

Name:

Date:

Class:

Knolls Fire and Evacuation Worksheet **Answer Key**

Scenario: Saratoga Springs, Utah, is a city with a population of 58,500, located just south of Salt Lake City. Saratoga Springs is blocked on both sides by topographical features. Utah Lake borders the east side of the city, and the Lake Mountains border the west, as shown in Figure 1. On June 28, 2020, a fire broke out south of the city that was named the Knolls Fire. This was a human-caused fire that quickly spread and threatened the southern area of the city. An evacuation was declared, forcing 13,000 residents from their homes, as shown in Figure 2. The only route moving out of town was northbound on Redwood Road. This caused congested or stop-and-go traffic as residents slowly moved north 5 miles to safety.

After this evacuation occurred, news organizations began to run stories wondering which causes more CO₂ to be released into the atmosphere: cars or wildfires. As an environmental engineer, you are going to analyze the Knolls Fire to determine whether more CO₂ was released from the fire or from the evacuating cars. This is only one case of a small fire, so you also need to go back to your wildfires vs. cars graphing exploration in Excel to also consider a broader picture of all the cars and wildfires in the U.S.



Figure 1: Map of Saratoga Springs, Google Earth

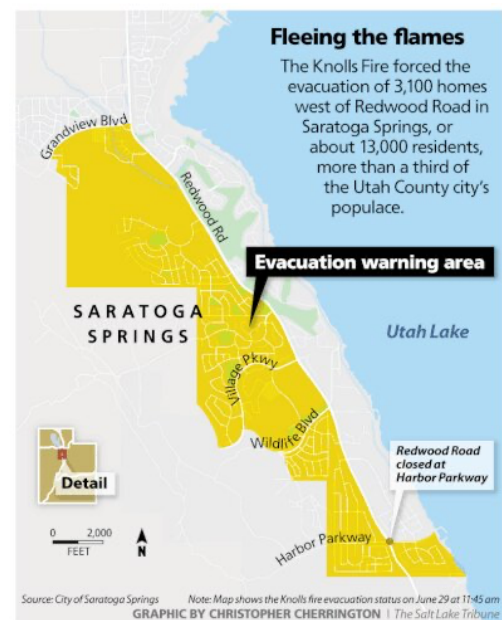


Figure 2: Evacuation Area, Graphic by Christopher Cherrington, The Salt Lake Tribune

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Directions: Your first job as an environmental engineer is to analyze the Knolls Fire. Did the evacuating cars or the wildfire emit more CO₂? Remember, the numbers have labels, so use your unit analysis skills to determine the labels.

1. Estimate the amount of CO₂ emitted from cars evacuating the Knolls Fire and compare it with an estimate of the amount of CO₂ emitted from the Knolls Fire.

A. **Wildfire Emissions:** *The Knolls Fire burned approximately 15.6 mi².*

Recall from your Excel graphs that an estimate of the CO₂ released by a forest fire is between 3,125 kg/mi² (low boundary) and 12,500 kg/mi² (higher boundary) burned. Show your work below.

(15.6 sq. miles)(3125 kg/sq. mile)

(15.6 sq. miles)(12,500 kg/sq. mile)

Lower estimate 48,750 kg CO₂

Upper estimate 195,000 kg CO₂

B. **Vehicle Emissions.** Decide how many people would be in each car to determine the total number of cars evacuating.

- a. 13,000 residents evacuated at 4 persons /car.

3,250 cars

(students could pick any number; we are showing 4 in this key)

- b. Evacuation route 5 is miles. Multiply by your number of cars to find miles driven.

16,250 miles driven

- c. Average miles per gallon (mpg) for a car is 24. Congested traffic can reduce mpg up to 40%. (24 * 0.6)

14.4 mpg

- d. Estimate the number of gallons of fuel burned. (miles driven/mpg) 1,128.47 gallons

- e. Estimate the kg of CO₂ emitted. (gallons)*(8.887 kg of CO₂/gal). 10,028 kg of CO₂

<https://www.epa.gov/greenvehicles/tailpipe-greenhouse-gas-emissions-typical-passenger-vehicle>

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Conclusions:

Answer each of the following questions.

1. For this fire, what were your results for wildfire emissions of CO₂ and cars evacuating?

The emissions from the Knolls Fire, if it burned out right away, would be on the low boundary and emit 48,750 kg of CO₂. If the fire burned longer and hotter, thus getting closer to the upper boundary, it could emit 195,000 kg of CO₂. This fire caused an evacuation, so I think it would be closer to the upper boundary, or 195,000 kg of CO₂.

I chose to show 4 people per car would evacuate, so the amount of CO₂ emitted would be 10,028 kg of CO₂. This is much lower than the CO₂ emitted from the Knolls Fire.

2. Compare the Knolls Fire data to the Excel graphing activity for all the cars and wildfires in the United States. Do you think the Knolls Fire is an accurate representation of CO₂ emissions? Why or why not?

The Knolls Fire data shows that the wildfire is emitting much more CO₂ than the vehicles.

The Excel data shows that, on average, wildfires in the U.S. emit up to 200,000,000 kg of CO₂ at their upper boundary. On the other hand, the vehicle data shows that it is emitting 29,000,000,000,000 kg of CO₂. Vehicles are much higher in CO₂ emissions than wildfires.

Students should note that after a wildfire, the forest will begin to grow again and become a carbon sink and absorb CO₂. Vehicles never stop running unless they note the dates in 2020 (during Covid) when people were home.