Name _____   Date _____

Turbidity & Hydrofracking

1) Go to www.fractracker.org.
   a. Highlight the link at the top to "All Articles & Maps"; then "By Location", then go to "State-by-State".
   b. Click on the state you are interested in learning more about. Describe what you learn about fracking in this state:
   Answers will vary. In New York, there is a ban on high-volume hydraulic fracturing.

2) Now, go back to the "State-by-State" landing page and click on Pennyslvannia. Click on the top picture which takes you to the PA Shale Viewer. You'll have to click on this one more time to explore PA and the layers available.
   a) You can get details about all of the information in the legend by clicking on the "i" for information at the top left hand side of the screen. Using this information, answer the following:
      i) How many wells does the map estimate are in PA? *There are aprox 9,900 wells in PA.*
      ii) How many violations are there in the state?   *There are 6,855 violations.*
      iii) Where are most of the wells located?
            Most of the wells are located outside of Pittsburgh and northwest of Scranton.

3) Now, zoom in on a location in PA until the wells, permits, and violations are smaller colored dots (the scale at the bottom left should read 0-4 miles; if it doesn't, keep zooming in). List two-three of the towns that you see in your new, zoomed-in view:
   Answers will vary.

4) The streams and rivers on this map are light and black grey. Based on what you see, does PA seem to have regulations about whether wells need to be located away from waterways? Why or why not?
   Wells are often drilled right next to streams and rivers.

5) Based on what you have learned about turbidity, what do you think this information suggests about streams and turbidity levels in Pennsylvannia?

The impact on streams is likely high because of the number of wells in and around streams and rivers.

6) Use the data table below to answer the questions that follow.

| Shale	State	Total Wells	Average distance to a waterway (m)	% of wells within 100m of waterway	% of wells within 200m of waterway	% of wells within 300m of waterway
Marcellus	PA	2091	319	4	28	55
Marcellus	WV	1599	214	26	50	75
Marcellus	OH	42	230	19	55	79
Marcellus	NY	26	247	35	46	54
Fayetteville	AR	2834	353	10	32	51

* Note: data are through 2010

** Data are from Entrekin et al, 2011

a. Which state has the most wells? *Arkansas*
b. In which state are the wells the closest to a waterway? *West Virginia*
c. Which state has the highest percentage of wells within 300m of a waterway? *Ohio.*

7) Look at the graphs below. Graph A is the same graph you saw in the first lesson, while Graph B shows averaged data and error bars for the active and inactive sampling sites:
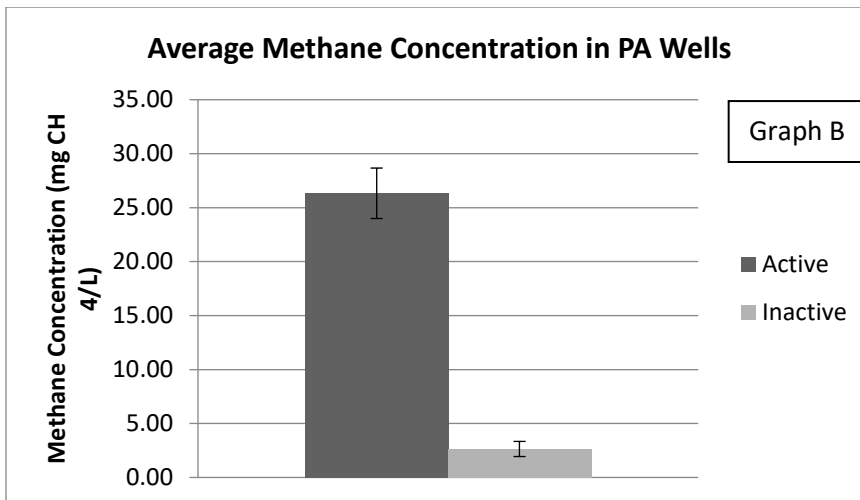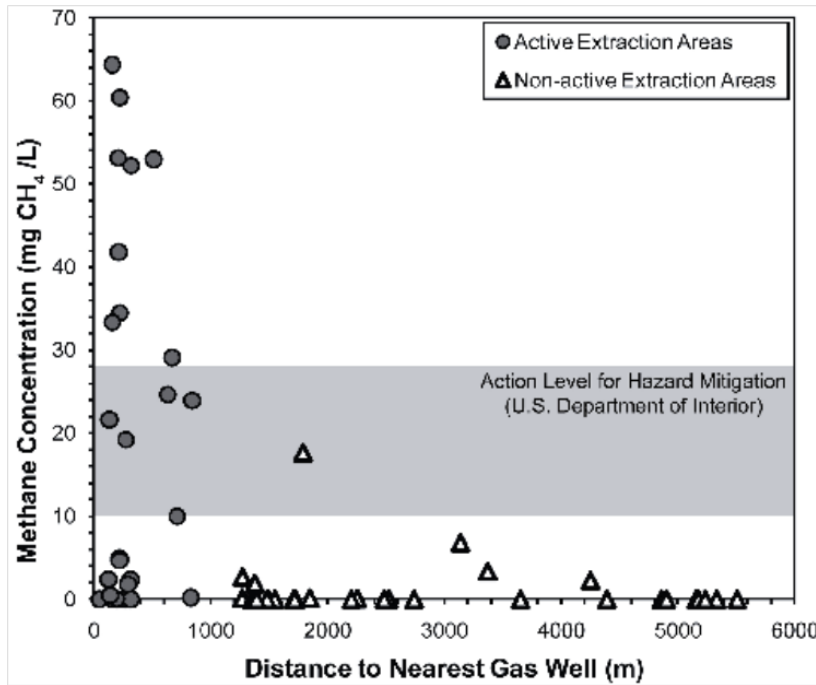
a. Explain the trend you notice in the methane concentration.
   There is more methane near the active wells.

b. Which graph do you think more clearly shows the trend? Explain.
   Graph B more clearly shows this trend, because it gives an overall average of the two types of sampling sites.

c.   Complete this chart:

Benefits of the scatterplot (Graph A):	Benefits of the bar graph w/ error bars (Graph B):
Allows you to see all of the data points and shows all of the variability.	More clearly shows a trend and also shows you the range around the mean for each data set.
Drawbacks of the scatterplot (Graph A):	Drawbacks of the bar graph w/ error bars (Graph B):
It is harder to see a trend over time because of all the data points.	You can't see all of the data points.

d.   Based on the information you have and what you've learned in this module, make a scientific argument (claim, evidence, reasoning) about whether hydrofracking causes ecological harm.

Claim: Fracking is common near waterways which increases turbidity and can negatively impact aquatic ecosystems.

Evidence: In all five states sampled by Entrekin et al (2011), more than 50% of wells were within 300m of a waterway. Streams that were near waterways had higher levels of turbidity. High turbidity levels, above 200NTUs caused 80% of our organisms to die within three days.

Reasoning: High turbidity is caused by runoff from construction near the wells. Turbidity causes organisms to die because it reduces their food source and affects their ability to breathe and find food.

6. Finally, what else would you like to know in order to make your scientific argument in 5c, above, stronger? Explain.

Answers may vary, but students should be interested in getting additional turbidity data from streams that are near hydrofracking wells. They should also want to investigate how turbidity affects different kinds of organisms and over what time period.