Topic: How the Acidity of Precipitation Affects Water Quality

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Period 4/5

AP Biology

I. Introduction

The purpose of this research is to determine the effects of acid precipitation on water quality. Factors that lead to acid precipitation are the combustion of fossil fuels, by factories or other businesses, which releases the gases sulfur dioxide, phosphates, and nitrogen oxide into the environment.. When these gases get released into the air, the particles are carried to a very high altitude by the wind into the clouds, mixing with oxygen, water, and other chemicals. When the clouds produce precipitation, it will mix with the gases, forming acid precipitation caused from the sulfates, phosphates, and nitrates in the atmosphere from the fossil fuels. Acid precipitation then falls out of the clouds and travels into the water, onto rocks, statues, and soil causing erosion, color change, and pollution. "Sunlight increases the rate of most of these reactions. Rainwater, snow, fog, and other forms of precipitation containing those mild solutions of sulfuric and nitric acids, fall to the earth as acid rain."(EPA). This ultimately affects water quality in a negative way.

While precipitation naturally has a slightly acidic pH levels of around 5.0, human activities have made it worse and more acidic. Humans have released so many different harmful substances into the atmosphere that the mixture of gases has changed. The amounts of sulfates, phosphates, and nitrates in the atmosphere have increased over the past years, causing very negative effects on the environment. Power plants and car exhausts are just two of the many different things that humans have produced which contributes to acid precipitation. Little does everyone know that acid precipitation may affect them in more ways than they know. It has been proven that acid precipitation can cause asthma, premature death, and many hospital visits per year. It is also a fact that acid precipitation affects the death rate of aquatic animals. "As this acidic water flows over and through the ground, it affects a variety of plants and

animals."(polymaniac). This can be harmful for humans since fish is a source of food.

This lab with investigate the problem statement that, if a lower pH is found in the water, then the precipitation is more acidic because the lower the pH, the higher the level of acidity there is. The independent variable is the water test being performed. The dependent variable is the pH levels, dissolved oxygen, temperature, phosphate, and nitrate levels.

II. Procedure

1. Gather materials: buckets attached to a rope, thermometer, probe wear, and other water testing kits.
2. Locate the water testing sites.
3. Throw the bucket into the water, making sure to hold on to the string, into the middle of the stream to get the greatest amount of water as possible.
4. Immediately after taking the water out of the stream test the temperature of the water using the thermometer, making sure to get the most accurate temperature as possible before the water temperature adjusts to the temperature of the atmosphere.
5. After taking the temperature record the data and remove the thermometer.
6. Place the dissolved oxygen probe wear into the bucket and record the data. This needs to be measured right after, or even at the same time as the temperature to ensure that the correct DO readings are being recorded before the atmosphere and temperature changes the reading.
7. Put the water in a sealed container to carry back to the lab.
8. Pour the correct amount of water into a small test tube and set up water testing kits, making sure to follow the instructions.
9. Using the water testing kit measure the pH level of the water and record data.

10. Using the water testing kit measure the waters nitrate levels and record data.
11. Using the water testing kit measure the amount of phosphate and record data.
12. After recording data compare to people who tested the water of different areas and record results.
13. Put materials away.
14. Dispose of tested water properly.

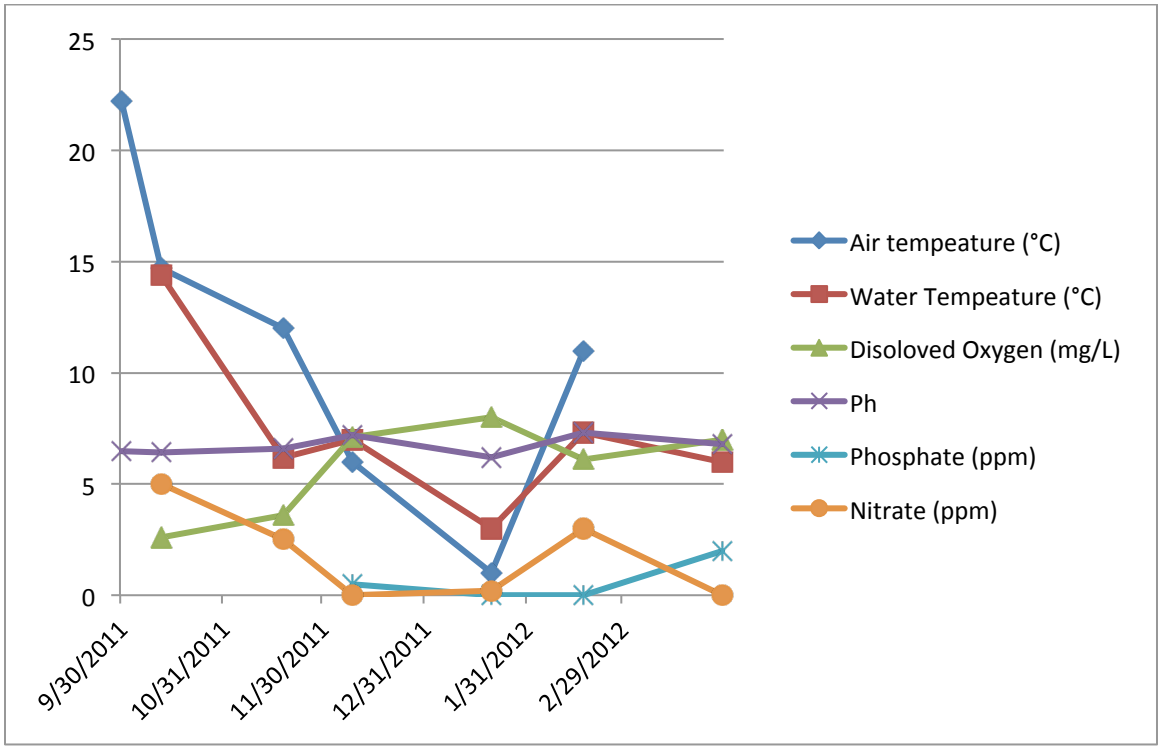
III. Observations

Almost every time that data was collected at Cove River, the weather conditions were sunny with limited cloud cover. The leaves had fallen from the trees earlier in the year than it usually expected. This is most likely due to the hurricane which happened over the summer, causing a lot of stress on the leaves from the wind and the salt from the ocean water. It barely snowed during the winter months that we took measurements. There were never more than a couple of inches on the ground. The weather was very unpredictable; it was warmer one day, and freezing cold the next. The weather was much warmer than average for most of the winter months. It was found that the pH ranged mostly from 5.0 to 8.0. The water temperature changed with the air temperature. During typically warmer months, the water was also warmer. However, after colder days, the water temperature was lower. The least acidic pH was a 7.3, which just so happened to be a day after it rained. This may suggest that the area where the rain traveled from does not have a lot of air pollution. This allowed the rain to do one of the things it is meant to do, which is to neutralize environments which are too acidic.

IV. Data Tables

Water

	9/30/2011	10/21/2011	11/18/2011	12/9/2011	1/20/2012	2/17/2012	3/30/2011
Air Temperature (°C)	22.2	14.7	12	6	1	11	—
Water Temperature (°C)	—	14.4	6.2	7	3	7.3	6
Dissolved Oxygen (mg/L)	—	2.6	3.6	7.1	8	6.1	7
Ph	6.48	6.41	6.6	7.2	6.2	7.3	6.8
Phosphate (ppm)	—	—	—	0.5	0	0	2
Nitrate (ppm)	—	5	2.5	0	0.2	3	0



V. Conclusion

If a lower pH is found in the water, then the precipitation is more acidic because the lower the pH, the more acidic the water is. Once source of error for the data collected could be not all of the data was collected for the dissolved oxygen, nitrate and phosphate levels. This would alter the results because it would make it less accurate since there were fewer trials. To fix this problem, it could be made sure that all the correct data is recorded. There could be a check list of all the things to be examined and this way nothing will be forgotten. Another source of error could have been the probe wear. Some of the probe wear that we used could have been malfunctioning and not working properly which would cause us to get inaccurate numbers. This can be prevented by using more than one method to test the water so it can be determined if the probe wear was working or not. Also, calibrating the equipment right before taking measurements will make sure the measurements are accurate. And lastly, the temperature and dissolved oxygen measurement was necessary to take right after it was removed from the main source. If it was not the water could have been warmed by the air or even by the person holding it and the DO level changed by the atmosphere. This can be prevented by having thermometers and probe wear handy after taking the water sample so that can be the first thing to do.

Acid precipitation is an important thing to study because if effects so many people. It may not be realized how much this acidic change in the precipitation really effects our everyday lives. It may cause asthma from people breathing in the gases in the air from the acid precipitation. Acid precipitation may cause premature death and more hospital visits per year. It is possible to become ill from consuming an animal or a plant which was exposed to a lot of acid precipitation. “Acid Rain is one of many environmental problems which can be eased if we reduce emission of pollutants into the atmosphere.”(epa). This is why it is important to study,

because if you can understand it, then you can help stop it. This relates to AP Biology because it allowed us to connect our hands on experience to what we were studying in the classroom. It gives the material we are learning purpose, and allows us to understand why it is so important to study. It also allows us to understand how the things we are studying are actually used in all different kinds of important environmental studies.

Some things that can be done to continue the research is collect a cup of rain at least once a month. This way, the rain water can be tested directly to see exactly how acidic the rain is. And also, the amount of sulfate, phosphate, and nitrates can be tested from this rainfall so it can help determine how much fossil fuel were released into the atmosphere. Something else that could be tested is the soil. Many people add fertilizer to their soil to get their grass or plants to grow. This fertilizer runs off into streams or other bodies of water when it rains and can greatly affect the pH. Also, when the water evaporates and enters the clouds, the clouds can carry the precipitation with the fertilizer in it miles away and cause changes there in the acidity of the precipitation.

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The Effect of Acid Precipitation on Water Quality

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AP Biology

INTRODUCTION

Acid rain is precipitation containing harmful amounts of nitric and sulfuric acids formed by sulfur dioxide and nitrogen oxides released into the atmosphere when fossil fuels are burned. PH is a measure of acidity in a substance. Acid rain has a pH below 5.6 and normal rain has a pH of about 5.6, which is slightly acidic. Acid rain has many effects on not only the environment, but humans as well. When gases such as sulfur dioxide and nitrogen oxide are released into the environment, the particles are carried by the wind into clouds. The clouds then produce precipitation which is mixed with the gases to form acid rain. This acidic rain then travels into the water, rocks, statues and soil causing erosion, color change, and pollution. This ultimately affects the growth of plant life due to the acidity of the water. Humans also suffer the consequences of acid rain because the gases from acid rain make it harder to breathe for those with asthma. Aquatic life is affected too which can result in affected humans. If fish or other types of seafood are contaminated by acid rain, then consumed by humans that are unaware, this may result in death because of the acidity.

The problem that was tested is how acid rain affects the environment. For the past seven months, research was done at Cove River in West Haven. Many factors such as pH levels of the water, nitrite, nitrate, and phosphate of the area were tested. This research will be compared to similar research around the world. If pollution did not occur in the northeast area of the United States, the normal pH level of the river would be around 6.5. But pollution and acid rain have caused many places, possibly such as Cove River, to suffer. The data collected by this experiment will soon be compared and will reveal how acid rain is affecting environments worldwide.

The hypothesis of this lab is if a lower pH is found in the water, then acid rain is affecting Cove River because the lower the pH the more acidity there is in a substance.
The independent variable being tested is the water quality of Cove River. The dependent variables are the temperature, pH, phosphate, nitrite, and nitrate levels of Cove River.

The method which will be used is taking samples of water and determining their pH levels by using probe wear. The phosphate, nitrate, and nitrite levels will be tested using the API Freshwater

Aquarium Pharmaceutical Master Test Ki and the LaMotte Test kit according to their suggested directions. It will then be evident that these results are due to acid rain. The results of acid rain will conclude that gases are being released into the air from factories near the location of the water.

MATERIALS

1. Vernier probe wear
2. API Freshwater Aquarium Pharmaceutical Master Test Kit
3. Goggles
4. LaMotte Test Kit
5. Plastic Containers
6. Water samples from Cove River
7. Plastic buckets

PROCEDURE

1. Record observations about the weather.
2. Gather water samples from Cove River at three different sites- upstream, mid-stream, and downstream using a plastic bucket.
3. Using the Vernier probe wear, test the dissolved oxygen level, the pH level, and the temperature of the water. This must be done as quickly as possible because the dissolved oxygen level and temperature can be altered by atmospheric levels of pH and temperature.
4. Put small samples of water from each site into separate plastic containers to transport to the lab.
5. Use the API Freshwater Aquarium Pharmaceutical Master Test Kit to test the nitrite and nitrate levels of the water and record in journal.

6. Use the LaMotte test kit to test the phosphate level of the water.
7. Record all data in journal.
8. Clean up lab and dispose of chemicals using proper protocols.

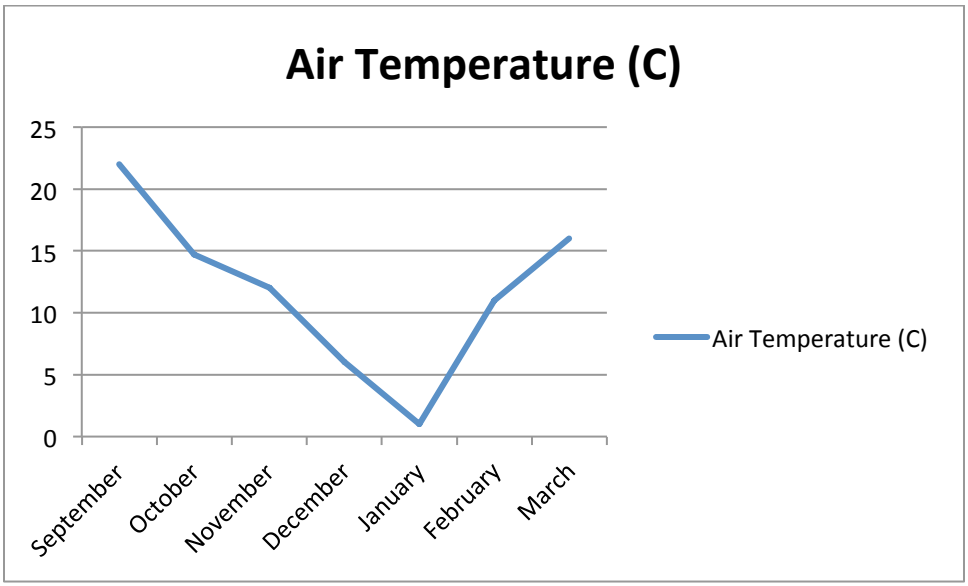
DATA

Month	Air Temperature (°C)	Water Temperature (°C)	Dissolved Oxygen mg/L	Phosphate (ppm)	Nitrate (ppm)	Nitrite (ppm)	pH of water (ppm)
September	22	22.2	-----	0	-----	0	6.48
October	14.7	14.4	2.6	0	5.0	0	6.41
November	12.0	6.3	3.6	0	2.5	0	5.25
December	6.0	6.8	7.1	0.5	0	0.25	-----
January	1.0	1.2	8.0	0	0.25	0.20	6.6
February	11.0	7.3	6.1	0	0	0	7.3
March	16	6.0	7.0	2	0	0	6.8

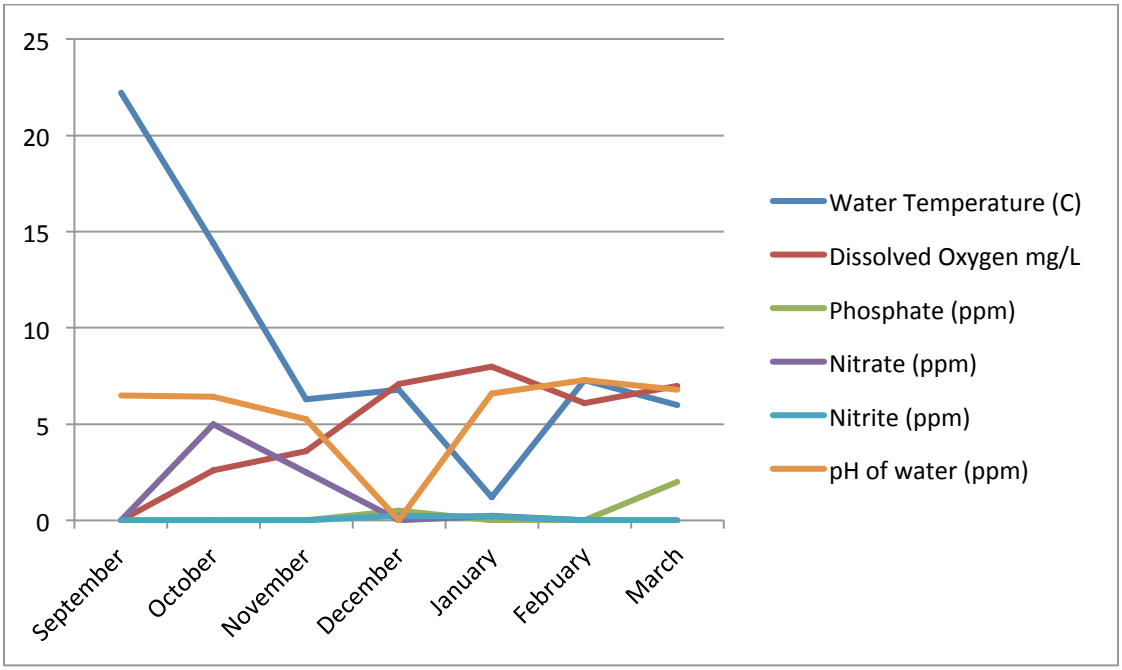
Dissolved oxygen and temperature are important to this lab because the warmer the temperature, the less dissolved oxygen is present in the water. For example, the water temperature in October was 14.4° Celsius and the dissolved oxygen level was 2.6 mg/L. However in January, the water temperature was 1.2° Celsius and the dissolved oxygen level was 8.0 mg/L.

Nitric oxides and sulfur oxides dissolve in the river water to form weak acids. These acids precipitate as acid rain, which is critical to the research. Nearby factories, or even the burning of fossil fuels, may have an effect on dissolved oxygen levels because pollution is known to decrease the average dissolved oxygen concentrations in lakes.

The Effect of Time of the Year on Air Temperature



The Effect of Time of the Year on Water Temperature, Dissolved Oxygen, Phosphate, Nitrate, Nitrite, and pH levels



OBSERVATIONS

September 20, 2011

- Ample rain the night before
- Canopy is still full-no leaf change
- Beautiful/hazy day
- Late August hurricane may affect leaf change (salt from ocean water)

October 21, 2011

- Beautiful day
- 5-10% canopy cover
- Windy

November 18, 2011

- No clouds, sunny day
- Little leaves- not different colors because of hurricane in August

December 9, 2011

- Most of the leaves have fallen
- 1% canopy cover
- Hazy, contrail clouds- 50% coverage

January 20, 2012

- Sunny, no clouds
- Snow dusting

February 17, 2012

- Rained a little the night before and this morning
- 100% overcast in the morning, 60% at present time
- Cloud layers moving in different directions

March 30, 2012

- Sunny, windy day
- Relatively warm last week but today is windy and chilly
- No clouds, a little haze- 68% canopy cover
- Trees starting to form buds/leaves
- Spring is early this year
- Soil is nutritious and rich in minerals but only in a small layer

CONCLUSION

The hypothesis was that if a lower pH is found in the water, then acid rain is affecting Cove River because the lower the pH the more acidity there is in a substance. Since the normal pH level of a

river in the Northeast of the United States would be around 6.5 without pollution, it is hard to determine whether pollution has been affecting Cove River these past seven months. According to the data, the average pH of the water is 6.47. This average is close enough to 6.5 that it can be said that not much pollution or acid rain has been occurring at Cove River, but making observations and collecting data for only seven months, a definite answer cannot be concluded as to whether acid rain is affecting Cove River. This research will have to be continued for much longer in order to come to a sure conclusion.

For future years and further research, it would be very helpful to perform these tests over a longer period of time. It takes a lengthy amount of time for acid rain and all of its components such as nitrate to affect the water and environment. This is why it is so difficult to make any conclusions at this time. It would also be more effective to take samples of rain water as it falls and test for pH levels of nitrate, nitrite, and phosphate immediately. This will add to the present research found at Cove River. Another suggestion for future research is to study exact locations of factories or other industries near Cove River. This will help to determine if any of the burned fossil fuels have an effect on the environment of Cove River. This research can then be compared to other research pertaining to acid rain around the world.

This research relates to AP Biology studies because the next area of study is ecology. The research has given students background knowledge on how people interact with their environment. A key example is how factories are affecting the water quality of Cove River. This has given way to acid rain as well as additional effects on the environment of Cove River.

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AP Biology
Mr. Dickson
13 April 2012

Globe Project: Acid Rain

I. Introduction

The problem being tested is how the acidity of water affects the environment. The tests for this experiment was being done at Cove River; a watershed providing diverse ecological search opportunities in West Haven, Connecticut. The factors that contribute to this problem are the combustion of fossil fuels, which releases the gases sulfur dioxide and nitrogen oxide. When the gases are released into the environment, the particles are carried by the wind into clouds. The clouds produce precipitation which is mixed with the gases to form acid rain. Acid rain then travels into the water, rocks, statues and soil causing erosion, color change, and pollution. During the experiment the water levels of phosphate and nitrates were measured to find the results for how much acid rain is produced. If nitrates and phosphates are found in the water then there is proof that acid rain has occurred. Nitrates and phosphates are found in fertilizers used on different crops. The runoff from the fertilized plants goes into nearby sources of water. As this water evaporates, it carries the fertilizer particulates with it to form clouds, which then release the chemicals as acid rain in a different location.

II. Problem Statement

The hypothesis is that if when water temperatures are warm, then less nitrates and phosphates will be found, because warm water releases oxygen, nitrogen, and phosphorus gases that combine to create acid rain. When the oxygen gets released then the gases that produced acid rain are being released back into the air. The creation of acid rain leads to detrimental impacts of surrounding area watersheds. Acid rain affects the soil, statues and even the air humans breathe.

The acidity of soil effects the plant growth and it is harder to have healthy plants. Statues start to ware away and become a copper color due to the acid rain. Humans breathe in the gases from acid rain.

III. Materials

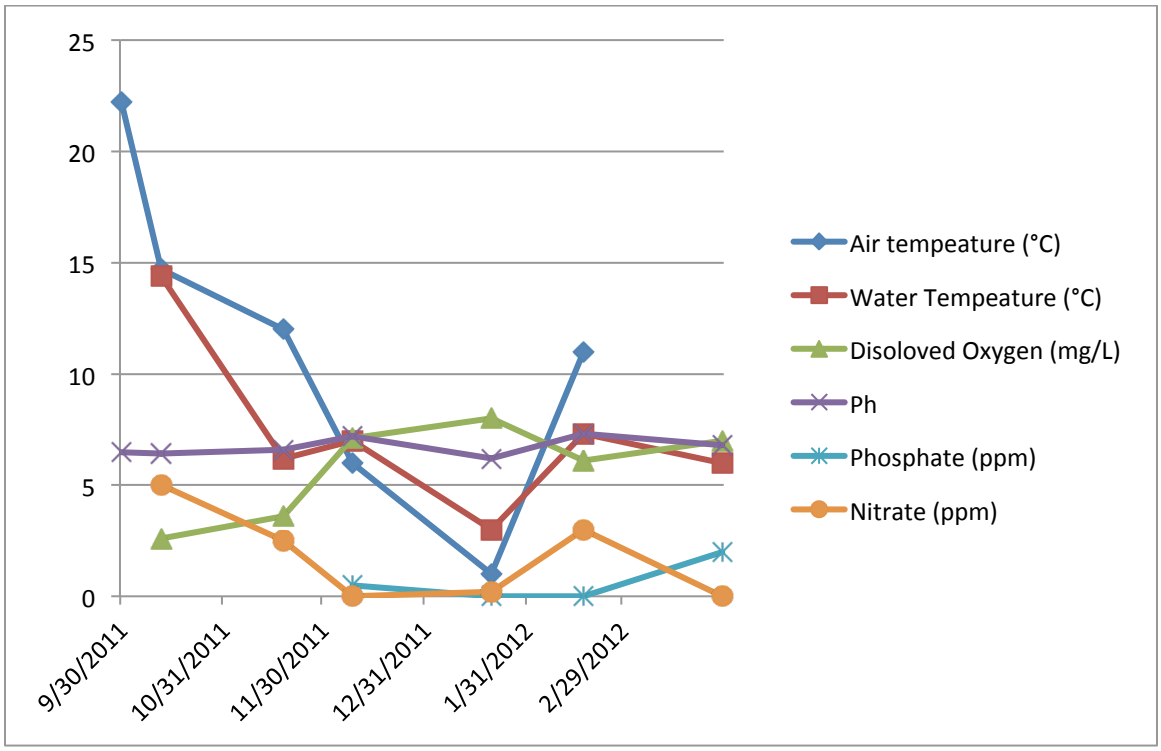
The materials needed in this study are Vernier probe ware to test the pH level, water temperature and dissolved oxygen of water samples. The Aquarium Pharmaceutical Fresh Water Test Kit was used to measure the phosphate and nitrates of the water samples. A bucket is needed to collect the water sample from the research site. You also need containers to transport the water back to the lab. You will need safety equipment to use when you get back to the lab.

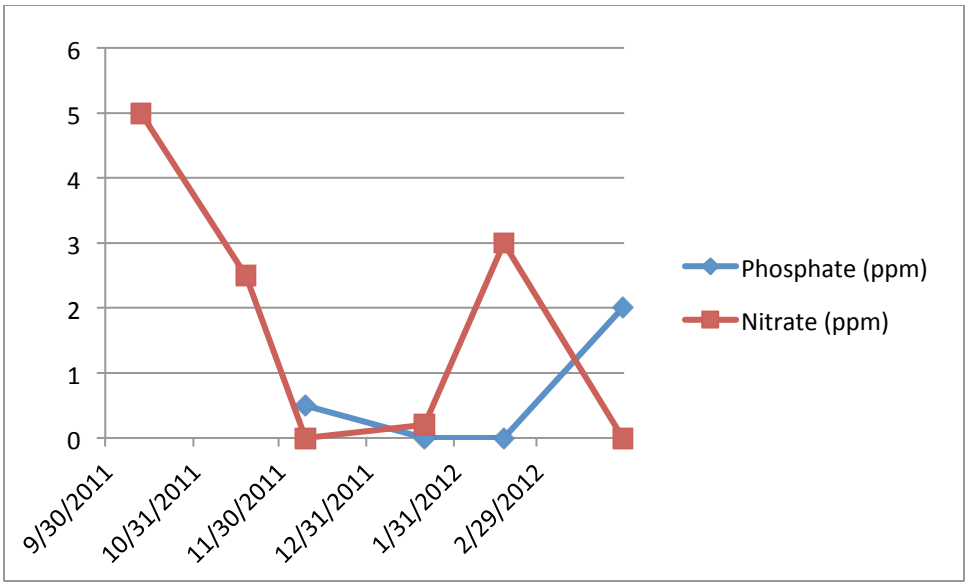
IV. Procedures

1. Find a watershed area that may be impacted by acid rain to research site to work at.
2. Get a water sample in a bucket from the river.
3. Immediately take the temperature of the water using the Vernier probe ware and record it before the temperature and DO of the water can be impacted by the atmosphere.
4. Take the Dissolved oxygen reading using the Vernier probe ware right after temperature and record it.
5. Transport the water samples in a sealed container to the lab.
6. Use the Aquarium Pharmaceutical Fresh Water Test kit directions to get the readings of phosphates and nitrates and record it.
7. Dispose the test tube liquids properly.
8. Dump the water out down the drain.
9. Clean up your lab station and put away safety equipment.

V. Data/observations

	9/30/2011	10/21/2011	11/18/2011	12/9/2011	1/20/2012	2/17/2012	3/30/2011
Air Temperature (°C)	22.2	14.7	12	6	1	11	—
Water Temperature (°C)	—	14.4	6.2	7	3	7.3	6
Dissolved Oxygen (mg/L)	—	2.6	3.6	7.1	8	6.1	7
Ph	6.48	6.41	6.6	7.2	6.2	7.3	6.8
Phosphate (ppm)	—	—	—	0.5	0	0	2
Nitrate (ppm)	—	5	2.5	0	0.2	3	0





9/30/2011: It had rained a little the night before but it was a beautiful day. It was a little hazy out. There canopy cover was full and there was not noticeable leaf change yet. It could be true that the August hurricane had a salt spray affecting the leaves changing.

10/21/2011: It was a beautiful day, with about five percent cloud cover. It was windy this day. This was the first day nitrates and dissolved oxygen levels were tested. It was shown that nitrate was found in the water, which provides evidence that acid rain occurs in the area. There are many other factors can lead to the nitrate levels as well, such as the runoff of fertilzers and pollution directly in the area.

11/18/2011: It was a sunny day with no clouds. The leaves that were left had a different color due to hurricane Irene. Nitrate was cut in half this time reading at 2.5 ppm. This shows that with a lack of rain the water is starting to cleanse itself.

12/9/2011: The leaves had all fallen off the trees. It was hazy day with a lot of clouds. It was a very cold day and no nitrates were found but phosphates were. This shows that due to the lack of

rain the nitrates cleaned themselves out over the past couple months. Due to the finding of phosphates in the water there is still the idea that acid rain is occurring.

1/20/2012: It was a sunny day with no clouds. It had snowed the night before and there was a light snow dusting on the ground. On this day no phosphates were found but nitrates were present again.

2/17/2012: It rained a little last night and this morning. The overcast had dropped to sixty percent from 100 percent by eleven o'clock. There were a lot of nitrates found today. This shows that due to the rain that came in there is acidity in it.

3/30/2012: It was sunny outside but it was windy. It was warm all last week but today was a colder day with a light haze. The leaves are starting to bud, causing an early spring. The top level of soil is nutritious, but only about three inches down. There was finally some phosphate found but no nitrates present.

Overall: It can be noted that more nitrates were found when rain was in the recent forecast. The phosphates started to show up in the water when it was a little bitter dryer in the weather. As the graph shows it nitrates were mostly present when the temperature was a little bit warmer because dissolved oxygen is being released at this time.

VI. Conclusion

It could be noted that dissolved oxygen is not held in warmer water and when it is being released more nitrates could be present in the water. The hypothesis that the warmer water will hold fewer nitrates due to the fact that oxygen is being released was found to be true, but more data would be needed to support the idea. The fact that nitrates and phosphates were found proves that acid rain maybe occurring in West Haven, Connecticut. Although it is not a high number there should still be a concern. If acid rain is occurring in one place it could be occurring

all around the world. Water travels through precipitation and when rain was present in the previous days before testing the nitrates and phosphates were found in the water samples. This experiment is a base for many other tests that could be done. This experiment could be continued by frequently checking the water quality on a weekly basis or bi-weekly basis instead of a monthly basis. Checking the water more frequently would give better and date and a way to figure out where the acid rain is coming from. As in West Haven there are many buildings and factories that run along Cover River. These factories could have a huge impact on what goes into the water and cause the acid rain or may be contributing to the water pollution directly. There are also local golf courses and parks that are treated with fertilizers that can add nitrates and phosphates to the water. There are other ways to follow up on this experiment; a person can test for sulfuric gases as well as nitrates and phosphates. Sulfuric gases are a key factor in acid rain. Researching sulfuric acid levels with nitric acid levels can also be another study. A key improvement to this experiment would be collecting rain during a storm and testing the nitrates and phosphates in the rainwater before the contaminants are diluted in a watershed. .

The research that was done relates back to biology class is because it is hand on research about the topics that are being studied. One of the topics is ecology, where the study of the environment is being taught. To go out into a watershed and get the research on a first hand basis is very helpful. It allows the students to get a chance to understand practice what they learning is actually important in everyday life.

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