

Analyzing the Rise of U.S. Wildfires Teacher Lesson Plan

Introduction

In this lesson, students graph the acres of land burned by wildfires across the U.S. by year, then compare yearly trends to that of rising global temperatures. Students practice graph comprehension on a double Y-axis graph before reading an article on how climate change fuels wildfires.

**This lesson has been updated to include temperature and wildfire data through 2018.*

Total Time

45 min (one class period)

Learning Outcomes

Students will be able to:

- Identify the dependent and independent variables of a double y-axis graph (Bloom's Taxonomy: Understand)
- Plot data points from a data table to a double y-axis graph. (Bloom's Taxonomy: Apply)
- Draw conclusions on the relationship between rising global temperature anomalies and acres of land burned from wildfires. (Bloom's Taxonomy: Analyze)

Materials

For students:

- [Analyzing the Rise of U.S. Wildfires Student Worksheet](#)

For teachers:

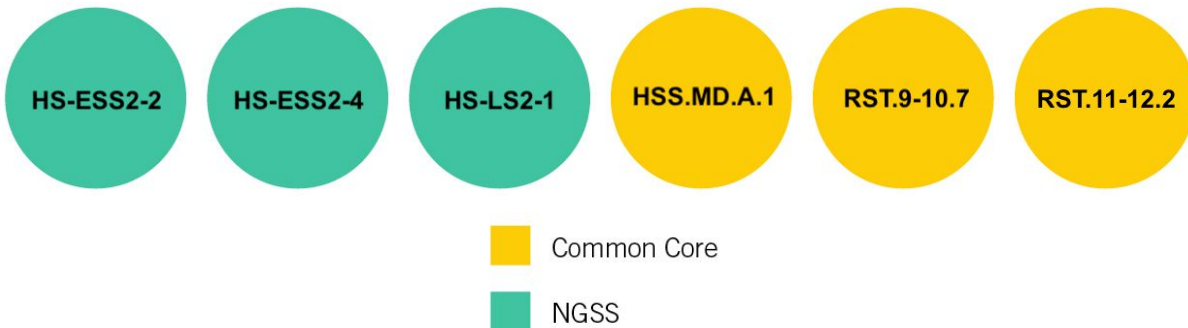
- [Analyzing the Rise of U.S. Wildfires Answer Key](#)
- Resources for graphing exercise:
 - Google Sheets: [Teacher Graph](#), [Student Graph](#)
 - Excel: [Teacher Graph](#), [Student Graph](#)

Context Video



[Youth Climate Story: Pine Beetles and Wildfires in Colorado \(1 min\)](#)

Standards



Sources & References

- ["National Time Series"](#), Climate at a Glance, NOAA, National Center for Environmental Information
- ["Climate Change Indicators: Wildfires"](#), Environmental Protection Agency, April 2016
- ["Is Global Warming Fueling Increased Wildfire Risks?"](#), Union of Concerned Scientists, July 24, 2018
- ["Total Wildland Fires and Acres \(1926-2018\)"](#), National Interagency Fire Center

Teaching-Learning Plan: The Inquiry 5E Instructional Model

Time	Teacher Does	Student Does
Engage (5 min)	<p>Elicit (1 min): Engage the class by explaining that they'll watch a short video on a young person's experience with wildfires in Colorado. While students are watching, have them consider the question "What are different factors you observe to be the cause of wildfires in this video?"</p> <p>Play Video (1 min): Play Our Climate Our Future's Youth Impact Story on Pine Beetles and Wildfires in Colorado.</p>	<p>Jot down ideas: As students watch the video, consider having them jot down different factors they observe that cause wildfires.</p>
Explore (5 min)	<p>Observations from the video (5 min): Ask students what they observed from the video to have caused wildfires.</p> <ul style="list-style-type: none"> Share that one reason wildfires have been on the rise in the western US is due to how climate change affects certain beetles. Warmer temperatures put pine beetles in a 'reproduction frenzy'. Pine beetles infest trees and kill them. The dry trees are fuel for larger wildfires. Learn more about how climate affects beetles and wildfires here. 	<p>Initial reactions: Allow students to reflect any initial reactions or emotional responses to the Youth Impact Story.</p>
Explain (15 min)	<p>Graphing Acres of Land Burned and US Surface Temperature Anomaly (15 min): Hand out the Analyzing the Rise of U.S. Wildfires Student Worksheets.</p> <ul style="list-style-type: none"> Depending on your class, students may need further support with distinguishing different components of a double y-axis graph. Students can graph by hand or by computer. (See links above in Materials section.) <p>Review the Discussion Questions (8 min): Take a couple minutes to review the Discussion Questions with the full class.</p>	<p>Setting up: Students read the introduction, vocabulary, objective, and procedure as a class.</p> <p>Working groups: In groups of 2-4, students work on the graphing exercise and answer the accompanying discussion questions.</p>
Elaborate (15 min)	<p>Read (5 min): Depending on your audience, consider giving students time to Talk to the Text before gathering the full class to read the excerpt from the article "Is Global Warming Fueling Increased Wildfire Risks?".</p> <ul style="list-style-type: none"> If your class needs more time to complete the 	<p>(Optional) Talk to the Text: Students engage in silent individual reading and annotate the text as necessary to enhance reading comprehension.</p>

	<p>exercise, consider having students complete the reading comprehension exercise as homework.</p> <p>Discussion in Groups (5 min): Give time for groups to discuss the accompanying discussion questions before reviewing as a class. Listen to group discussions and provide feedback or support as needed.</p>	<p>Popcorn: One student is selected to start reading the article, then they call on another student to pick up where they left off. Students continue in “popcorn style” until the article is complete.</p> <p>Working groups: In groups of 2-4, students discuss and answer the discussion questions.</p>
<p>Evaluate (5 min)</p>	<p>Reading Discussion Questions (5 min): Start a classroom discussion by using the discussion questions at the bottom of the article.</p>	<p>Report back: Students can report back their group discussion responses as a whole class.</p>

Analyzing the Rise of U.S. Wildfires Student Worksheet

Name: _____ Date: _____

Introduction:

Most wildfires are naturally occurring and many ecosystems benefit from the natural cycles of forest fires. Burned forests eventually decompose, replenishing the soil with nutrients that allow for new species to grow. Certain plants, such as the Giant Sequoia trees of the Redwood forests, even depend on fires to reproduce. However, man-made changes in Earth's climate have created hotter and drier fire environments, leading to larger wildfires and longer fire seasons.

Vocabulary:

Temperature Anomaly: the difference from a long-term average or reference value. A positive temperature anomaly indicates that the observed temperature was warmer than the long-term average, while a negative anomaly indicates that the observed temperature was cooler than the long-term average.

Objective:

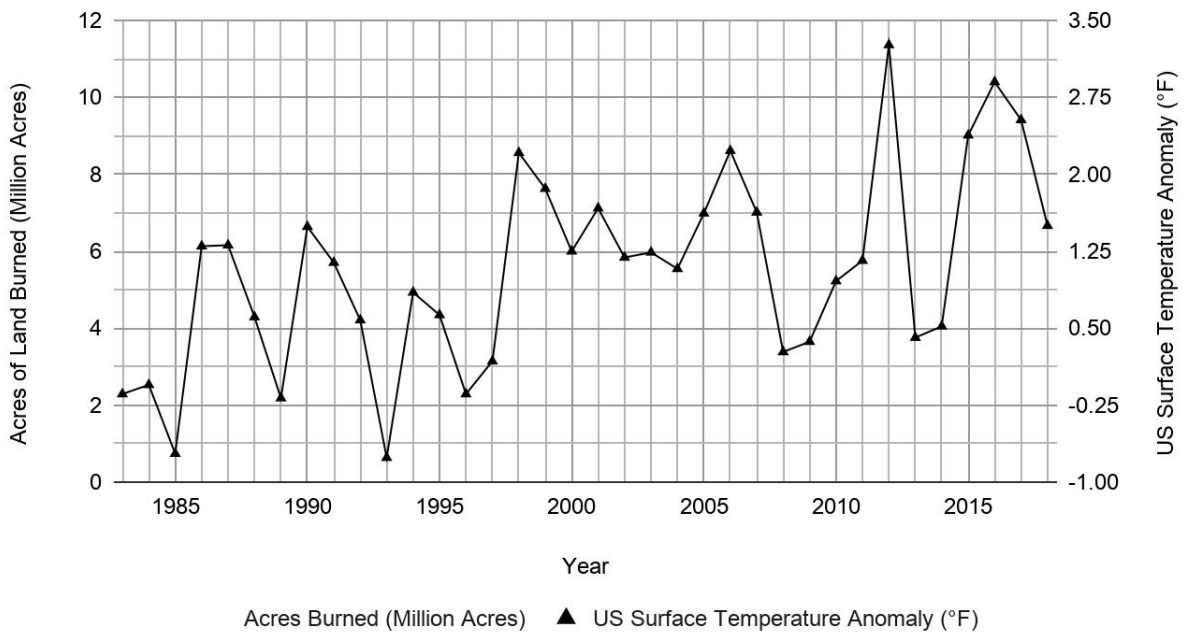
Create a double y-axis graph and analyze the changes in surface temperature and acres of land burned by wildfires in the United States.

Procedure:

- Using the data in the table below, graph the Acres of Land Burned in the years from 1983 to 2018.
- Note: Data on the US Surface Temperature from 1983 to 2018 is already plotted on this graph. Your graph will go on top of the existing data.

Year	Acres Burned (Million Acres)	Year	Acres Burned (Million Acres)	Year	Acres Burned (Million Acres)
1983	1.3	1995	1.8	2007	9.3
1984	1.1	1996	6.1	2008	5.3
1985	2.9	1997	2.9	2009	5.9
1986	2.7	1998	1.3	2010	3.4
1987	2.4	1999	5.6	2011	8.7
1988	5	2000	7.4	2012	9.3
1989	1.8	2001	3.6	2013	4.3
1990	4.6	2002	7.2	2014	3.6
1991	3	2003	4	2015	10.1
1992	2.1	2004	8.1	2016	5.5
1993	1.8	2005	8.7	2017	10
1994	4.1	2006	9.9	2018	8.8

US Surface Temperature Anomaly and Acres of Land Burned vs. Year



Discussion Questions: Answer using data from the exercise in complete sentences.

- 1) There are three variables in this double y-axis graph. What are the dependent and independent variables?

- 2) What is one advantage of using double y-axis graphs?

- 3) In what three years did the US experience the largest temperature anomaly above normal since 1983? How many degrees above normal did the US experience in those years?

- 4) In what three years did the US experience the largest amount of land burned from wildfires since 1983? How many acres of land were burned in those years?

- 5) Based on the trends you see in the graphs, what do you expect to happen to the overall amount of land burned by wildfires in the US in the future?

Reading Comprehension: Read the excerpt of the article below and answer the following questions using complete sentences.

Is Global Warming Fueling Increased Wildfire Risks?

Union of Concerned Scientists

The effects of global warming on temperature, precipitation levels, and soil moisture are turning many of our forests into kindling during wildfire season. As the climate warms, moisture and precipitation levels are changing, with wet areas becoming wetter and dry areas becoming drier. Higher spring and summer temperatures and earlier spring snow-melt typically cause soils to be drier for longer, increasing the likelihood of drought and a longer wildfire season, particularly in the western United States. These hot, dry conditions also increase the likelihood that, once wildfires are started by lightning strikes or human error, they will be more intense and long-burning.

What is the relationship between precipitation patterns, global warming, and wildfires?

While severe wildfires have been observed to occur more frequently and this trend is projected to continue throughout the 21st century, it is worth noting that not every year has an equal likelihood of experiencing droughts or wildfires. Natural, cyclical weather occurrences, such as El Niño events, also affect the likelihood of wildfires by affecting levels of precipitation and moisture and lead to year-by-year variability in the potential for drought and wildfires regionally. Nonetheless, because temperatures and precipitation levels are projected to alter further over the course of this century, the overall potential for wildfires in the United States, especially the southern states, is likely to increase as well.

A conflagration of costs

The economic costs of wildfires can be crippling. Between 2000 and 2009, the property damages from wildfires averaged \$665 million per year. In addition to the property damage they wreak, wildfires cost states and the federal government millions in fire-suppression management; the U.S. Forest Service's yearly fire-suppression costs have exceeded \$1 billion dollars at least twice since FY 2000. The environmental and health costs of wildfires are also considerable: not only do wildfires threaten lives directly, but they have the potential to increase local air pollution—exacerbating lung diseases and causing breathing difficulties even in healthy individuals.

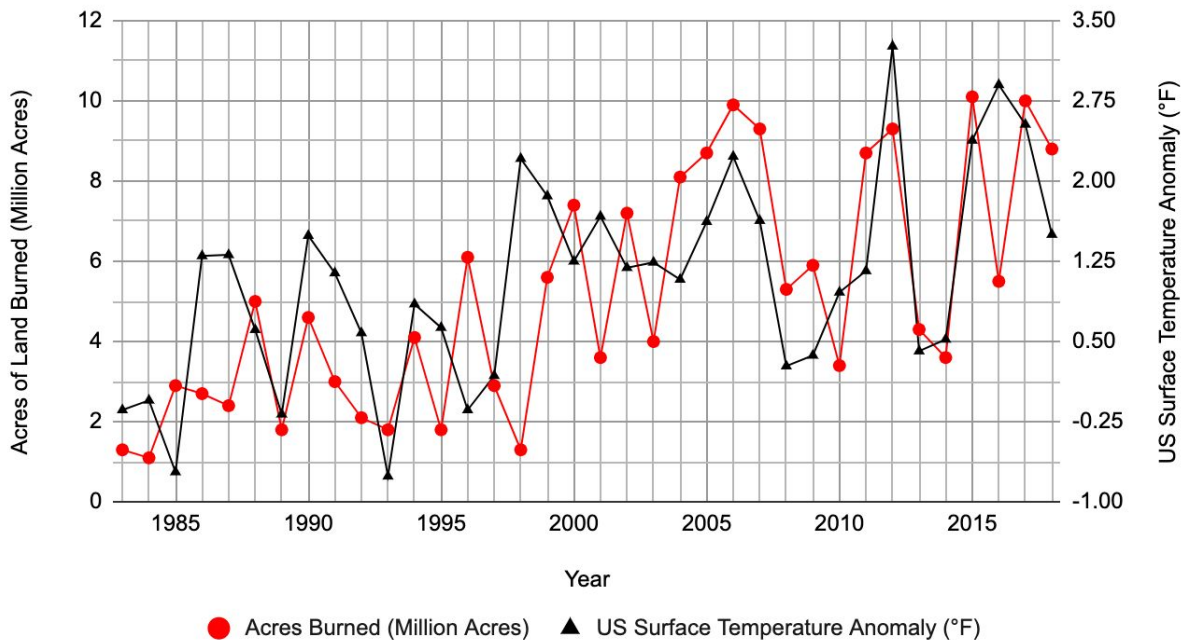
What can we do to address the threat of wildfires?

The global temperature is increasing and the climate is changing due to the greenhouse-gas emissions we have already produced, leading to a likely rise in the incidence of wildfires. But it is not too late. What we do now has the power to influence the frequency and severity of these fires and their effects on us. By engaging in mitigation efforts—creating buffer zones between human habitation and susceptible forests, and meeting home and city fire-safety standards— and by taking steps to reduce our impact on the climate, we can help to keep our forests, our homes, and our health safe.

Analyzing the Rise of U.S. Wildfires Teacher Answer Key

Graph:

US Surface Temperature Anomaly and Acres of Land Burned vs. Year



Discussion Questions Answer Key:

- 1) The dependent variables are US Surface Temperature Anomaly (°F) and Acres of Land Burned (Million Acres). The independent variable is Year.
- 2) One advantage of using double y-axis graphs is being able to compare two dependent variables to one independent variable.
- 3) The US experienced the largest temperature anomaly above normal in 2012, 2016, and 2017. The temperature anomaly was 3.3°F above normal in 2012, 2.9°F above normal in 2016, and 2.5°F in 2017.

- 4) The US experienced the largest amount of land burned in 2015, 2017, and 2006. The amount of land burned was 10.1 million acres in 2015, 10.0 million acres in 2017 and 9.9 million acres in 2006.
- 5) The US should experience an overall continued increase in amount of land burned by wildfires as temperatures increase.

Reading Comprehension Questions Answer Key

- 1) Warmer climate leads dry areas to become drier. Higher spring and summer temperatures as well as earlier arrival of spring causes snow to melt earlier, which allows soil to dry out for a longer period of time. The drier the soil, the more likely it is for wildfires to start and burn longer.
- 2) Not every year will experience the same amount of wildfires and wildfires won't progressively get worse from year to year because of natural weather cycles like El Niño.
- 3) Wildfires cause air pollution, which makes lung diseases worse and can cause breathing difficulties even in healthy people. *Examples of climate justice impacts from wildfires include:*
 - Elderly and very young people are less mobile and are less able to escape wildfires
 - People with less money and resources are less able to protect themselves from wildfires or recover from wildfire damages
 - People with disabilities or health issues such as respiratory diseases like asthma are disproportionately affected by health impacts of wildfires
- 4) Some ways people can reduce impacts of wildfires are:
 - Engaging in mitigation efforts - create buffer zones between human residences and wildfire-prone forests
 - Ensuring homes and buildings meet fire-safety standards
 - Take steps to reduce climate change and climate impacts