “Democracy in Action,” and “Living With Fire” as additional resources.

# WEB RESOURCES



## USDA Forest Service Fire Information

<https://www.fs.fed.us/science-technology/fire/>

## USDA Forest Service – Managing Fire

<https://www.fs.fed.us/managing-land/fire>

## Smokey Bear

<https://smokeybear.com/en>

## National Fire Protection Association, Teens Take Action

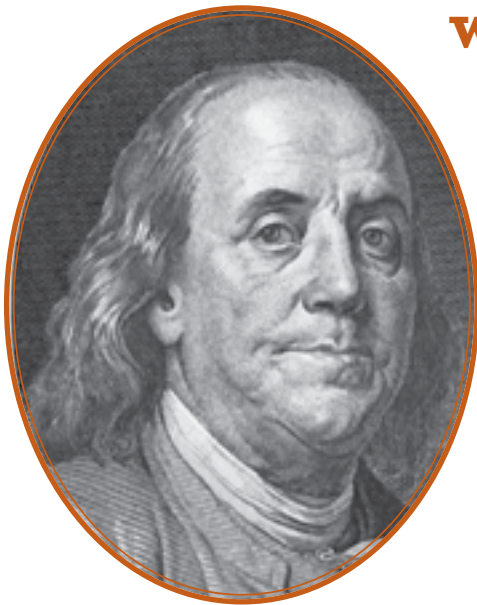
<https://www.nfpa.org/Public-Education/Campaigns/TakeAction>

## National Interagency Fire Center

<https://www.nifc.gov/>

## Wildfire Education Programs

<https://www.fs.usda.gov/main/conservationeducation/about/education-themes/wildland-fire>



## WHAT'S IN A NAME?

Have you heard this saying?

**“An ounce of prevention is worth a pound of cure.”**

Benjamin Franklin was thinking about fire safety when he said, “An ounce of prevention is worth a pound of cure.” Today, most people think of health when they hear that quote. Explain in your own words what this saying means. Apply this saying to something in your own life.

<https://www.ag.ndsu.edu/news/columns/beeftalk/beeftalk-an-ounce-of-prevention-is-worth-a-pound-of-cure/?searchterm=Benjamin%20Franklin>

Photo of Benjamin Franklin from 100 dollar bill by Leslie Shaw.



# A BURNING QUESTION

## eyeChallenge


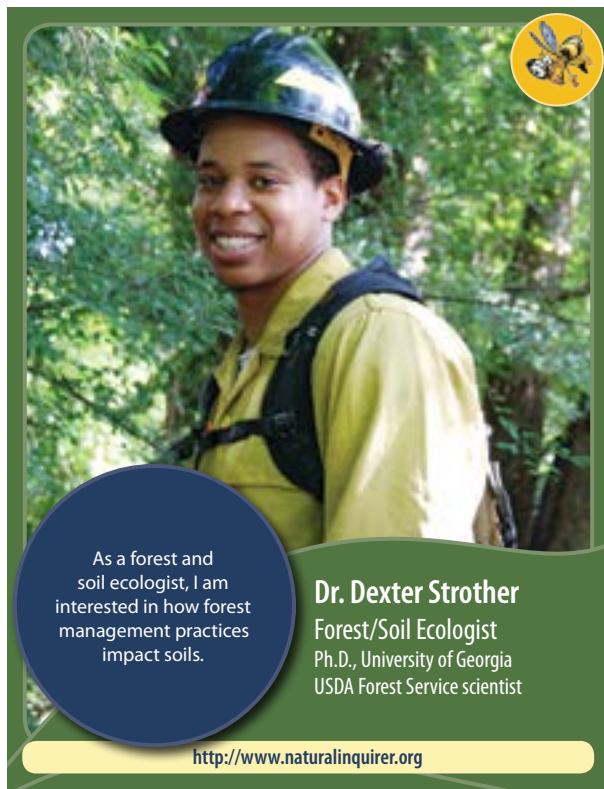


In this article, you learned about scientists and engineers who studied wildfire prevention education programs. Forest Service scientists and engineers study many different topics related to wildland fire. Below, you will read about eight different Forest Service fire scientists and engineers. Each scientist and engineer is presented on the front of a trading card.



You can order these and other scientist and engineer cards for free by visiting [www.naturalinquirer.org/Scientist-Card-Ordering-Page-v-155.html](http://www.naturalinquirer.org/Scientist-Card-Ordering-Page-v-155.html).


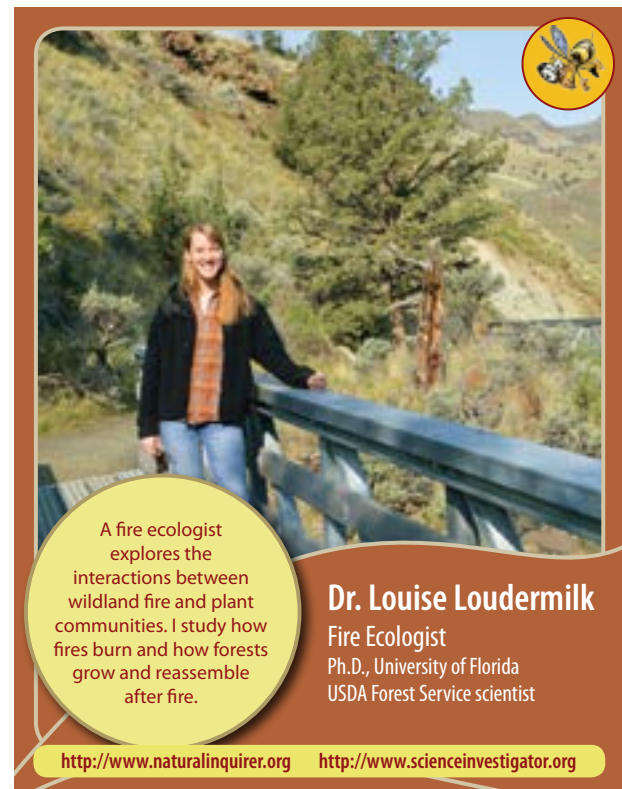
Answer each of the questions beginning on page 36 based on your observation of these eight scientist and engineer cards. You may answer these questions in a class discussion or write your answer below the question. If you write, use correct spelling, punctuation, and grammar.



As a forest and soil ecologist, I am interested in how forest management practices impact soils.

**Dr. Dexter Strother**  
Forest/Soil Ecologist  
Ph.D., University of Georgia  
USDA Forest Service scientist


<http://www.naturalinquirer.org>



A fire ecologist explores the interactions between wildland fire and plant communities. I study how fires burn and how forests grow and reassemble after fire.

**Dr. Louise Loudermilk**  
Fire Ecologist  
Ph.D., University of Florida  
USDA Forest Service scientist

<http://www.naturalinquirer.org> <http://www.scienceinvestigator.org>



Ecology is the study of interactions between organisms and their environment. A fire ecologist studies fire as a disturbance process in the environment.

**Dr. Morris C. Johnson**  
 Research Fire Ecologist  
 Ph.D., University of Washington  
 USDA Forest Service scientist


<http://www.naturalinquirer.org> <http://www.scienceinvestigator.org>



Fire ecologists study how wildfire changes ecosystems. As a fire ecologist, I focus on forests. Specifically, I study the impacts of removing fire from, or changing how fires burn in, forests which originally had fire.

**Dr. Sharon Hood**  
 Fire Ecologist  
 Ph.D., University of Montana  
 USDA Forest Service scientist

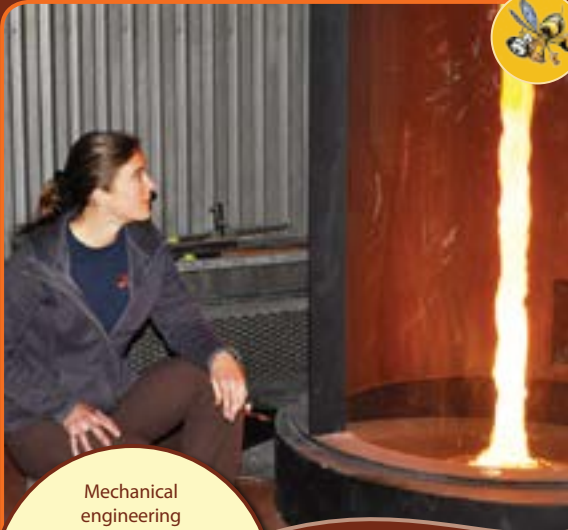
<http://www.naturalinquirer.org>



As a research fire ecologist, I study how vegetation, weather, and terrain interact to influence wildland fires.

**Dr. W. Matt Jolly**  
 Research Fire Ecologist  
 Ph.D., University of Montana  
 USDA Forest Service scientist


<http://www.naturalinquirer.org>



Mechanical engineering usually deals with things that move. This includes automobiles and roller coasters, as well as manufacturing processes, such as fluids, heat, and fire.

**Dr. Sara McAllister**  
 Research Mechanical Engineer  
 Ph.D., University of California  
 USDA Forest Service scientist

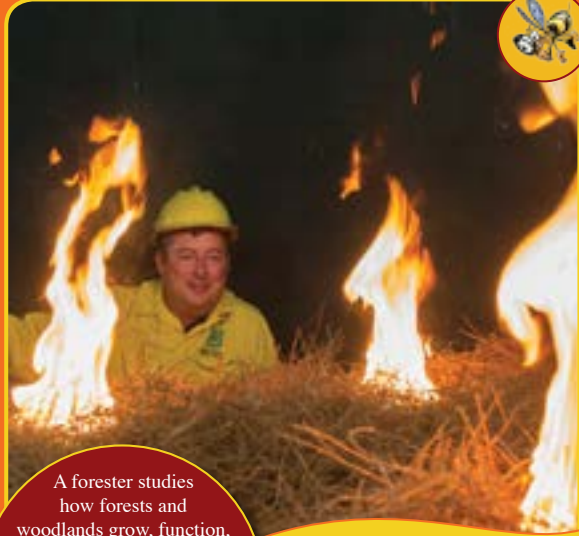
<http://www.naturalinquirer.org>



**A landscape fire ecologist studies:** How past and present forest fires spread across large areas, how the fire impacts the forest (which trees are killed and which trees survive), what trees begin to grow after the fire and; how surviving trees and the new vegetation influence how future fires spread.

**Dr. Pepe Iniguez**  
**Landscape Fire Ecologist**  
 Ph.D., University of Arizona  
 USDA Forest Service scientist

<http://www.naturalinquirer.org>   <http://www.scienceinvestigator.org>



**A forester studies** how forests and woodlands grow, function, and are managed to provide things that people want and need from forests. Specifically, I study prescribed fire and how it can be used as a tool to manage our forests and wildlands.

**Dr. David R. Weise**  
**Forester (specializing in fire)**  
 Ph.D., USDA Forest Service scientist  
 University of California - Berkeley  
 USDA Forest Service scientist

<http://www.naturalinquirer.org>   <http://www.scienceinvestigator.org>

Observe each fire scientist and engineer closely. What similarities and differences do you notice about the scientists and engineers themselves? What extra equipment do they have with or on them? What do you think is the purpose of this extra equipment?

---



---



---



---



---



---



---



---



Observe the setting of each photograph. Describe the setting, noting similarities and differences between each scientist and engineer card. What do you think each scientist or engineer is doing in this setting?

---

---

---

---

---

What kinds of fire scientists and engineers are represented on these cards?

---

---

---

---

---

Read about each of these fire scientists and engineers. Which of these fire scientists and engineers is your favorite and why?

---

---

---

---

---

# 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
- Understandings About Science and Technology
- Natural Hazards
- Risks and Benefits
- Science and Technology in Society
- Science as a Human Endeavor
- Nature of Science
- History of Science
- Social Studies Education Standards Addressed in This Article
- Culture
- People, Places, and Environments
- Individuals, Groups, and Institutions
- Power, Authority, and Governance
- Science, Technology, and Society
- Global Connections
- Civic Ideals and Practices

## Common Core Education Standards Addressed in This Article

### Reading: Informational Text

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

### Science and Technical Subjects

- 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
  - Life Science: LS4.D Biodiversity and Humans
  - Earth and Space Science: ESS3.B Natural Hazards; ESS3.C Human Impacts on Earth Systems
  - Engineering Design: ETS1.B Designing Possible Solutions; ETS1.C Optimizing the Design Solution
- Crosscutting Concepts
  - Patterns
  - Cause and Effect: Mechanism and Prediction
  - Systems and System Models
  - Stability and Change
  - Connections to the Nature of Science
  - Connection to Engineering, Technology, and Applications of Science



## 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 lands and grasslands. 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.fed.us>.

## What Is the Southern Research Station?

The Southern Research Station is part of USDA Forest Service Research and Development. Headquartered in Asheville, North Carolina, the Southern Research Station serves 13 Southern States and beyond. Its staff of 130 scientists is organized into Research Work Units, with science technicians and other support personnel who work at various locations throughout the region, including Federal laboratories, universities, and experimental forests. Since the beginning of the 20th century, the Southern Research Station's researchers have excelled in studies on temperate and tropical forests, forest resources, and forest products. These studies provide a wealth of long-term information on the dynamics of tree plantations and natural forest stands, watersheds, and wildlife habitats.

For more information, visit <https://www.srs.fs.fed.us>.

## What Is the Cradle of Forestry in America Interpretive Association?

The Cradle of Forestry in America Interpretive Association (CFAIA) is a 501(c)3 nonprofit organization based in Pisgah Forest, North Carolina. The CFAIA strives to help people better understand ecology through recreation and education opportunities. Their projects include the following:



- Campground and recreation area management
- Educational programs and services, including *Natural Inquirer*, *Investigator*, *Natural Inquirer Reader Series*, *NSI: Nature Science Investigator*, scientist cards, and *Leaf Prints* (formerly *Nature-Oriented Parenting*)
- Sales of forest-related gifts and educational materials
- Workshops, newsletters, and publications
- Partnership with the Forest Service to provide programming at the Cradle of Forestry Historic Site

For more information, visit <https://www.cfaia.org>.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (Braille, large print, audiotope, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at <https://www.ascr.usda.gov/filing-program-discrimination-complaint-usda-customer> and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410; (2) fax: (202) 690-7442; or (3) email: [program.intake@usda.gov](mailto:program.intake@usda.gov).

USDA is an equal opportunity provider, employer, and lender.

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.



**Student  
Editorial Review  
Board**

East Jackson Middle School  
Commerce, GA  
Amy Cartlidge's 7th grade  
science class



*Natural Inquirer*

<http://www.naturalinquirer.org>

**Forest Service Conservation Education**

<https://www.fs.usda.gov/conservationeducation>

**Smokey Bear**

<https://smokeybear.com/en>

**Follow us on**

**Twitter (@naturalinquirer)**

**and Facebook (<https://www.facebook.com/NaturalInquirer!>)**