

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.

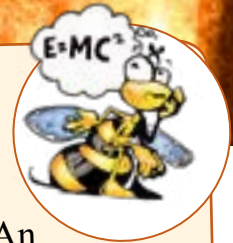
What Kind of Scientists Did This Research?

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.

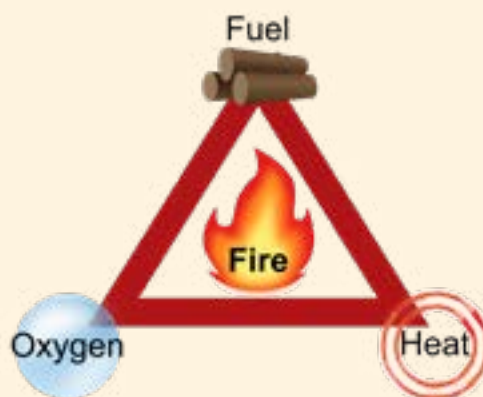


Figure 3. Three conditions must be present for a fire to burn.

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.

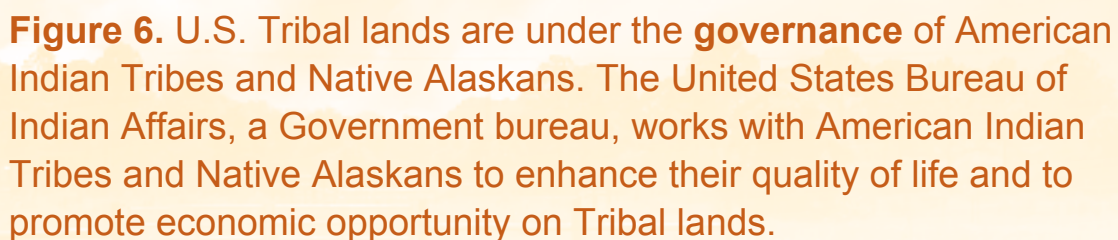


Figure 5. Fire prevention education programs may include posters, such as this Smokey Bear poster.

Illustration courtesy of Special Collections, USDA National Agricultural Library.

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

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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 (draught) 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 | Duration 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.

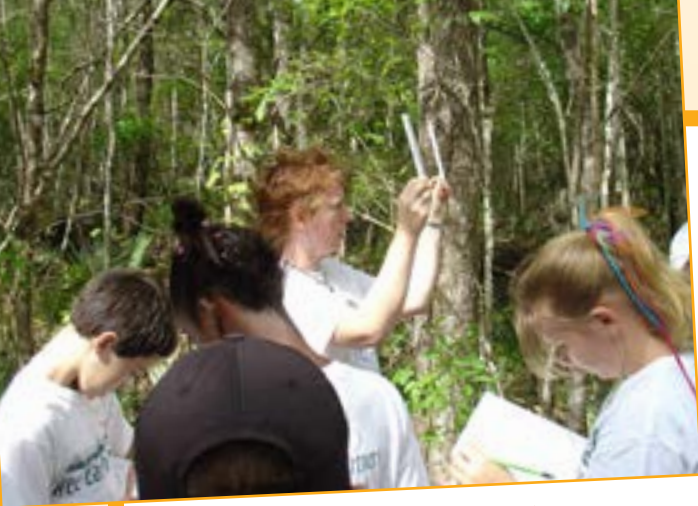


Photo courtesy of the SEWEE Center.

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 skribed 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

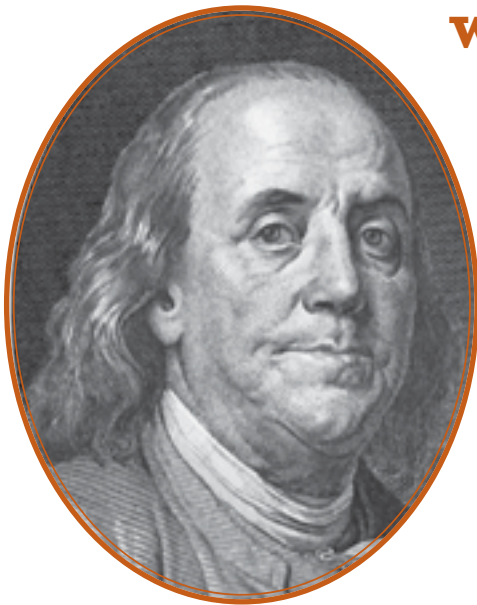
<https://www.nfpa.org/Public-Education/Campaigns/TakeAction>

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/beefstalk/beefstalk-an-ounce-of-prevention-is-worth-a-pound-of-cure/?searchterm=Benjamin%20Franklin>

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