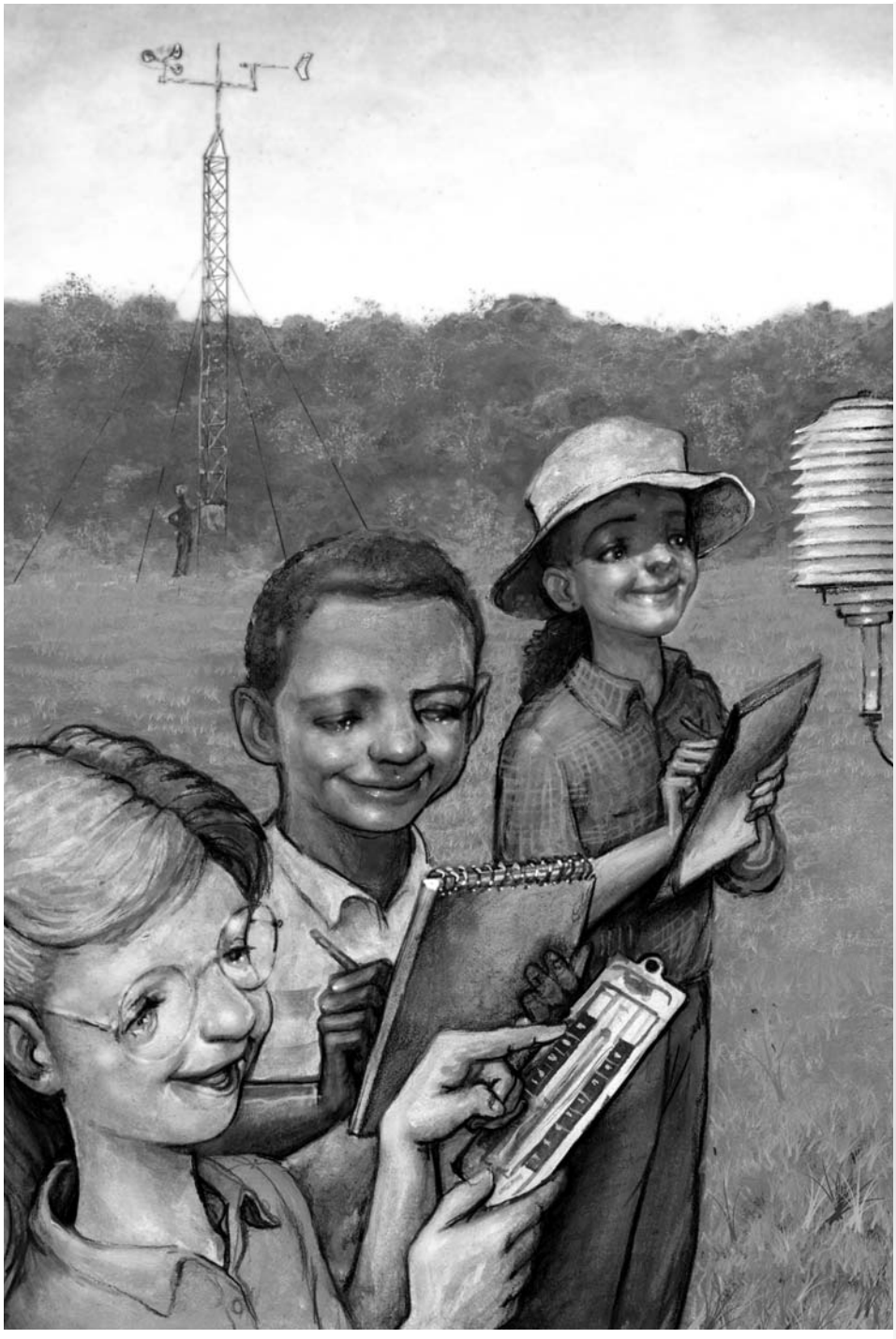
Dew It!

Which Weather Measurements Are Related to the Occurrence of Wildland Fire?



Glossary

complexity (käm **plek** suh tē): The state of being complicated or having many related parts.

predict (prē **dikt**): To tell what one thinks will happen in the future.

wildfire (**wīld** fīr): An uncontrolled wildland fire started naturally or by careless human action.

associated (uh **sō** shē ā ted): Closely connected with another.

relative humidity (**rel** uh tiv hū **mid** uh te): The percentage of water vapor in the air relative to the total amount of water vapor the air can hold at that temperature.

weather stations (**weh** thür **stā** shuns): Places where instruments measure and record weather conditions.

saturated (**sah** chür āt ed): Soaked completely through.

intensity (in **ten** si tē): The quality of being very strong.

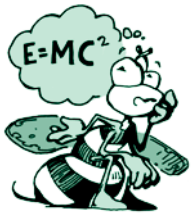
Pronunciation Guide

ā	as in ape	ô	as in for
ä	as in car	ū	as in use
ē	as in me	ü	as in fur
ī	as in ice	oo	as in tool
ō	as in go	*ng*	as in sing

Accented syllables are in **bold**.

Meet Dr. Potter:

I like being a scientist because as a child I never stopped asking why. As an adult, I'm still asking why.



Thinking About Science

The world is a complicated place. When you look closely at things in nature, you will find that many things are connected in one way or another. Scientists study this *complexity* in nature, but they also search for simpler ways to understand what they observe.

One of the ways that they try to simplify their research is by studying things piece by piece. Instead of observing everything all at once, they observe and measure separate things. Then, they examine how the separate things are related. In this study, the scientist wanted to know which daily weather conditions are most related to forest wildfires. To answer his question, he divided the daily weather conditions into separate measurements. The daily weather is not really a lot of separate conditions. Instead, it is a related set of conditions. However, by separating the weather into different kinds of measurements, the scientist made the problem easier to study and to understand.

Thinking About the Environment

Wildfires can be a threat to the health and safety of people and animals (figure 1). Wildfires might be started by mistake, as when people are not careful with campfires or with matches. Wildfires may also be started by lightning or by other natural means during dry weather. Most people know that weeks of dry weather will increase the danger of a wildfire. Whether a wildfire spreads may also depend on the weather that occurs each day. If the weather on some days is more likely to help a wildfire to spread, people should be extra careful with matches or with fire during those days. The scientist in this study wanted to identify the most important daily weather conditions that were *associated* with a dangerous or a large wildfire. To identify these conditions, the scientist measured things like air temperature, *relative humidity*, and wind speed.

Introduction

Although scientists know that many weeks of low rainfall increase the chances of wildfires, they do not know which daily weather conditions are the best for determining the danger of fire. Scientists believe that when certain kinds of weather conditions occur, they can better predict wildfires.

Unfortunately, they have not checked to see if these same conditions occur on days with no wildfires. If scientists can determine which daily weather conditions are the best for identifying the risk of wildfires, they can more easily determine which days wildfires might occur. The scientist in this study wanted to determine which daily weather conditions are associated with large or dangerous wildfires.

Figure 1. *Wildfire.*

Reflection Section

- What is the question the scientist is trying to answer?
- Is it important to be able to predict on which days a wildfire might burn? Why or why not?

Methods

The scientist collected information from large wildfires that had burned in areas across the United States. To make sure that he was collecting weather information only for large wildfires, the scientist decided that wildfires burning less than 400 hectares would not be included. (To find out how many acres this is, multiply 400 times 2.47.) He found information on 459 large wildfires that had burned between 1971 and 1984 (figure 2).

The scientist collected weather measurements recorded at 20 *weather stations* on the dates the fires had burned (figure 3). For each wildfire, he used information from the closest weather station. He then divided the weather information from each weather station into four groups, based on the season the fire had burned. This meant that the scientist had information from each weather station for the days that wildfires burned in the spring, summer, fall, and winter (figure 4). The scientist also collected weather measurements for days in which wildfires had not burned. In this way, the scientist was able to compare the weather measurements made on days when wildfires did not burn with measurements made on days in which wildfires had burned.

Figure 3. *Weather station.*

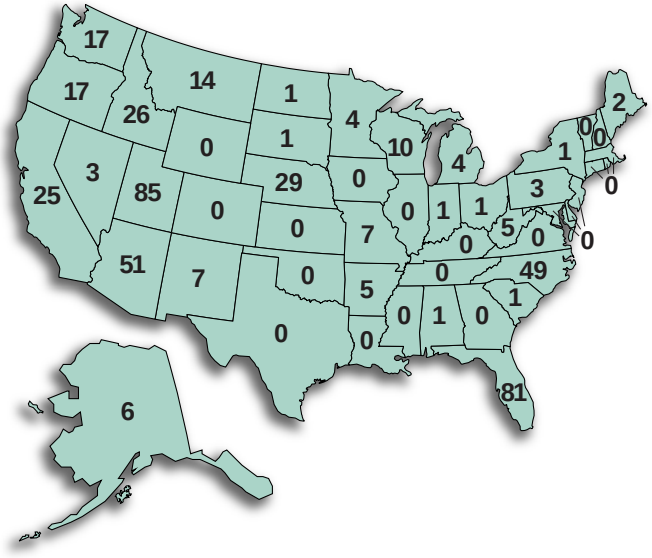


Figure 2. *Number of wildfires in each State.*

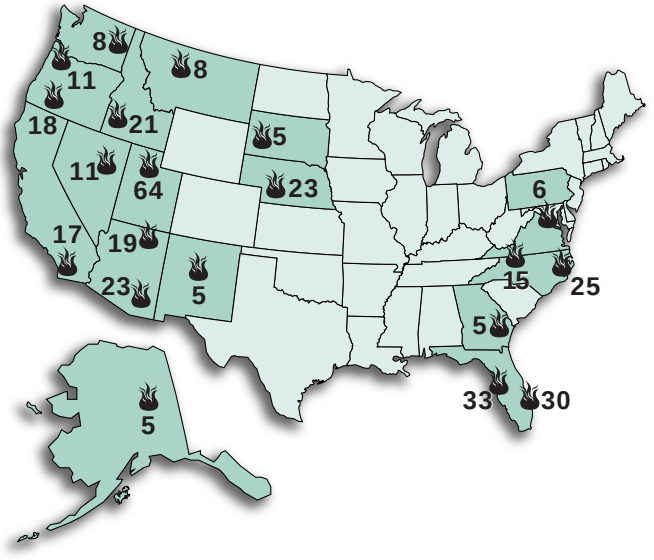


Figure 4. *Location of weather stations and number of days there were fires recorded at each weather station.*

Weather measurements used include air temperature, wind speed, relative humidity, dew point depression, and wind shear. Dew point depression is the air temperature minus the dew point temperature. The dew point temperature is the air temperature at which the air is *saturated* with water. Wind shear occurs when winds at different heights blow in different directions or at different speeds.

Reflection Section

- Why do you think that the scientist had to use weather data from fires that had already occurred?
- Which of the five measurements do you think were more closely associated with large wildfires? Why?

Findings

The scientist found that air temperature, relative humidity, and dew point depression were the three weather measurements most associated with wildfires. When air temperature is high and the amount of water in the air is low, large or dangerous wildfires are more likely to burn. Of these three measurements, dew point depression is the single best measurement to use when trying to predict wildfires. When dew point depression is low, there is a lot of water in the air, and wildfires are not as likely to burn. When dew point depression is high, there is little moisture in the air and a wildfire is more likely to become large or dangerous.

Reflection Section

- Even without weather instruments, humans can generally tell when the dew point depression is low. Even though you will perspire if the temperature is high, what happens to your perspiration when the dew point depression is low?
- Why do you think that your perspiration does not evaporate off of your skin when the dew point depression is low?

Implications

In the past, scientists thought that air temperature, relative humidity, dew point depression, and wind shear were the weather measurements most associated with large or dangerous wildfires. This research suggests that dew point depression is the most important measurement. On days when large wildfires burned between 1971 and 1984, the dew point depression was high. When people try to predict wildfires based on weather conditions, they should pay the closest attention to dew point depression.

Reflection Section

- How did this research simplify what was known about the association between wildfires and daily weather conditions?

Fire Facts

For wildland fires, fuels consist of burnable materials, such as trees, shrubs, and grasses. Besides the availability of fuel, the type of weather occurring at that time can help a wildfire spread. Air temperature, humidity, and wind affect the spread of a wildfire. A wildfire can generate its own wind, thus helping to spread itself. When the air above a flame gets heated, it rises. When it rises, fresh air rushes in to fill the vacuum. The fresh air provides a new source of oxygen for the fire. Thus, if fuels are available and there is a lack of moisture in the air, a wildfire can continue to spread in part by creating its own wind.

Fire Safety Tips from Smokey and His Friends at the Texas Forest Service!

The Keetch-Byram (kech **bi** rum) Drought Index, or KBDI, is a mathematical system developed to help people understand how likely a wildfire is to occur. The KBDI rates current and expected weather conditions and places them on a numbered scale, from 0 to 800. Here are what the numbers mean:

1. 0-200: Soil and fuel moisture content are high. Most fuels will not readily ignite. There is not much danger of wildfire.
2. 200-400: Fires will more readily burn, but heavier fuels will not ignite readily.
3. 400-600: Fires will readily burn in all directions. In some places, all of the fuel on the ground will burn away. Larger fuels may smolder for many days, possibly creating problems with smoke.
4. 600-800: Fires will burn all of the fuels off of the ground. Fires will burn throughout the night and heavier fuels will actively burn, increasing the intensity of the fire.

Discovery FACTivity

The best time to do this FACTivity is when the temperature is high. It is best if the temperature is over 85 °F (or 29 ° C). In this FACTivity, you will determine the air's dew point temperature. Dew point is the point at which the air, at a given temperature, can hold no more moisture. The question you will answer is: What happens when the air can hold no more moisture? For this activity, you will need a cleaned-out vegetable can, filled three-quarters high with water, a thermometer, a spoon, ice, paper, and a pencil. The method you will use to answer this question is: Let the vegetable can filled with water sit for a few hours outside in the shade. It should reach air temperature before you continue. Using the thermometer, measure the air temperature in the shade and record the air temperature. Hold the thermometer against the outside of the can so you can measure the temperature of the air immediately outside of the can. Put some ice into the water and stir. The dew point of the air surrounding the can is the temperature registered on the thermometer when the first sign of moisture appears on the outside surface of the can. Record the temperature at dew point. What has happened? The ice has caused the air immediately surrounding the can to cool. As the air cools, it absorbs moisture which you cannot see until it can hold no more moisture. Now calculate the dew point depression. (See "Methods" to learn how to do this.) If the air temperature and the dew point are far apart, the air is dry and the relative humidity is low. Weather reports often give the air's dew point temperature. Knowing the dew point will help you to determine whether dew or fog is likely to occur.

Activity from: Bosak, S. V. (2000). *Science is...: A source book of fascinating facts, projects, and activities*, Ontario, Canada: Scholastic Canada, Ltd., p. 446.

From Potter, Brian E. (1996). Atmospheric properties associated with large wildfires. *International Journal of Wildland Fire*, 6(2): 71-76.