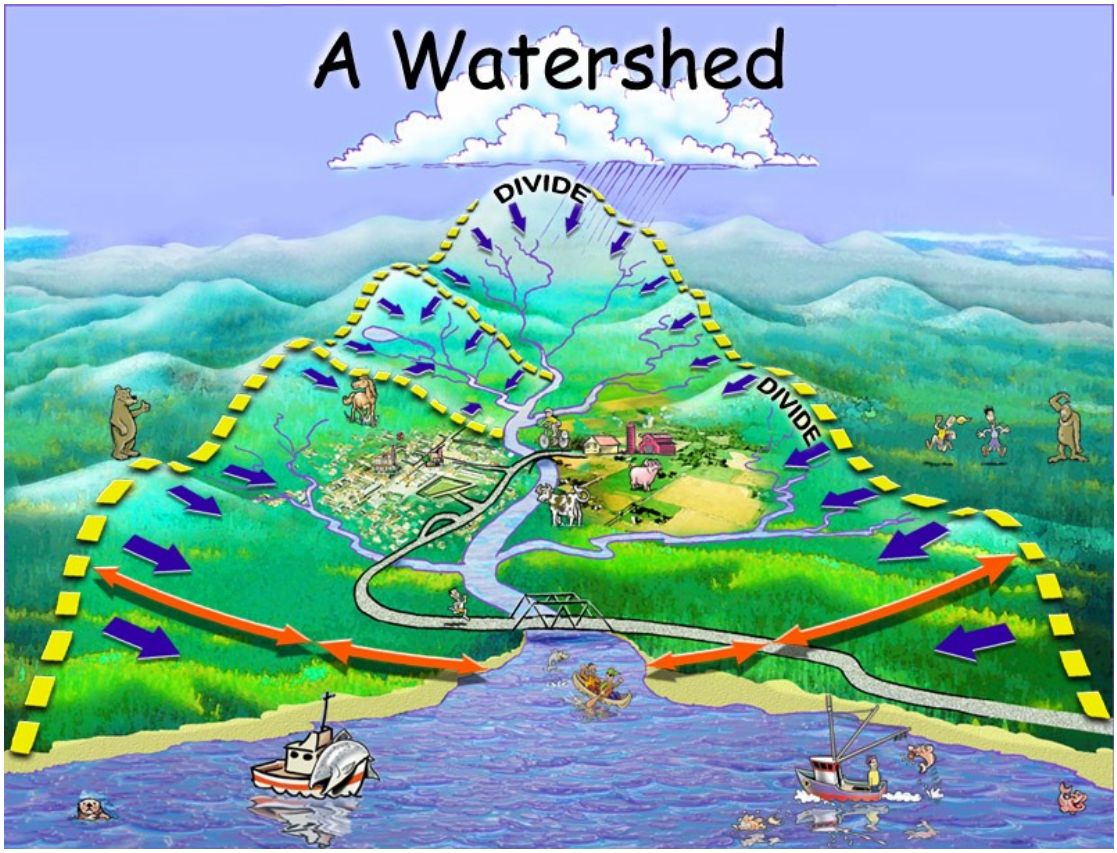
Student Journal Activity 1 Hudson River Watershed

Download the map of the Hudson River Watershed at http://www.dec.ny.gov/education/63069.html and paste it below**.**

1. Use the map of the Hudson River Watershed to refer to place names for this question. As you followed the Hudson River on Google Earth, describe the features that you noticed – wooded areas, farm areas, cities, etc. Include changes in the River that you noticed – where it seems straight and narrow, where it bends and curves. How many bridges can you find crossing the Hudson River?

2. Examine the human activities depicted in the watershed diagram below. List and describe each activity. How might each of those activities affect the water quality of the river and ocean?



Source: http://www.recycleworks.org/images/watershed_800.jpg

3. Based on your experience, what other human activities might be added to the diagram? Describe how each of them might influence water quality, either positively or negatively.

4. Use the Hudson River Watershed map to locate the city of Troy. Draw a

line running across the Hudson River at that point. The line represents the Troy dam (officially named the Federal Dam). This dam is considered the dividing line between the upper and lower portions of the Hudson River. From your viewing of the slide show, describe why this dam is considered important.

Student Journal Activity 3 Cascade Brook - Water Temperature

1. How do you think Cascade Brook water temperature will change during one year? In the space below, sketch the way you think the graph will look. Use months as the labels on the x-axis and degrees on the y-axis (either Celsius or Fahrenheit are fine for this right now).

2. What factors might affect water temperature throughout the year? Describe them here:

3. Return to the Student Guide now to find and follow the steps for using the Graphing Tool to construct the water temperature graph for 2009, based on actual data. Look at the overall shape of the graph and compare it to the graph you sketched above. Use the space below to describe the differences and similarities you notice between your predicted graph and the actual graph:

4. Use the instructions in the Student Guide to practice getting detailed information from the graph. In the space below, record the extremes of temperature (maximum and minimum) in Cascade Brook during 2009 and when they occurred.

5. The Student Guide gives instructions for downloading your Cascade Brook Water Temperature graph into the space below:

D. Which organisms can live in Cascade Brook?

6.Based on the class discussion, enter the list of organisms that can live in Cascade Brook in the space below:

E. Air temperature graph

7. Draw your ideas for a graph of **air** temperature for 2009 in the space below:

8. Now return to the Student Guide and use the Graphing Tool to construct the actual graph of air temperature, based on collected data.

9. How does the actual graph compare with your predicted graph? How are they similar or different from each other?

x

10. Move the cursor along the air temperature graph to get information on the extremes (maximum and minimum) of air temperatures. When do they occur and what are the actual degree measurements at those spots?

F. Compare air temperature and water temperature graphs

11. Download the air temperature graph into the space below. Copy and paste the water temperature graph directly below it so that the vertical axes line up directly above each other. That will help you answer the questions below.

12. Notice the y-axis on both graphs. What differences do you see? Why do you think the temperature ranges in air and water are different?

13. What other differences do you notice in the graphs? What do you think might explain the differences you've noticed?

14. Do you think the stream ever froze during 2009? What makes you think so?

15. Are there times when you think some other factor besides air temperature affected the water temperature? When did those occur? What do you think might have caused the effect you see?

Student Journal Activity 4 pH: Acidity and Aquatic Environments

A. Introduction to pH and the pH scale

1. For an animal living in pH 7 water, how much more acidic is pH 5 water?

B. pH in the Environment

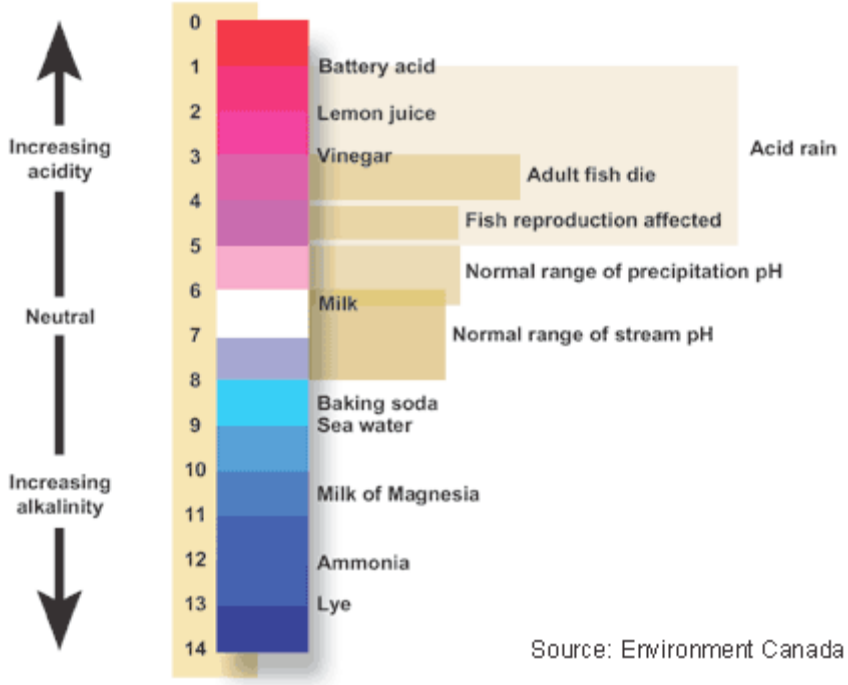
2. What are two natural factors that could affect the pH of a stream?

3. What are two examples of human activities that can change the pH of a stream?

C. Acid Rain

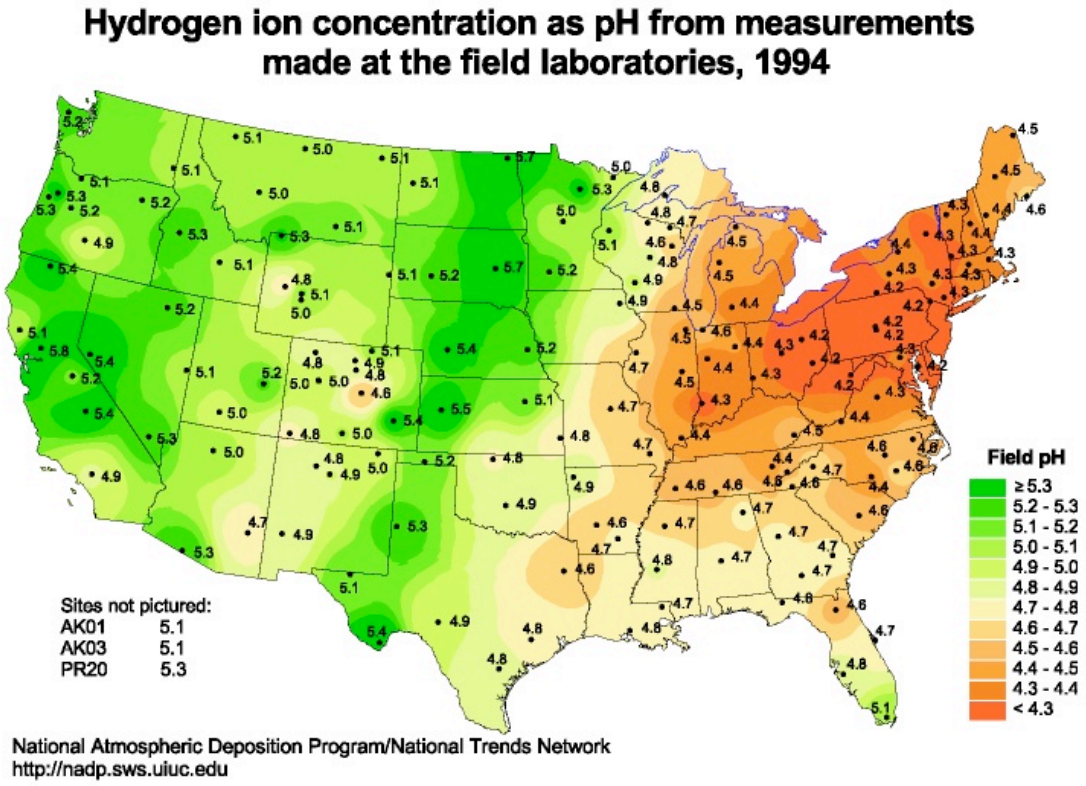
4. What is the pH range of normal precipitation (rain and snow not affected by acid rain)?

5. According to the diagram below, what is the approximate pH of a normal stream – a stream not affected by acid rain?



6. What is the pH range of Acid Rain, as shown in the above diagram?

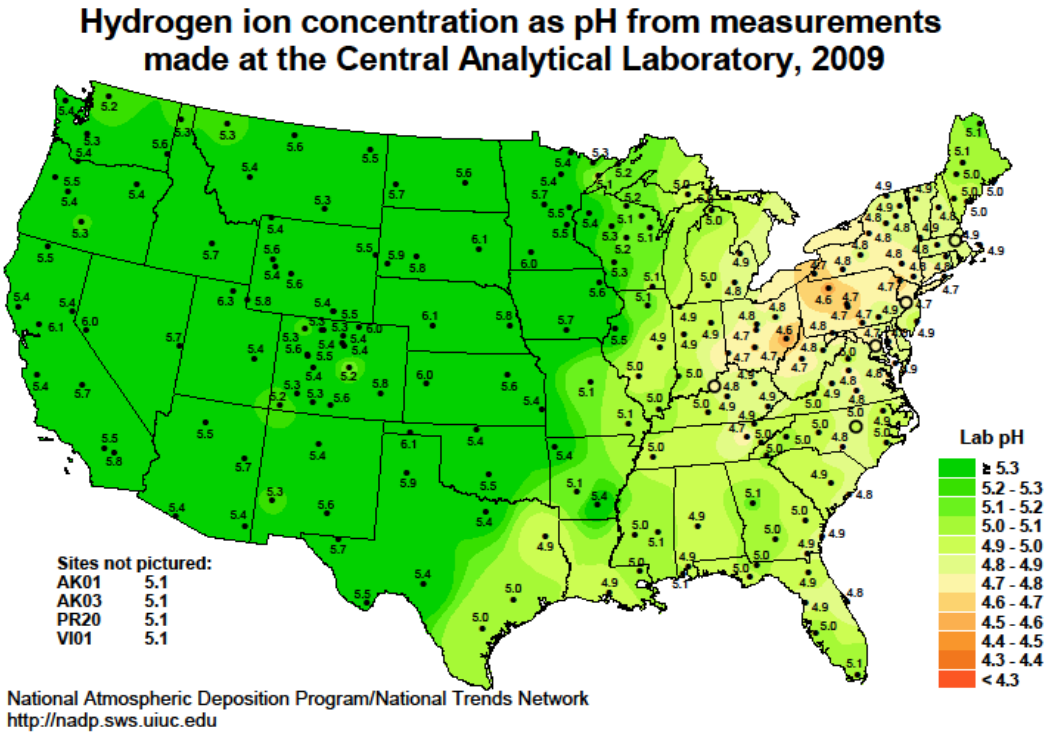
Below is a map that shows the pH of rain samples from across the continental US in 1994.



7. What do you notice about the differences in the pH of rainfall across the country in 1994? Which part of the country had rainfall with the lowest pH?

8. What was the average pH of rainfall in New York in 1994?

Fortunately several laws passed a few years earlier started taking effect. The laws required power plants to reduce their emissions of sulfates and nitrous oxides, both of which contributed to acid rain. Compare the 1994 map above with a similar map produced in 2009, seen below.



9. How has the picture changed in 16 years?

10. What was the pH of rain falling in New York in 2009?

11. Compare this figure with the level defined as acid rain on the diagram you looked a at earlier. Would you say that the acid rain problem in New York was over in 2009, or was New York still experiencing acid rain?

D. What else can be done?

12. What are 3 things families can do to help reduce acid rain?

13. What is something you are willing and able to do right now?

E. Acid rain in Cascade Brook?

Examine the Cascade Brook graph of pH for Jan 2, 2009 – Dec 31, 2010 and consider the following questions:

[Place graph here]

14. Remember that a normal stream or brook has a pH of between 6 and 8. In general, how does the pH in Cascade Brook compare with that of a normal brook?

15. Did the pH in Cascade Brook ever fall within the pH range for acid rain, as indicated on the chart above? On what dates did this happen?

16. Notice that on some of these dates the graph shows sharp downward spikes. What are some possible causes of these abrupt low pH events?

Read the Instructions in the Student Guide about constructing the pH and rainfall graphs for Oct 24 - Nov 3, 2009. Download them into your Journal, compare the graphs and answer the question below:

17. What do you observe about the timing of rainfall with the pH changes on October 29th? What's a possible explanation?

The Student Guide asks you to examine another time period, August 15 – 24, 2009, which also contains a downward spike in pH. Construct the pH and rainfall graphs for this period, download them into your Journal, compare them and consider the following question:

18. Is there any correspondence between the drop in pH and rainfall on August 20, 2009?

F. Aquatic animals and pH

How does the changing pH in Cascade Brook affect aquatic animals in general and <u>your</u> selected animal in particular? Look at the chart of pH requirements in the Student Guide and then compare your animal's pH requirements with the 2009 pH graph you made earlier.

19. Was the pH at Cascade Brook ever outside the optimum range for your organism? When?

20. Would your study organism have experienced pH stress at any times during this period? Indicate those times on the graph using a red pencil or pen. What might it have done to try to minimize the effects of stress?

21. Compare your animal with someone else's. Would their animal survive or experience stress?

Student Journal Activity 5 Introduction to Dissolved Oxygen

1. What is oxygen? Why is it important to living organisms? (What biological process do organisms use it for?)

2. Where does oxygen in the atmosphere come from?

3. Do plants ever use oxygen? Explain.

4. Where do fish and aquatic animals that don't breathe at the surface get the oxygen they need to live?

5. Why is there less oxygen available to organisms living underwater than to organisms living on land?

6. What are some actions or processes that might put more dissolved oxygen into the water?

7. What are some actions or processes that might lower the amount of dissolved oxygen in the water?

Student Journal Activity 6 DO in Cascade Brook

In the space below, paste the graph of DO in Cascade Brook during 7-14 days selected sometime during the summer (May to mid-September).

Write a report describing your investigation of **What Factors Influence DO in Cascade Brook?** and what you found out. Include the following topics in your report:

Procedure
What steps did you take to carry out your investigation? (Your procedure might not be the same as someone else's.)

Results
What factor or factors seem to influence dissolved oxygen in Cascade Brook, and in what way? What evidence did you find for these conclusions (include any graphs that support your conclusions here.)

Discussion
Where there any other things you noticed as you investigated the graphs? Did you run into any problems—such as evidence that wasn't consistent? Is there any other information about Cascade Brook that would have been useful to have?

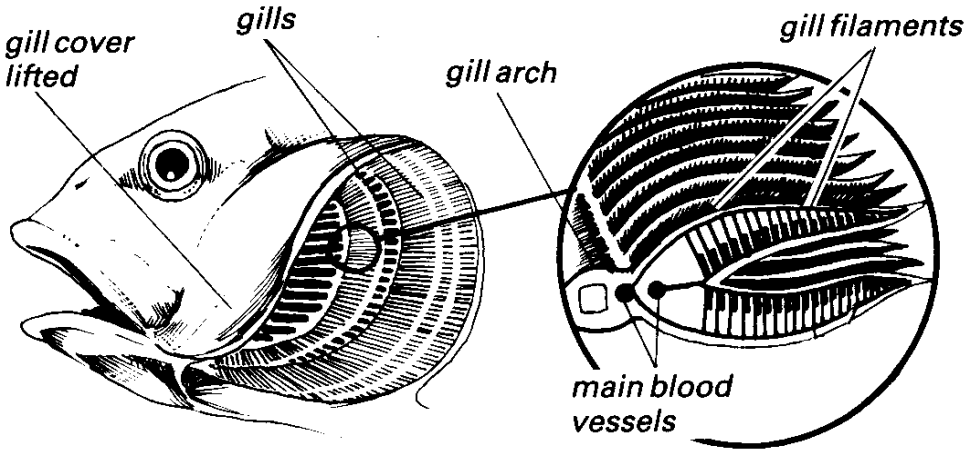
Student Journal Activity 7 Dissolved Oxygen and Aquatic Animals

1. The first picture at http://www.cals.ncsu.edu/course/ent425/tutorial/aquatic.html is of a mayfly larva. Notice how much of its body is covered with gills! Mayfly larvae can only live in streams with water constantly flowing past them. Why do you think they're not able to live in places without flowing water?

2. The second picture is of a mosquito larva. It has gills too, but it also has something the mayfly larva doesn't have. What is it, and how does it help the mosquito larva live in places with low DO?

3. 3The third picture shows two diving beetles. Notice that the beetles have something attached to the backs of their wing covers. What is it and how do they use it? Do you think these diving beetles are affected by low DO? Explain.

4. The last picture shows bloodworms, a kind of aquatic worm that lives in mud with extremely low DO. Unlike most other invertebrates they have blood with hemoglobin. Hemoglobin is what makes our own blood red. In our bodies it is hemoglobin that binds quickly with oxygen in our lungs and stores it in the bloodstream. How do you think hemoglobin helps a bloodworm live where oxygen is scarce?



The gills of a fish.

5. How do you think the delicate, featherlike structure of gills helps the fish get

large quantities of oxygen from the water?

6. Why do fish either need to swim constantly or gulp water continuously?

Use the Graphing Tool to make a graph showing DO for the full year (2009) and use it to answer the following:

7. Approximately, what is the lowest DO level recorded in Cascade Brook?

8. In which months of the year is DO close to that level?

Examine this chart and answer the questions below it.

Aquatic Organisms	DO Needed (mg/L)
Macroinvertebrates	
Stonefly larva	5.0
Mayfly larva	5.0
Caddisfly larva	5.0
Hellgrammite	5.0
Dragonfly larva	3.0
Scud (amphipod)	3.0
Whirligig beetle	3.0
Water boatman	3.0
Mosquito larva	1.0
Leech	1.0
Aquatic Worm	1.0
Vertebrates	
Brook Trout	7.0 (needed for spawning)
Black Nose Dace	6.0
Creek Chub	6.0
Northern Two-lined Salamander	5.0

9. Which animals on the chart would be unable to live in Cascade Brook or would be
living under stress because DO is too low for their needs?

10. Which animals would probably be able to survive even lower DO levels?

Student Journal Activity 8 Hudson River Estuary – Salinity and Tides

Before starting the Animation, answer the questions below:

1. Describe the areas of highest salinity (26 – 30) on the satellite photo. You can refer to any place names you know or use place names from the blue map in your **Guide.**

2. Where are the areas of lowest salinity (15 – 18)?

3. Compare the surface salinities of the Atlantic Ocean and the small part of Long Island Sound visible on the satellite image. What are some possible reasons for any differences you notice?

Return to the Student Guide and follow the instructions for starting the animation.

4. Describe the changes in surface salinity you saw in the Hudson River.

5. Describe the changes in surface salinity you saw in the East River (on the opposite side of Manhattan).

Return to the Student Guide to now observe a different parameter – Bottom Salinity.

Observations of Bottom Salinity

6. **Before starting the animation**, describe the bottom salinity of the Atlantic Ocean near New York Harbor. Compare your results with the answer to #3 above.

7. **Before starting the animation**, describe the bottom salinity of Long Island Sound where it enters NYC. Compare your results with the answer to #3 above.

Now start the Animation and observe it for several minutes and record your observations in **8 -12** below:

8. Describe the bottom salinity changes you observe in NY Harbor

9. How do those changes compare with the surface salinities you examined earlier?

10. Focus on the Hudson River and describe the changes in bottom salinity you see.

11. How do those changes compare with the **surface** salinity changes in the Hudson River that you observed earlier?

12. How would you explain the differences you observed between surface salinity and bottom salinity in both places?

Student Journal Activity 9 Hudson River Fish Life Cycles and Habitat

Use the **Resources** in the Student Guide to research **one** of the fish on the list below. Your teacher will help you choose a fish. Focus your research on the fish's requirements at each life stage – does it need fresh river water, salty Atlantic Ocean water or the brackish (mixed fresh and salt) waters of the Estuary? Use the Salinity Chart in the Student Guide to enter the specific ranges for each life stage.

American eel
American shad
Atlantic sturgeon
Blueback herring
Bluefish
Carp
Channel catfish
Mummichog
Shortnose sturgeon
Spottail shiner
Striped bass
White catfish
Yellow perch

Record the information below:

1. Name of Fish.

2. Web address of photograph/illustration of your fish (for use in class presentation).

3. Where does it spawn (releases eggs and sperm)? In the river, estuary or ocean? Include range of salinity.

4. Where is the juvenile fish found? River, estuary or ocean? Include range of salinity.

5. Where is the adult fish found? River, estuary or ocean? Include range of salinity.

6. Is your fish anadromous (spends most of its life in the ocean and moves to fresh water to reproduce) – or catadromous (spends most of its life in fresh water and moves to the ocean to reproduce)? Or neither? If neither, describe where it spends most of its life.

7. With your classmates, construct a large wall chart of **Hudson River Fish and Life Cycle Habitats** that contains the above information for all thirteen fish.

8. After you've made and examined the 2009 Hudson River Salinity Graph for the period July 17-24, 2009, download it into this Journal. Use the graph and the chart your class has developed to decide which fish might be found near this site, on the basis only of salinity. Write the names of those fish and their appropriate life cycle stages below the graph.

Student Journal Activity 10 DO – How Low Will it Go?

A. Interactive Map of Eutrophication

Questions 1 to 8 are based on the Interactive Map of Eutrophication.
http://www.wri.org/project/eutrophication/map

Hudson River

1. The Hudson River been labeled as improved on this map. What change led to an improvement in water quality in the Hudson River?

2. Does the Hudson River still have a problem with eutrophication? Explain.

The Narrows

3. Water moves back and forth through the Narrows, as you saw in the tidal animation. In places like this, algae and plants often get washed away before they have time to cause problems. Yet water in the Narrows gets hypoxic every summer. What source of organic material is making this water hypoxic?

Harlem River

4. What two rivers does the Harlem River connect with?

5. What classification was the Harlem River given in the Interactive?

To answer the next question, close the information frame and move the map slightly so you can see the very large bay to the east, Long Island Sound. (On the map it's to your right.) Long Island Sound is very often hypoxic and sometimes even anoxic (DO level of zero, or a level so low that no life form requiring oxygen can survive).

6. Do you think the Harlem River is ever affected by water conditions in Long Island Sound? Explain your reasoning.

East River

7. When did the East River first start having very DO levels?

8. The East River was once very polluted. How is it classified now? How did this change occur?

B. Hudson River DO Graph

Use the Graphing Tool to construct a graph of DO at the Hudson River site for the period 2009-06-01 to 2009-12-31. Answer questions 9 and 10 by examining the graph.

9. Did DO at the Hudson River site ever drop below 3 mg/L? (You'll probably need to run the cursor over the graph, looking at the numbers that appear in the small box above it). Did DO at this site ever drop below 4mg/L?

10. What was the lowest DO level recorded at the Hudson River site and what date was it recorded on?

Now make a graph of Cascade Brook DO using the same dates as above, 2009-06-01 to 2009-12-31. Then answer questions 11 and 12 by examining the graph.

11. Did DO at Cascade Brook ever drop below 4 mg/L?

12. What was the lowest DO level recorded at Cascade Brook, and what date was it recorded on?

Paste your graphs of Hudson River DO and Cascade Brook DO here:

Answer questions 13 and 14 by comparing the two graphs above.

13. Look at the overall patterns you see on the DO graphs of Hudson River and Cascade Brook. What similarities and what differences do you notice between them?

14. Based on those observations, what are some factors (besides eutrophication in the Hudson River) that you think might also be influencing DO at that site?

Student Journal Activity 11 Harlem River – Student Monitoring and Data

C. View Harlem River Salinity Animation

1. Before you start the Animation, compare the surface salinity of the Harlem River with surface salinity of the Hudson River, on the other side of Manhattan. What do you notice?

Now start the Animation and watch for a while.

2. Which river seems to have a higher surface salinity?

3. Now switch to bottom salinity. Does this change your answer to the last question?

4. What's a possible explanation for the differences in salinity between the Harlem River and the Hudson River?

Now watch the movement of salt water as it moves back and forth in both the Hudson River and the Harlem River.

5. Does ocean water flow into the Harlem River and the Hudson River at the same time?

6. What do you think is happening to water in the Harlem River when salt water moves up into the Hudson River?

7. Do you think that water in the Harlem River always flows in the same direction? Explain your reasoning.

RETURN TO THE STUDENT GUIDE

D. Do other parameters in the Harlem River change along with salinity?

Paste your graphs here:

HARLEM RIVER WATER

When the Harlem River receives water from the ocean, its waters will have a			
higher	Salinity	Range (psu)	17-19
	Temperature	Range (°C)	
	DO	Range (mg/L)	

When the Harlem River receives water from the Hudson River, its waters will have a			
lower	Salinity	Range (psu)	
	Temperature	Range (°C)	
	DO	Range (mg/L)	

Look at these results, think about the questions below and then record your response:

8. Did these results surprise you? (Did you see anything that seems inconsistent with what you have seen in other sites?) If so, explain your thinking.

   If these results didn't surprise you, why do they make sense to you? Explain why you think these results are reasonable to expect.

E. Hypoxia in Harlem River?

Paste your graph(s) here:

9. On what dates—or range of dates— was water in the Harlem River hypoxic?

10. What's a likely reason the Harlem River has problems with low DO levels?

Student Journal Activity 12 Students' Research Questions

1. What is your research question, or what information would you like to try to find out?

2. What's the first thing you'll do to try to answer the question?

3. As you conduct your investigation, record the steps you take as you take them – not afterwards. List and describe each step below. If you make any changes in your investigation, that's fine – but explain why you made those changes.

4. When you finish your investigation answer the questions below. They will help you record both your results and your analysis:
   a. Were you able to answer your original question? If so, how would you answer it? If you weren't able to answer the original question, explain what you found out instead.

   b. What evidence did you find in the data to help you with your investigation? Paste copies here of any graphs that gave you information related to your question.

   c. How would you explain what you found out? (If your results make sense to you, explain why they do. If they were a surprise, what are some possible explanations for what you observed?)

   d. Is there any other kind of data that would help you know whether your explanation is valid? If so, what kind of data would that be?

   e. What questions do you still have? These might be questions that remain unanswered or they might be new questions.