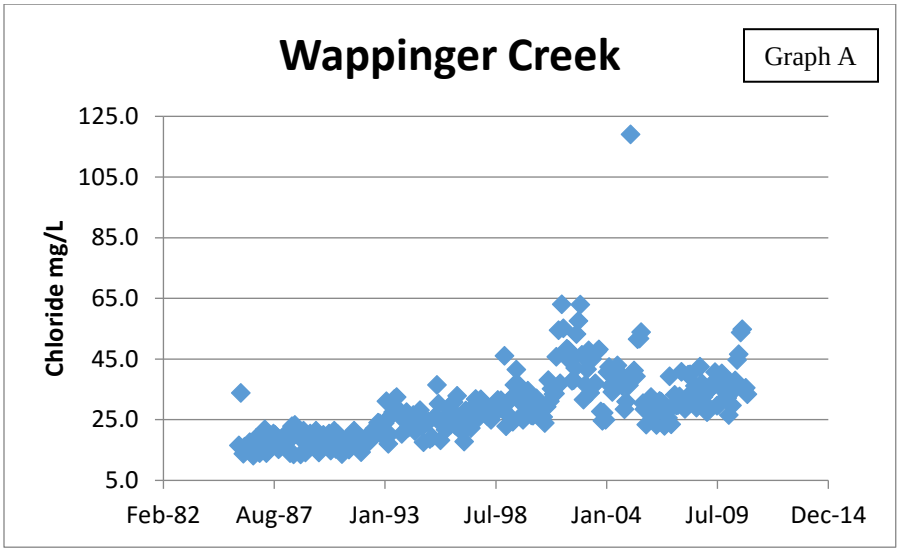
Name _____ Student ID _____ Date _____

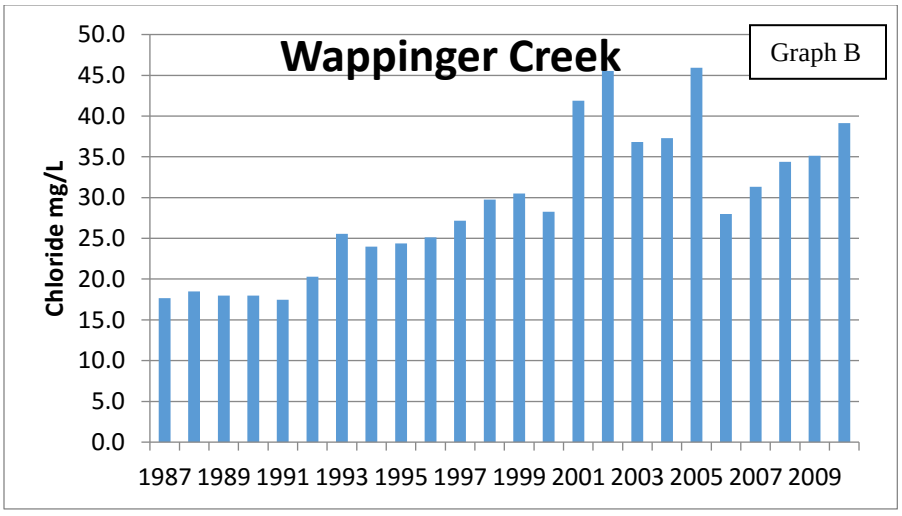
Salt Pollution & Land Use

1. Explain how pollutants get from the surface of the ground into the water underground.
   Pollutants move with the water from the surface into streams and rivers. Water also seeps into the ground, unless the ground is impermeable. The water that seeps into the ground can contain pollutants.

2. If current practices continue, what do you think will happen to the concentration of salt in groundwater and surrounding streams? Why?
   The concentration of salt will probably go up. We put salt on our roads every year, and that salt doesn't evaporate or get used by plants, so it stays in the water.

3. Use the graphs to answer the questions that follow. Both of the graphs show the same data; in Graph B, all of the data for each year (one sample per month) have been averaged together.





a. Explain the trend you see in chloride concentrations in the Wappinger stream.

There is a trend of increasing chloride.

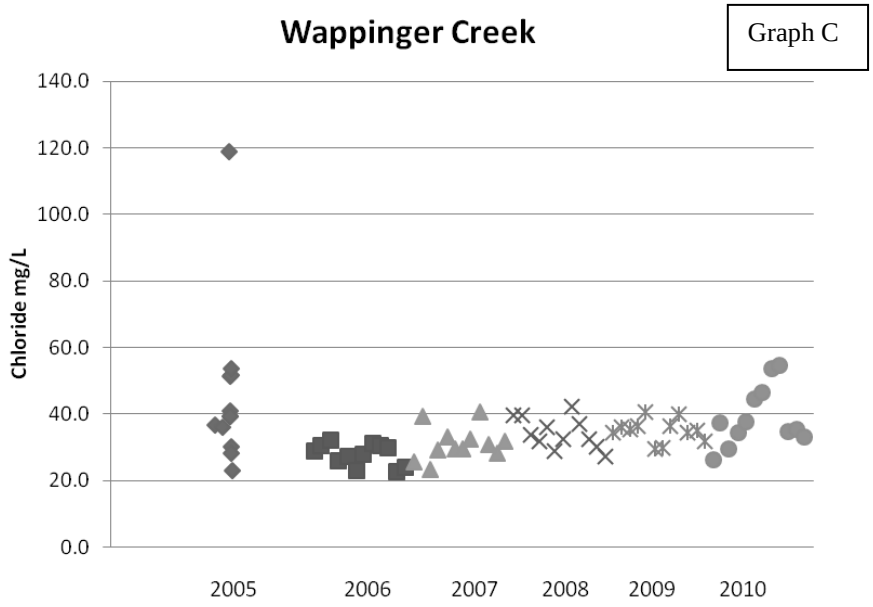
b. Which graph do you think more clearly shows the trend? Explain.

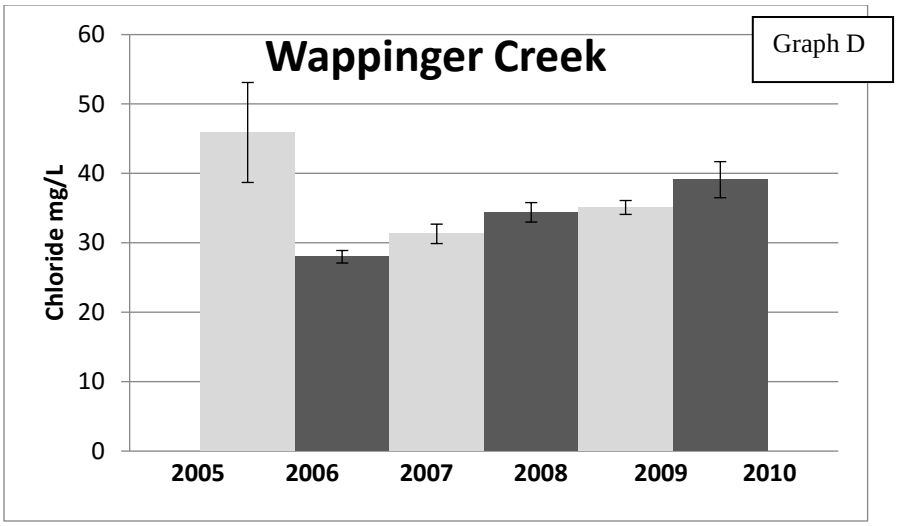
Graph B more clearly shows this trend, it is easier to read than Graph A because it doesn't have all of the data points. Instead, it shows an annual average.

c. Complete the chart below for Graphs A & B:

Benefits of the scatterplot: (Graph A)	Benefits of the bar graph: (Graph B)
Allows you to see all of the data points – shows the variability.	*More clearly shows a trend because all the data are averaged.*
Drawbacks of the scatterplot:	Drawbacks of the bar graph:
It is harder to see a trend over time. It is very busy.	*You can't see the range of samples each year.*

4. Use the graphs to answer the questions that follow. Both of the graphs show the same data. In Graph D, all of the data for each year have been averaged together. The error bars show you how much of a difference there is between the average of each year and the range of the data (standard deviation). The larger the error bar, the larger the standard deviation of the data in that year – so, because of the outlier in 2005, the spread of the data are larger and the error bar is larger.





a. Explain the trend you notice in the Wappinger Creek from 2005-2010.

There doesn't seem to be much of a trend; however if you look at Graph D it looks like the chloride levels are increasing, at least starting in 2006.

b. Which graph do you think more clearly shows the trend? Explain.

Graph D shows more of a trend (after2006).

c. Complete this chart for Graphs C and D:

Benefits of the scatterplot (Graph C):	Benefits of the bar graph w/ error bars (Graph D):
You can see all of the different points each year.	*You can see the average but also the range.*
Drawbacks of the scatterplot (Graph C):	Drawbacks of the bar graph w/ error bars (Graph D):
You don't know what the average for each year is.	*You can't see the individual data points.*

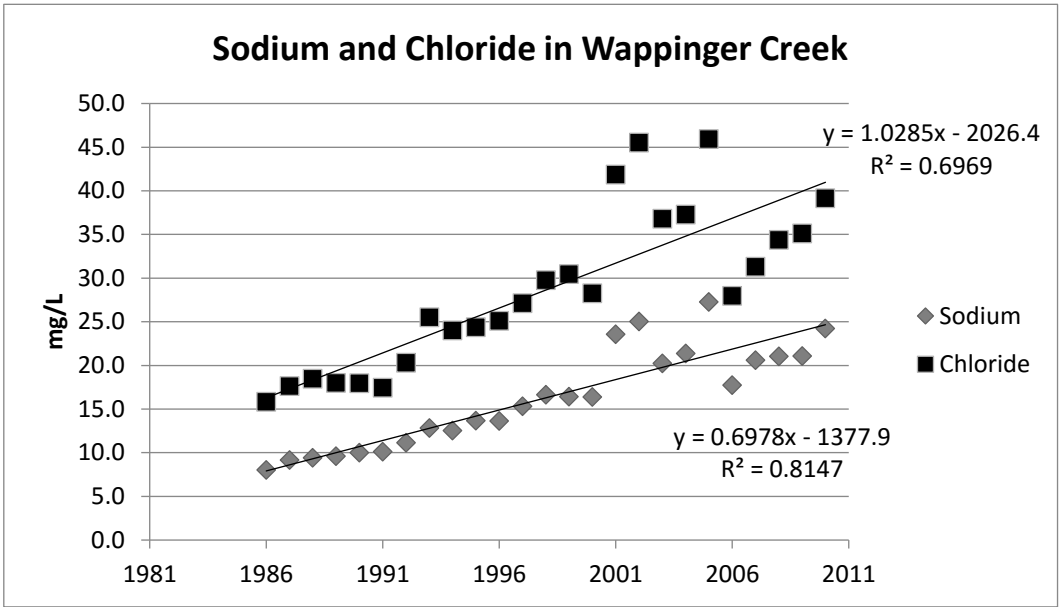
b. Which graph – A, B, C, or D, most clearly supports this claim:

Chloride levels are increasing in the Wappinger Creek.

Circle one: A (B) C D

Explain your answer: *Graph B is the easiest to see a trend over time, because it shows yearly averaged data.*

4. Look at the graph below. This graph shows the trend in sodium and chloride in the Wappinger Creek since 1985.



a. Based on this graph, what has happened to the concentrations of sodium and chloride in the Wappinger Creek since 1985?
Both the sodium and chloride levels have increased since 1985.

b. Look at the two line equations for sodium and chloride. Based on these equations, is sodium or chloride increasing more rapidly in the stream? *Chloride.*
c. Explain how you got your answer. *The slope of the chloride equation is higher, which means that it is increasing more rapidly.*
d. Each line has an "R^2" value associated with it. This r value is the amount of variation in your data set that is explained by fitting the line, so that you know your relationship is actually valid – in other words, if you have a data set where almost all of the points fall along the line (are "explained" by the line), your r-squared value will be very high. Based on the information in the graph, which variable (sodium or chloride), is better described by the line? *Sodium is better described by the linear regression line because the r^2 value is higher.*

e. Based on what you know about these data, explain how confident you are in the trend you explained in part (a). *I am somewhat comfortable with the trend for chloride, and more comfortable with the trend for sodium since the R2 value is higher.*

5. Finally, look at the chart below that shows the amount of impervious surface in several watersheds around the Hudson River valley. Use this information, plus what you have learned in this unit (especially about your own watershed), to complete the claims-evidence-reasoning boxes that follow. The chloride data are yearly averages from the

sites; please note that the East Branch of the Delaware River does not have the same date range as the other sites due to lack of sampling in that period of time, and thus is not included in this chart.

Watershed	**% impervious**	**Chloride changes**	**% increase in Chloride from 1993-2004**
East Branch of the Wappinger Creek	9 %	1993: 25.5mg/L 2004: 37.3 mg/L	146%
Sawkill Creek	14 %	1993: 25.8 mg/L 2004: 39.6 mg/L	153%
Sparkill Creek	50 %	1993: 81 mg/L 2004: 95.7 mg/L	118%
Esopus Creek	7 %	1993: 5.4 mg/L 2004: 5.5 mg/L	2%

Claim: Make a claim about why you think the chloride levels are changing	*Chloride levels are increasing in all watersheds.*
Evidence: Provide evidence to support your claim	*The chloride levels are increasing in all locations, with the Esopus Creek watershed having the smallest increase between 1993-2004. The Esopus also has the smallest amount of impervious surface.*
Reasoning: Explain how your evidence supports your claim	*If there is more development, there are more impervious surfaces. While some of these surfaces will be buildings, some will be roads, sidewalks, and parking lots. All of these surfaces are treated with salt in the winter, which means that we have more salt pollution in watersheds with more impervious surfaces.*

6. What else would you like to know in order to feel more confident in your claim?
   I would like to know the change over time in the % of impervious surfaces. This would help me understand whether the change in chloride concentration is changing at the same rate as the change in impervious surface. I would also like to know more about how these data are collected.

7. How can you remove salt from water? Explain:
   You can't remove salt from water except for expensive reverse osmosis systems.

8. Consider what your answer to #8 means for the streams, rivers, and other aquatic ecosystems around the world. Is it actually possible to remove the current salt pollution

from our ecosystems? Why or why not? What are the consequences of this for local ecosystems?
No, we cannot remove the salt pollution problem. This could cause severe problems for freshwater organisms that cannot tolerate salty water.

9. Based on what you have learned about salt pollution, do you think we should try and reduce our use of salt on our roads? Why or why not?
Answers will vary.