

**Student Handout 4**  
**Earthquakes and Gas Wells: Correlation vs. Causation**  
**Webquest**  
**Research Results**

**Directions:** Use the following outline to record data from your research.

**1. Natural Gas Wells and Earthquake Frequency---State data**

A. Trend in number of Natural Gas wells from 1990 to 2012.

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B. Periods of sharp increase in Natural Gas wells in Arkansas.

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C. Number of 3.0 earthquakes per even year

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2011	2012
No. of Earthquakes													

D. Compare earthquake data/ number of gas wells.

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E. Correlation?

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F. County with largest number of earthquakes? \_\_\_\_\_

G. Causation?

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**2. Natural Gas Wells and Earthquake Frequency---County data**

A. Compare the number of wells by county and the Earthquake Epicenter Map

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B. Number of wells and the number of earthquakes on a county by county basis?

County	Number of Wells	Earthquake Frequency
Van Buren		
White		
Conway		
Cleburne		
Faulkner		
Independence		

C. Correlation? \_\_\_\_\_  
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**3. Injection wells in Fayetteville Shale Play and South West Arkansas Oil Fields**

A.

County (Fayetteville Play)	Number of Injection Wells
Van Buren	
White	
Conway	
Cleburne	
Faulkner	
Independence	

County (South West oil fields)	Number of Injection Wells
Lafayette	
Columbia	
Union	

B. Magnitude 3 or greater earthquakes (from 2002 to 2011) in counties with injection wells.

County (Fayetteville Play)	Number of 3.0 or greater earthquakes
Van Buren	
White	
Conway	
Cleburne	
Faulkner	
Independence	

County (South West oil fields)	Number of 3.0 or greater earthquakes
Lafayette	
Columbia	
Union	

C. Have all counties with injection wells had the same number of earthquakes? \_\_\_\_\_

D. Correlation?

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**4. Earthquakes and Fault lines in the Fayetteville Shale Play**

A. Number of injection wells in permanent disposal well moratorium area \_\_\_\_\_

B. Injection wells closest to the concentration of earthquake activity

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C. Yellow circles on "Three Centuries of Earthquakes in Arkansas" map represent \_\_\_\_\_

D. Fayetteville Shale Play county containing yellow circles: \_\_\_\_\_

E. Record the number of 4.0-4.9 earthquakes by year:

Year	Number of 4.0-4.9 Earthquakes
1982	
2001	
2010	
2011	

F. Age of faults found in the Fayetteville Shale Play:

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G. Correlation between injection wells and earthquakes?

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H. Correlation between faults and earthquakes?

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I. Causation for the increase in earthquakes in the Fayetteville Shale Play?

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J. What was the Enola Swarm and when did it occur?

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K. Correlation between the Enola Swarm and Natural Gas Wells?

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L. Enola Swarm and causation of earthquakes in Faulkner County?

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**5. Conclusion:**

The data you have examined show several correlations. These correlations do not necessarily indicate causation. After examining the data, what is the most likely cause of the increased number of earthquakes in the Fayetteville Shale Play during 2011? Support your claim with evidence. Be prepared to share your conclusions with the class.