



Megafires: Changes in Colorado Wildfire

Setting the Stage

The number, severity, size, and seasonal duration of wildfires is increasing. The 2012 and 2013 fire seasons were the most destructive in Colorado's history. The 2012 High Park Fire, west of Fort Collins, was the most destructive wildfire in the state when it occurred. But just a few days later, the Waldo Canyon Fire near Colorado Springs surpassed it. The 2013 fire season turned out to be even worse, with the Black Forest Fire now ranking as the most destructive wildfire in the state to date. This trend continued in 2018 with the Spring Creek Fire ranking as the third largest wildfire in state history.



Wildfire burns through the Black Forest area near Colorado Springs, 2013.
Photo Credit: <https://vimeo.com/84393594>

Lesson Overview

Students will build understanding about wildfires in Colorado through the following learning activities:

- **Activity 1 – Engage (10 minutes) Introduction to Wildfire Concepts and Case Study**
As a class, watch a short documentary about wildfires in Colorado and have a brief whole group discussion about the video.
- **Activity 2 – Explore (40 minutes) Wildfire Data Analysis Jigsaw**
In small groups, analyze wildfire information and data to build understanding of the causes, impacts, locations, and frequency of wildfires.
- **Activity 3 – Explain (50 minutes) Community Wildfire Risk and Response**
In small groups, create a local news story for your (or another) community to share information about wildfire causes and impacts, and how people prepare for, respond to, and rebound from wildfires.



Instructional Overview	
Grade Level	Middle School
Instructional Time	100 Minutes
Standards Alignment	NGSS: MS-ESS3-2 CDE: MS3.ESS-GLE9
Anchoring Phenomenon	<ul style="list-style-type: none"> • Causes and effects of wildfire can be identified and measured • Natural factors, such as weather and climate, affect the potential for and severity of wildfire. • Human impacts and land use change, such as infrastructure and residential development, affect the impacts of wildfire.
Driving Questions	<ul style="list-style-type: none"> • What are the main causes and impacts of wildfires? • When and where are wildfires most likely to occur in Colorado? • What action should people take before, during, and after a wildfire?
Learning Goals	<ul style="list-style-type: none"> • Students will understand the basic causes and impacts of wildfires. • Students will analyze data to build understanding about the location and frequency of wildfires. • Students will know what actions people take to prepare for, respond to, and rebound from wildfires.
Materials	<ul style="list-style-type: none"> <input type="checkbox"/> <i>Students:</i> One student handout per student (digital access or printed copy & pencil) <input type="checkbox"/> Individual student computer devices or classroom computer with projector, and internet <input type="checkbox"/> <i>Entire class:</i> For the Activity 2 wrap-up discussion, 12 large Post-Its or pieces of poster size paper, 12 packs of sticky notes, and 12 felt markers <input type="checkbox"/> Materials for Activity 3, depending on the format each group chooses (e.g., poster paper, access to slide presentation and word processing software, audio/video recording, internet, etc.)
Material Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Print student handouts if needed <input type="checkbox"/> Ensure computer access <input type="checkbox"/> Cue and test web links <input type="checkbox"/> Plan vocabulary integration <input type="checkbox"/> For Activity 2 stations: If internet is available, use student handouts with embedded activity links with student personal devices or two to four shared devices with activity links bookmarked at each station. If internet is unavailable, print two copies of materials located in the MS Wildfire Resources Folder per station and show video links as a class. Set up two sets of large Post-It or poster size paper, sticky notes, and markers.
Vocabulary	<u>Natural hazards</u> are naturally occurring phenomena such as floods,





	<p>wildfires, extreme heat, or drought, which may disrupt or damage a community.</p> <p><u>Wildfire</u> is a widespread and destructive fire in a wilderness or rural area.</p> <p><u>Fuel load</u> is the total amount of combustible (burnable) material in a defined space.</p> <p><u>Ignition</u> is the starting of a fire.</p> <p><u>Anthropogenic</u> means the influence of human beings on nature.</p> <p><u>WUI</u> is an acronym for the Wildland-Urban Interface, the area where forests and human development overlap.</p> <p><u>Emissions</u> are products, such as gases, that are released into the atmosphere (e.g., smoke from a fire).</p>
<p>Instructional Strategies</p>	<ul style="list-style-type: none"> • Jigsaw (optional, used in Activity 2): A cooperative learning strategy in which each group is responsible for learning one “piece of the puzzle” and then sharing that information with other groups to complete the whole picture. Consider using Activity 3 for students to present the information they learned at their stations. Teachers can choose to use this strategy if time is limited, and stations can be differentiated for different student abilities and levels of teacher assistance. • <u>Mind mapping</u> (optional; used in Activity 2 wrap-up): A creative way to “map out” students’ thoughts and ideas. Similar to a concept map, multiple formats can be used to develop students’ trains of thought and make connections between main ideas or concepts.

<p>Activities</p>	<p>Web Links for Lesson Resources Note: all resources are downloaded as pdfs in the <i>Activity Resources Folder</i></p>
<p>Activity 1</p>	<ul style="list-style-type: none"> • Video: Colorado’s Forests: Past, Present, and Future https://www.youtube.com/watch?v=t5MVM6R9nCU
<p>Activity 2</p>	<p>Station.1</p> <ul style="list-style-type: none"> • Text: Colorado Planning for Hazards—Wildfire https://www.planningforhazards.com/wildfire <p>Station 2</p> <ul style="list-style-type: none"> • Data Visualization: Wildfires in Colorado https://www.colorado.edu/climate/extremes/maps/index.html#wildfires <p>Station.3</p> <ul style="list-style-type: none"> • Data Visualization: Wildfire Statistics Figure 1 https://www.hsdl.org/?view&did=813795 • Data Visualization: Risk and Wildfires in Colorado Maps https://drive.google.com/open?id=1Df2d2ljWwVfC0cJFy9eq06RHKmW/hxpr • Wildland-Urban Interface http://www.wildlandfirersg.org/about/wildland-urban-interface <p>Station 4</p> <ul style="list-style-type: none"> • Data Visualization: Lightning-caused Fires https://www.nifc.gov/fireInfo/fireInfo_stats_lightng.html • Data Visualization: Human-caused Fires https://www.nifc.gov/fireInfo/fireInfo_stats_human.html <p>Station.5</p> <ul style="list-style-type: none"> • Data Visualization: Wildfire Infographic





	<p>https://www.colorado.edu/coloradan/2017/12/01/infographic-wildfire</p> <ul style="list-style-type: none"> Text: Fire Triangle & Fire Tetrahedron https://drive.google.com/open?id=1YJTpJE2Kc6cmoqrVKJobc08xb6AEeDNWxE32sTnea4s <p>Station 6</p> <ul style="list-style-type: none"> Text: Wildfires Ready.gov https://www.ready.gov/wildfires Text: Wildfire Safety https://www.weather.gov/safety/wildfire
Activity 3	<ul style="list-style-type: none"> Video: Wildfire Expert https://www.youtube.com/watch?v=82bEpFhXDk8&feature=youtu.be Video: Evacuating the Waldo Canyon Fire https://www.youtube.com/watch?v=P43RUtldg4I Video: The Waldo Canyon fire: Remembering it five years later https://www.youtube.com/watch?v=kMJm87Ro0rM Video: The Waldo Canyon fire, five years later: Colorado Springs rebuilds https://www.youtube.com/watch?v=NEJMS_zbjqE Video: The Waldo Canyon fire, five years later: Restoring the fire ravaged land https://www.youtube.com/watch?v=cN5-2E7UwZl <p>Optional resources</p> <ul style="list-style-type: none"> Website: NFPA FireWise USA https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA Website: NFPA Wildfire Safety Tips https://www.nfpa.org/Public-Education/By-topic/Wildfire/Wildfire-safety-tips Website: NFPA Preparing homes for Wildfire https://www.nfpa.org/Public-Education/By-topic/Wildfire/Preparing-homes-for-wildfire Website: CSFS Are you firewise? https://csfs.colostate.edu/wildfire-mitigation/colorados-are-you-firewise-program/ Data Visualization: NOAA Science on a Sphere-Fire Dataset in Real Time https://sos.noaa.gov/datasets/fires-real-time/





Activity 1 (Engage)

Introduction to Wildfire Concepts & Case Study (10 minutes)

Why are wildfires a risk in Colorado?

Think: What do you know about wildfires?

1. In one minute, jot down as much information as you know about wildfires in the “What I Know” section of the KWL Chart on page 2.

Responses vary.

Watch [Colorado’s Forests: Past, Present and Future](#), a documentary about wildfire in the state, to get a feel for the impacts of wildfire on people and the environment.



Pair: Discuss your observations and wonderings about the video with a partner.

2. Write down your observations and questions about wildfire as a natural hazard in the “What I Wonder” section of the KWL Chart.

Responses vary.

Share: As a class, briefly discuss observations and wonderings about the videos.





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KWL Chart	
1. What I K now	
2. What I W onder	
What I L earned (Activity 3)	





Activity 2 (Explore)

Wildfire Data Analysis Jigsaw (40 minutes)

Activity 2 is designed as a jigsaw in which students work in small groups to complete the activities at six different stations and then share out. Consider giving the small groups expert names, like “fire science experts,” “emergency managers,” etc. Alternatively, teachers may decide to run some stations as whole-class, teacher-led activities before assigning the remaining stations as a student-led, small-group jigsaw.

Station 1: Colorado Wildfire Fast Facts

Read highlights from the [Colorado Planning for Hazards—Wildfire](#) webpage (first three sections only).



3. What are the main causes of wildfires?

Human activities such as campfires and debris burning, fireworks, etc., cause most wildfires (83%) and a lesser amount are caused by lightning (17%).

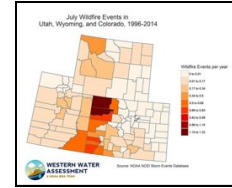
4. What are the greatest risks that wildfires pose in Colorado?

Wildfires pose most risk to property and buildings. Colorado ranks third in the country as having the most residential homes at risk to wildfires.



Station 2: Location and Frequency of Wildfires in Colorado

Explore the Monthly Maps of Significant Weather Events "[Wildfire](#)" series to assess the frequency and location of wildfires in the state.



5. In Colorado, when does wildfire mainly occur (months/seasons)?

Summer (June-August)

6. Do wildfires occur year-round in Colorado? Describe the seasonal pattern of wildfires in the state.

Yes. There are the least number of fires in the winter months; the summer months have the greatest number of fires. Fall and spring have a moderate amount of fires.

7. During times of high wildfire activity, where do wildfires mainly occur (geographic area/counties) in Colorado?

Western and southern central Colorado



Station 3: Wildfire Trends

Identify patterns and trends in [Figure 1: Annual Wildfires and Acres Burned](#) graph and the [Wildfire Risk map](#) and [Wildfires in Colorado map](#).

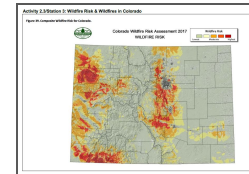
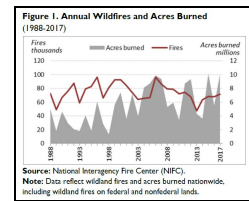
8. What data does the graph illustrate?

The number of wildfires and acres burned over time.

9. What is the independent variable and its units? What are the dependent variables and their units?

Independent variable: Years (1-year intervals).

Dependent variables: The left vertical axis is the number of fires (thousands) and the right vertical axis is acres burned (millions).



10. Describe the trend for acres burned in relation to the number of fires over time?

In the past, the number of fires exceeded the number of acres burned. Recently, the number of acres burned has increased and exceeded the number of fires. This means that larger fires are now burning.

11. Look at the Map of Wildfire Risk in Colorado. Describe the pattern of areas that have higher and lower wildfire risk throughout Colorado.

The areas of greatest wildfire risk are the Front Range area, eastern Rocky Mountains, western slope, and southwestern Colorado. The areas of lowest wildfire risk are the eastern plains and the central Rocky Mountains.

12. Focus on south Denver Metro and Colorado Springs areas, which have high populations and are located in the [Wildland-Urban Interface](#) (WUI). What do you observe about the number, location, and severity of wildfires in these areas?

There is a high wildfire risk and three major wildfires have occurred in the south Denver Metro and Colorado Springs areas. There were three major wildfires that occurred in areas of high wildfire risk—Hayman Fire, Waldo Canyon Fire (bordered Colorado Springs), and the Black Canyon Fire (also near Colorado Springs).



Station 4: Causes of Wildfires

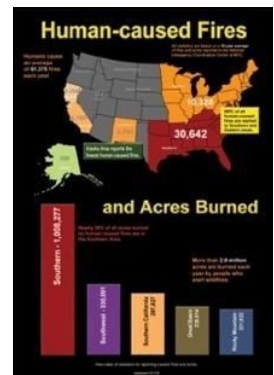
Compare and contrast the [Lightning-caused Fires](#) and [Human-caused Fires](#) infographics. Write your responses to the following questions about the causes of wildfire in your student handout.

13. Compare and contrast lightning-caused fires vs. human-caused fires. Describe the patterns in the data.

Each year, lightning causes 9941 wildfires, and humans cause 61,735 wildfires; therefore, humans cause many more fires than are caused naturally. There are more lightning-caused fires in the western U.S. and more human-caused fires in the eastern U.S.

14. How does the Rocky Mountain region compare for lightning- and human-caused wildfires?

The Rocky Mountain region is 3rd highest in the number of lightning-caused fires, and 4th in the number of acres burned each year. For human-caused fires, the Rocky Mountain region does not have a specific number of fires listed, so it's likely this isn't a main cause of wildfires. However, the Rocky Mountain region ranks 5th in the number of acres burned from human-caused fires.





Station 5: Wildfire Behavior & History

Review the [Wildfire Infographic](#) and the [Fire Triangle & Fire Tetrahedron](#) images.

15. Describe what the infographic illustrates about wildfires.

Increase in number of acres burned, longer wildfire season, increased cost to fight wildfires.

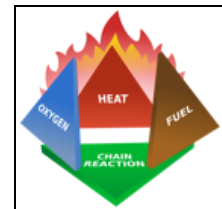


16. Summarize the main factors that contribute to wildfires.

More development and people living in and near wildfire-prone areas, global warming (climate change), increased fuel for fires, and political/economic concerns are contributing to wildfires.

17. Describe the relationship between the different factors in the “fire triangle” and the “fire tetrahedron.”

Both the fire triangle and fire tetrahedron include fuel, oxygen, and heat (a source of ignition to start the fire requires a chemical reaction) as elements of a fire. The fire tetrahedron also includes an exothermic chain reaction (releases energy) to keep a fire burning.





Station 6: Wildfire Safety

Read the [Wildfires Ready.gov](https://www.wildfiresready.gov) webpage and the National Weather Service [Wildfire Safety](https://www.weather.gov/wildfiresafety) plan in your wildfire research team. Make sure to click on all tabs in the Wildfire Safety plan website.

18. What are the main impacts of wildfire?

Power outages, disruption to transportation (e.g., damage to roads, railways, etc.), building damage and destruction, environmental damage and destruction, and post-fire landslides.



19. What is a “Fire Weather Watch” and what should you do in response to it? What is a “Red Flag Warning” and what should you do in response to it?

A Fire Weather Watch is given during critical fire weather conditions (dry, hot, windy) are possible in the next 1-4 days; be prepared for possible evacuation. A Red Flag Warning is given if critical fire weather is ongoing or expected to occur in the next 12-24 hours; be prepared to evacuate if ordered.



20. If you live in an area at risk of wildfires, what should you and your family do to prepare? In the event of a wildfire warning, what should you do to protect yourself and others with you?

Before a wildfire, have an emergency and evacuation plan in place, emergency kit prepared, a “go bag” ready, communication and meeting place, etc.

During a wildfire warning, leave immediately if ordered to evacuate and do not return until the area has been designated safe, listen to emergency alerts, call 911 if trapped, etc.





Activity 2 Wrap Up Discussion

Have a 10-minute [mind mapping](#) session or consensus discussion session about your findings and learning from the activity sections. Start the class mind map with “Wildfire” labeled in the center of a large Post-It, poster paper, or shared digital document.

(continued)

As a class, briefly share findings from the station to check and correct your responses, as needed, and add key information to the wildfire mind map.

Collect student handouts and/or have them digitally share their copy with you. Student handouts will be used for Activity 3, and it is important for students to have complete and correct responses to communicate information.

Suggested discussion questions:

- What are key factors about the causes and impacts of wildfire?
- In which locations and at what time of year do most wildfires occur in Colorado?
- How should people prepare for and respond to be safe in the event of a wildfire?

Activity 3 (Explain)

Community Wildfire Risk & Response (50 minutes)

How can communities know about and manage their wildfire risk in Colorado?

For Activity 3, students will work in new groups, or hazard expert teams. Each hazard expert team is made up of one student from each of the jigsaw groups, so that the team consists of students that collectively completed each of the Activity 2 stations. The goal is to have an expert from each station in order to communicate key wildfire information to your (or another) community that faces wildfire risk and/or has experienced a wildfire in the past.

In addition to using their student handouts, use Activities 3.1 and 3.2 as models for students to develop their ideas about how wildfires affect communities. See Activity 3.3 for the final product instructions (summative assessment for the lesson).





Activity 3.1 Wildfire Expert Interview (5 min)

First, watch the short film with Dr. Megan Cattau, wildfire expert with Earth Lab at the University of Colorado Boulder. Megan talks about many of the concepts that you learned in the previous activities and that you will present in this activity:



[Wildfire Expert video](#)

Activity 3.2 Wildfire Virtual Diary (10 min)

Next, watch the virtual diary on how people and communities prepared for, responded to, and rebounded from the devastating Waldo Canyon Fire. Feel free to use video or press coverage from a local wildfire in place of Waldo Canyon Fire information if available.

- [Evacuating the Waldo Canyon Fire](#) (3:42)
- [The Waldo Canyon fire: Remembering it five years later](#) (1:51)
- [The Waldo Canyon fire, five years later: Colorado Springs rebuilds](#) (1:14)
- [The Waldo Canyon fire, five years later: Restoring the fire ravaged land](#) (2:16)



The 2012 Waldo Canyon Fire heading towards Colorado Springs. It is the most expensive wildfire in Colorado's history to date; 346 homes burned and two lives were lost. (Photo: <https://commons.wikimedia.org/wiki/File:Waldocanyon.jpg>)



The 2013 Black Canyon Fire surpassed the Waldo Canyon Fire, with two deaths and at least 509 homes destroyed, making it the most destructive wildfire so far in Colorado. (Photo: U.S. Army)



Activity 3.3 Local Wildfire News Story (35 min)

Prompt: Create a local news story in a format of your choice (see options below), that summarizes important information about for people in your community to be “firewise” before, during, and after a wildfire.

The format choices for the local wildfire news story include:

- Newspaper article with one picture and one graph or map (one page)
- Radio story (2-3 minutes in length)
- Video newscast (2-3 minutes in length)

Follow the steps in the table below to create your news story. Be creative, but accurate.

In addition to using your student handout, check out some of these additional resources:

- The National Fire Protection Association (NFPA) leads the [Firewise USA program](#). Their motto is “residents reducing wildfire risk.” Check out their [wildfire preparedness tips](#) and [preparing homes for wildfire](#) for more information as you develop your news story.
- In Colorado, the Colorado State Forest Service (CSFS) and NFPA implement the Colorado Firewise USA program, which teaches people how to adapt to living with wildfire in Colorado and encourages neighbors to work together and take action now to prevent losses. Check out the CSFS’s [Are You FireWise?](#) guide for more information as you develop your news story.





Local Wildfire News Story Instructions	
<p>1) KWL Chart “What I Learned” (see page 2)</p> <p><input type="checkbox"/> Check when completed</p>	<p>As a group, reflect on what was learned in Activities 1, 2, and 3. Then independently complete the “What I Learned” section of your KWL Chart (see page 2 of the student handout) to summarize your learning. Use these prompts to reflect on what you learned:</p> <ul style="list-style-type: none"> • What important things do you now know about wildfires that you didn’t know before? • What should people do to be “firewise” before, during, and after a wildfire?
<p>2) Choose a Format</p> <p><input type="checkbox"/> Check when completed</p>	<p>As a team, choose one of the following formats for your group’s news story:</p> <ul style="list-style-type: none"> • Newspaper article with one picture and one graph or map (one page) • Radio story (2-3 minutes in length) • Video newscast (2-3 minutes in length)
<p>3) Create a Draft</p> <p><input type="checkbox"/> Check when completed</p>	<p>Referring to notes and responses in your student handout, make a quick draft of your group’s product ideas. Your team’s product should summarize and share information about:</p> <ul style="list-style-type: none"> ● Causes and impacts of wildfires in Colorado ● Locations and times of higher wildfire risk in Colorado ● How to prepare for a wildfire ● How to respond and stay safe during a wildfire ● Describe how people and communities rebound from wildfire
<p>4) Create the Final Product</p> <p><input type="checkbox"/> Check when completed</p>	<p>Create your team’s Local Wildfire News Story. Remember to keep your product brief and summarize these key elements for your community audience:</p> <ul style="list-style-type: none"> • What are the causes and impacts of wildfires in Colorado? • Which regions and times of the year have higher wildfire risk in Colorado? • How can people prepare for a wildfire? • How should people respond to stay safe during a wildfire? • What are some ways that people and communities have rebounded after a wildfire?
<p>Lesson Rubric</p>	<p>Refer to the rubric to help you assess Activity 3.</p>





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Teacher Guide
Middle School
Hazard Lesson: Wildfire

If there is extra time, participate in a [class gallery walk](#), where teams share and learn from other groups' News Stories.

Products will vary; they may be assigned as homework, if needed.

Post products in the classroom and/or online for hosting the class gallery walk.



These materials were developed by CIRES Education & Outreach at CU Boulder.
<https://cires.colorado.edu/outreach/projects/HEARTForce>

