Explore: How do respiratory related ER visits from the Rice Ridge fire in 2017 compare to respiratory related ER visits from the same area in 2016?

Name_____ Class_____ Date_____

> *"For he who has health has hope; and he who has hope, has everything."*
>
> Arthur Owen
>
> Former Prime Minister of Barbados

Background: The Rice Ridge Fire – northeast of Seeley Lake, Montana – Summer, 2017

The Rice Ridge fire started after a lightning strike on July 24th, 2017. "For 50 consecutive days from July 31st to September 18th, dense smoke covered the Seeley Lake valley. For 44 of these days, air quality was designated harmful to human health (above the National Ambient Air Quality Standard for PM2.5 of 35 µg/m^3 averaged over 24 hours), and for 35 of the 50 days either part or all of the day was labeled hazardous." The U. S. Environmental Protection Agency (EPA) defines healthy air as having a 24-hour average of 35µg/m^3 of PM2.5 or less and over 250 µg/m^3 as hazardous. The air quality monitor in Seeley Lake takes hourly readings and can measure PM2.5 levels up 1,000 µg/m^3. The smoke in Seeley Lake surpassed this maximum hourly measurement on 20 separate occasions. These particulates accumulate when you breathe them in, which can lead to cardiovascular and respiratory issues. By September 3rd the fire had grown from 40,000 acres to 100,000 acres and became the nation's top wildfire priority.

Besides the high concentrations of $PM_{2.5}$ from the smoke in the Seeley Lake valley, the geography of the area lends itself to inversions which hold the smoke closer to the ground. "As the wildfire seasons continue late into the summer, nights become longer and colder, strengthening these inversions that trap smoke in mountain valleys. Thick smoke prevents sunlight from reaching the ground level and breaking the inversion through warming." The forest fire smoke was trapped in an inversion in the Seeley Lake valley during the Rice Ridge Fire exposing the population to very high levels of $PM_{2.5}$.

The Rice Ridge fire was an extreme fire with concentrations of $PM_{2.5}$ among the highest that have ever been reported in the United States. Chris Migliaccio, from the University of Montana's School of Pharmacy, worked with a team of researchers that tested the lung function of the people impacted by the Rice Ridge fire directly after the fire and one year after the fire had ended. He concludes, "Residents' lung function was worse a year after the fire than it was directly after breathing some of the highest measured wildfire smoke levels ever recorded." "The men whose lung function was tested, had lower lung function than the women who were tested. The reason for this is not yet known."

He expected that the lung function results would be the lowest immediately after 50 days of smoke inhalation, and that given a year had passed, it would give people that much time to rebound and start getting back to normal. "But people's lungs didn't rebound. They got worse."

Table 1: Total Respiratory-related ER Visits in the Seeley Lake Fire Area during the 2017 Rice Ridge Fire and Total Respiratory Related ER Visits in the Seeley Lake Fire Area during the Same Period in 2016.

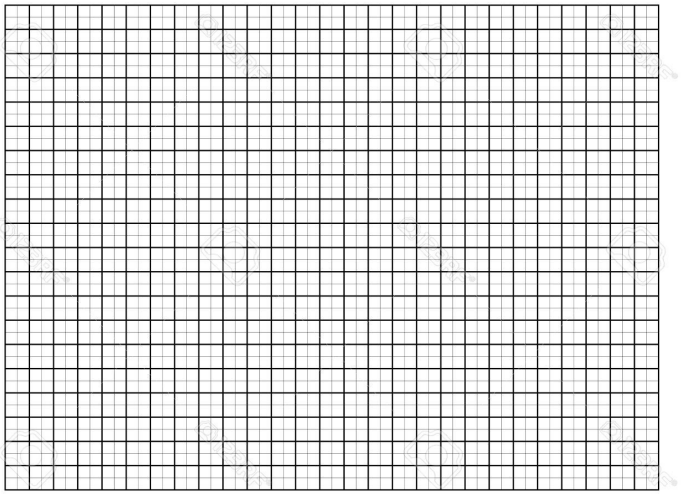
Date	2016 # of ER Visits	2017 # of ER Visits
24-Jul	7	3
26-Jul	1	10
28-Jul	3	5
30-Jul	1	10
1-Aug	3	10
3-Aug	2	8
5-Aug	3	8
7-Aug	4	5
9-Aug	3	9
11-Aug	9	6
13-Aug	8	7
15-Aug	4	8
17-Aug	3	8
19-Aug	4	14
21-Aug	2	6
23-Aug	0	14
25-Aug	4	8
27-Aug	2	11
29-Aug	3	9
31-Aug	5	10
2-Sep	2	8
4-Sep	2	19
6-Sep	1	12

Table 2: 24-hour averages of ambient $PM_{2.5}$ in the Seeley Lake Fire Area during the 2017 Rice Ridge Fire and 24-hour averages of ambient $PM_{2.5}$ in the same area during the same period in 2016.

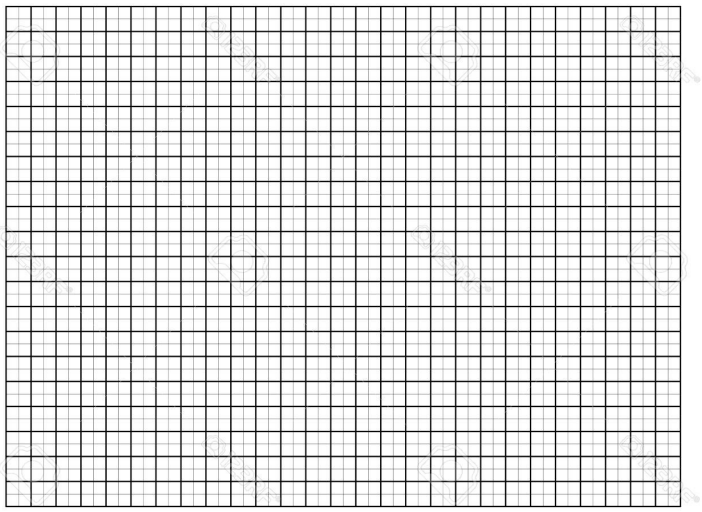
Date	2016 $PM_{2.5}$ ($\mu g/m^3$)	2017 $PM_{2.5}$ ($\mu g/m^3$)
24-Jul	8.3	20.6
26-Jul	9.2	22.5
28-Jul	7.5	21.3
30-Jul	9.7	19.1
1-Aug	10.9	196.4
3-Aug	8.7	186.7
5-Aug	10.6	31.8
7-Aug	11.5	276.6
9-Aug	10.3	83.5
11-Aug	6.9	200.3
13-Aug	7.9	93.3
15-Aug	8.9	179.9
17-Aug	10.8	243.5
19-Aug	5.4	153.5
21-Aug	8.8	201.2
23-Aug	19.2	363.4
25-Aug	7.8	169.1
27-Aug	11.9	378.9
29-Aug	12.8	187.5
31-Aug	22.6	261.8
2-Sep	9.4	342.4
4-Sep	7.3	249.8
6-Sep	10.1	636.8

1. Graph 1: use the data from Table 1 and the coordinate system below to construct a scatter plot graph showing Emergency Room Visits vs. Time for 2016 and 2017. You are comparing data in this graph, not determining if there is a relationship between the two variables, so use a straight edge to connect the points on each line. Be sure your graph has all of the properties of a properly constructed graph.

   Graphs that are to be submitted digitally on this pdf must be constructed on another platform—Microsoft Word or Excel or Google docs or sheets. It is easiest to insert these constructed objects into a pdf when the pdf is opened in **Adobe Acrobat Reader**. To insert a graph in this pdf, copy the constructed object from the original platform using the Copy function or the snipping tool. In Adobe Acrobat Reader, open the *Stamp* tool from the right side tool bar. The *Stamp* commands will now appear on the upper tool bar. Click on *Stamp,* then click on *Paste Clipboard Image as Stamp Tool* from the bottom of the opened menu. The cursor will now appear as a stamper. Move the stamper to the center of the coordinate system below and left click. The pasted object can be moved or re-sized by left clicking on the object.



2. Graph 2: use the data from Table 2 and the coordinate system below to construct a scatter plot graph showing 24 Hour Average Ambient $PM_{2.5}$ vs. Time for 2016 and 1017. You are comparing data in this graph, not determining if there is a relationship between the two variables, so use a straight edge to connect the points on each line. Be sure your graph has all of the properties of a properly constructed graph.



Explain:

Use the information from the Background materials and graphs 1 and 2 to completely and concisely answer the following questions.

3. Does the Rice Ridge ER visit data fall into the category of Population health? Why or why not?

4. Is there something specific about the Seeley Lake valley that caused thick smoke to settle there for 50 consecutive days? Explain.

5. What about the size of a $PM_{2.5}$ particle makes the particle more hazardous to inhale?

6. Describe the relationship between the data in graphs 1 and 2. What could you say about correlation vs causation in this example?

7. Do you think the residents of the Seeley Lake area had any remaining symptoms or effects from the Rice Ridge fire when the fire stopped burning on 9/18/2017? Why or why not?

8. How does the ER visit data and the $PM_{2.5}$ data relate to Population Health?

9. What is the difference in $PM_{2.5}$ concentrations between indoor air and outdoor air? How can someone decrease $PM_{2.5}$ concentration in indoor air?

Teacher Comments: