The Reflection of Water Quality on the SFX Pond

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Abstract

This experiment was conducted by measuring the quality of the SFXCS pond using LaMotte pH, dissolved oxygen, and phosphate kits, an alcohol filled thermometer, and transparency tube. This experiment focused on the question, how do pH, dissolved oxygen, water transparency, phosphate, and water temperature relate and reflect a healthy aquatic environment? The hypothesis states that if overtime the pH, dissolved oxygen, phosphate, water transparency, and water temperature levels are tested in the pond, then the pH levels should range between 6 and 8, the dissolved oxygen should range from 4.0 mg/L to 10.0 mg/L, the phosphate levels should be no more than 0.1 ppm, the water transparency levels should be determined when the bottom of the tube is not seen, and the water temperature should stay between 0℃ to 32℃ because these levels reflect good water quality that should come from the trees that provide shade and oxygen and the high grass that keeps runoff from getting into the pond. All procedures were taken from GLOBE protocols and phosphate procedures were taken from the LaMotte kit. The data supported the hypothesis because through research, the levels fell within the accepted range of a healthy aquatic environment except for phosphate.

Keywords: pH, dissolved oxygen, phosphate, water temperature, water transparency

The Reflection of Water Quality on the SFX Pond

Research Question and Hypothesis

The research question states: How do pH, dissolved oxygen, water transparency, phosphate, and water temperature relate and reflect a healthy aquatic environment? The hypothesis states that if overtime the pH, dissolved oxygen, phosphate, water transparency, and water temperature levels are tested in the pond, then the pH levels should range between 6 and 8, the dissolved oxygen should range from 4.0 mg/L to 10.0 mg/L, the phosphate levels should be no more than 0.1 ppm, the water transparency levels should be determined when the bottom of the tube is not seen, and the water temperature should stay between 0℃ to 32℃ because these levels reflect good water quality that should come from the trees that provide shade and oxygen and the high grass that keeps runoff from getting into the pond.

Introduction

Ponds are freshwater water sources that shelter many living things. These living things need to have certain water quality levels to survive (Hester, 2004). These certain levels can change depending on the weather, humans, or just the amount of animals living in the water.

pH is determined by defining how acidic or basic a body of water is along a scale. The lower the number, the more acidic the water is. The higher the number, the more basic the water is (Environmental, 2013). Lakes and ponds mostly have pH levels that range between 6 and 8. Humans can carry acids and bases with them which affects the water quality (GLOBE, 2018). Some ways humans cause this include acid rain, wastewater discharge, and pollution. Pollution is a common cause that can affect the pH depending on the chemicals involved. These chemicals can come from agricultural runoff, wastewater discharge or industrial runoff (GLOBE, 2018).

Acid rain is well known for being the biggest cause by humans to affect the quality of water. Acid rain comes from the reaction of water with nitrogen oxides, sulfur oxides, and other acidic compounds which usually come from mining and smelting operations or fossil fuel combustion. (Environmental, 2013). pH has a strong influence on aquatic organisms that need certain pH ranges to survive. Amphibian life and many macroinvertebrates are particularly sensitive to extreme pH levels either too low or too high. Most insects, amphibians, and fish are not present in water with a pH level below 4.0 or above 10.0 (GLOBE, 2018). If the pH falls below this range most living organisms will die because of respiratory failure (Kimmel, 1983). While some organisms thrive at high pH levels, most fish cannot tolerate them. Death can occur even at typical levels if ammonia is present in the water (Environmental, 2013). pH can also affect the solubility of chemicals and heavy metals in the water. Low pH levels encourage the solubility of heavy metals. As the hydrogen ions level increases, aluminum, lead, copper and cadmium are released into the water instead of being absorbed into the sediment. As the concentrations of the heavy metals increase, their toxicity increases as well. In addition, metals can be taken in by organisms during respiration, causing physiological damage (Environmental, 2013).

Dissolved oxygen refers to the molecules of oxygen gas that have dissolved in the water. Without sufficient levels of dissolved oxygen in the water, aquatic life suffers which causes the mortality rate to rise (GLOBE, 2018). When aquatic life suffers, it is known as a fishkill, which occurs when a large number of fish in an area of water die. It can be species-based or a water-wide mortality. Excess nutrients carried to streams and lakes encourage abundant growth of algae, which leads to low oxygen in the water and the possibility of fish kills. Fish kills occur for a number of reasons, but low dissolved oxygen is often a factor. When a body of water is over productive, the oxygen in the water may get used up faster than it can be replenished. This can occur when a body of water is overstocked with living organisms or if there is a large algal bloom die-off. Fish kills are more common in eutrophic lakes or lakes with high concentrations of nutrients such as phosphorus or nitrate. High levels of nutrients can fuel algae blooms, which will initially boost dissolved oxygen levels. When the algae die, bacterial decomposition rises which uses up most or all of the dissolved oxygen available. This creates an oxygen-depleted environment where fish and other organisms cannot survive. These nutrient levels can occur naturally, but are more often caused by pollution from fertilizer runoff or poorly treated wastewater. In the winter, fish kills are known as winter kills, which are caused by reduction in dissolved oxygen due to ice or snow cover on a lake or pond. Winter kills occur when respiration from fish, plants, and other organisms is greater than the oxygen production by photosynthesis. They also occur when the water is covered by ice, and cannot receive oxygen by diffusion from the atmosphere. If the ice is then covered by snow, photosynthesis also cannot occur, and the algae will depend entirely on respiration or die off. In these situations, fish, plants, and decomposition are all using up the dissolved oxygen, and it cannot be replenished, resulting in a winter kill. The shallower the water, and the more productive the water is, the greater the chance of a winter kill (Environmental, 2013). Another way fish kills can occur is when toxic compounds are released into a body of water. In order for this to occur, the toxic compound must be highly concentrated. Another cause of fish kills is infections caused by fish pathogens such as the dinoflagellate pfiesteria. Fish pathogens can enter our water from leaking septic tanks, wastewater-treatment discharge, and animal wastes (USGS, 2016). Dissolved oxygen levels below 3 mg/L make it difficult for most aquatic organisms (GLOBE, 2018).

There is more oxygen available in the atmosphere for animal respiration than in water. Two out of ten air molecules are molecular oxygen. In water, there are only five or six oxygen molecules for every million water molecules. Dissolved oxygen can be added to water by plants during photosynthesis and through diffusion from the atmosphere. The amount of dissolved oxygen in the water determines what can live there. The amount of dissolved oxygen in the water is called the solubility of dissolved oxygen. Factors affecting the solubility of dissolved oxygen include water temperature and salinity (GLOBE, 2018). Cold water can dissolve more oxygen than warm water because the pressure is greater in colder water and lower in warmer water. Also, warmer water does not need as much oxygen as colder water does. Solubility of dissolved oxygen also decreases as water temperature increases. As temperature goes up, water releases some of its oxygen into the air because the warmer the water, the lower amount of dissolved oxygen is needed. If there is a significant occurrence of photosynthesis or a rapid temperature change, the water can achieve DO levels over 100% air saturation. At these levels, the dissolved oxygen will evaporate into the water and air until it levels out at 100%. The amount of dissolved oxygen also is affected by what lives in the water (Environmental, 2013).

Photosynthesis by aquatic plants contributes dissolved oxygen to the water. Water may become supersaturated, meaning that the dissolved oxygen levels are greater than its solubility. The extra dissolved oxygen would then eventually be released back into the air or be remove ecosystems is non-living and it is collectively referred to as detritus. During respiration, biota consumes dissolved oxygen (GLOBE, 2018).

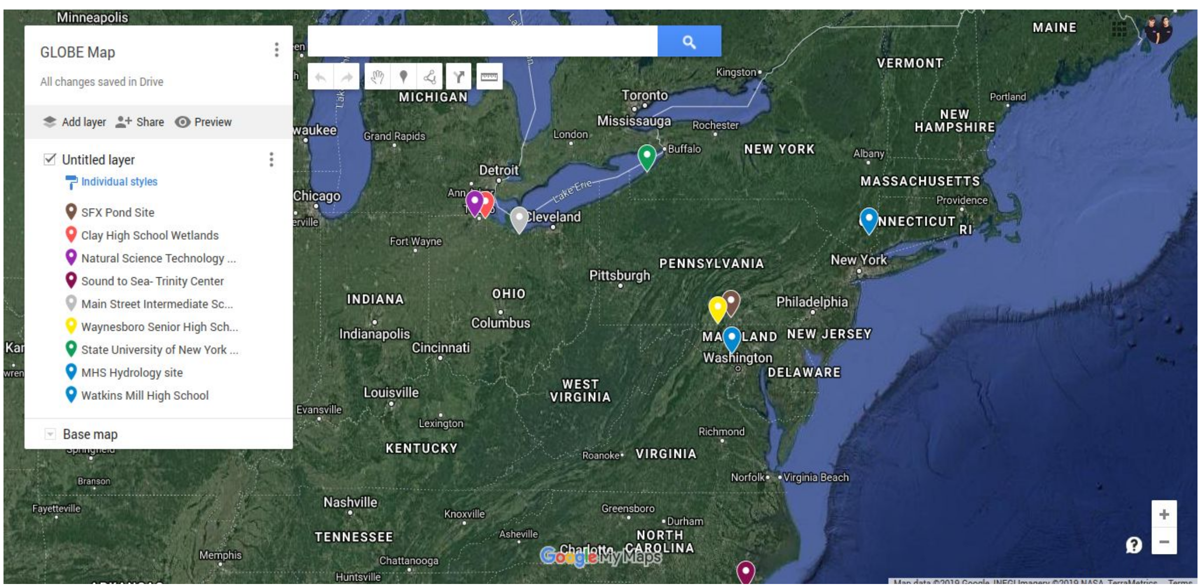
Water temperature is a measure of how hot or cold the water is. Water temperature is important to look at to better understand the impact of pH and DO levels. Temperature influences the amount and diversity of aquatic life. Ponds that are cold and have little plant life in winter, bloom in spring and summer when water temperatures rise and the nutrient-filled bottom waters mix with the upper waters. Because of this mixing and the warmer water temperatures, the spring overturn is followed by a period of rapid growth of microscopic aquatic plants and animals. Many fish and other aquatic animals also spawn at this time of year when the temperatures rise and food is abundant. Water temperature is important because warm water can be fatal for sensitive species which require cold, oxygen-rich conditions. Warmer water tends to have lower levels of dissolved oxygen. Water temperature is important for understanding local and global weather patterns. Water temperatures changes differently than air temperatures because water has a higher heat capacity than air. Water also helps to change air temperature through the processes of evaporation and condensation (GLOBE, 2018) .

Phosphorus is a key element that is necessary for the growth of plants and animals. Phosphate levels between 0.01 - 0.03 mg/L are uncontaminated, levels at 0.025 - 0.1 mg/L stimulate plant growth, levels at 0.1 mg/L is the maximum level to avoid accelerated eutrophication, and levels that are more than 0.1 mg/L cause accelerated growth and consequent problems (Oram, 2014). The presence of phosphorus is often hard to find in well-oxygenated lake waters and low levels of phosphorus limit the production of freshwater systems. Unlike nitrogen, phosphate is preserved in the soil by a complex system of biological uptake, absorption, and mineralization. Phosphate is not harmful to people or animals unless it is present in very high levels. The soluble or bio-available phosphate is then used by plants and animals. Phosphate becomes incorporated into the biological system, but the key areas include ATP, DNA, and RNA. Mr. Brian Oram says, “ATP, adenosine triphosphate is a key stage in the Krebs

Cycle. RNA and DNA are the backbones of life on this planet (Oram, 2018).” In the Krebs Cycle, the carbon of pyruvate is broken down by a cyclic series of reactions that will produce carbon dioxide and water. The Krebs Cycle occurs in the mitochondrion (Morgan, 2003).During this reaction, the energy in the original pyruvate is carried as a high-energy electron by the electron shuttles NADH and FADH2 . These electrons will then be passed to the electron transport chain, where their energy will be used to synthesize ATP by oxidative phosphorylation. Much more ATP is made by the Krebs cycle and oxidative phosphorylation than by glycolysis alone. The availability of phosphorus is a key factor controlling photosynthesis. Phosphate will activate the growth of plankton and aquatic plants which provides food for larger organisms. The increase in the growth of plankton and aquatic plants will cause an increase in the fish population and overall biological diversity of the system. As the phosphate continues to build-up, the aging process of a lake or surface water ecosystem will be accelerated. The overproduction of a lake or water body can lead to an imbalance in the nutrient and material cycling process. Blue-green algae are small single-celled prokaryotic microorganisms. When present in large groups, this algae appears as a blue-green discoloration in the water. This type of algae is usually found in freshwater and most commonly found in areas with high levels of nutrients and warm, sunny, and calm conditions. A lot of the algae attaches on to the surface of rocks and stones, on submerged plants, or on the bottom sediments of lakes. Some species of blue-green algae produce chemicals that are harmful to animals and humans. These algal blooms can lead to health problems ranging from skin irritation to liver damage to death, depending on the type and duration of exposure. Fish, shellfish, and livestock have also been endangered through contact with this toxin (Oram, 2018).

Transparency decreases with the presence of molecules and particles that can absorb or scatter light. Dark or black material absorb most wavelengths of light, however white or light materials reflect most wavelengths of light. The size of a particle is important as well. Small particles can scatter light. The fate of light entering a water body depends on the amount, composition ,and size of the dissolved and suspended material, but whatever happens to it, it is important that the light reaches the plants so they can photosynthesize. Lakes with organic materials appear more green or yellow. Sediments can come from natural and human sources. GLOBE states, “Colored, organic material can come from in situ productions such as detritus and biota or from inputs into the water body” (GLOBE, 2018).

Materials and Method



Map 1: This map shows the testing site where the water quality tests were taken.

Clay High School Wetlands (41.658737, -83.414149)

Hill Ditch Foot Bridge (41.667177, -83.674452)

Trinity Center Dorm Dock:SWS-02 (34.69386, -76.86297)

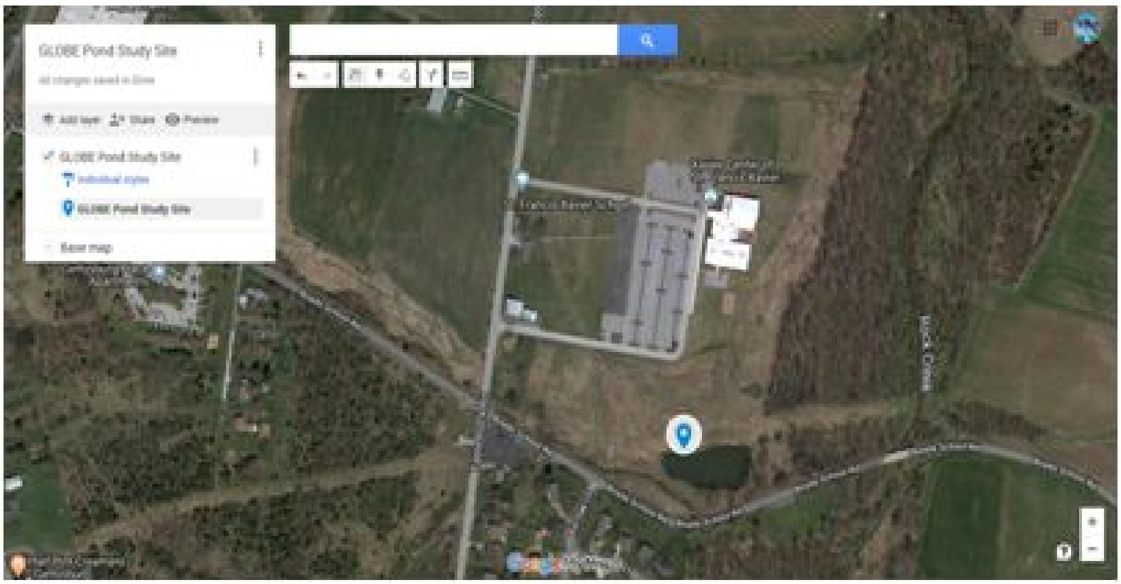
Mudbrook Creek (41.38062, -82.56179)

Pond:SWS-03 (39.7487, -77.5693)

Lake Erie (42.487615, -79.335598)

MHS Hydrology site pre pond:SWS-05 (41.3658, -73.7557)

Watkins Mill High School (39.185501, -77.21773)



Map 2: This shows an aerial view of the pond study site at school.

Image 1: This image shows the actual GLOBE pond study site.

Planning Investigations

The site is at the edge of a pond beside our campus stream and Rock Creek beside our school. It has a muddy bottom with unmowed, vegetated banks on our property. There are some areas close to mowed grass. There are trees and a wooded area nearby. Our school is in a rural area with farms and pasture land on the north and west sides, a small housing development on the south side, and a forested area with a creek to the east side. We experience a humid, continental climate. The coordinates of this site are 39.85685, -77.22606 with an elevation of 147.6m.

GLOBE protocols for pH, DO, phosphate, transparency, and water temperature will be followed. The GLOBE ADAT will be used to find other nearby locations to compare water quality. Testing will be done once a week.

Materials

- 1 Alcohol Filled Thermometer
- 1 Clock or Watch
- 1 pair of Latex Gloves
- 1 LaMotte Dissolved Oxygen Kit (5860-01)
- 1 LaMotte pH kit (5858-01)
- 3.8 Liters Great Value Distilled Water
- 1 Blue Bic Cristal Stic Pen
- 18.93 Liter Pitcher
- Waste Bottle with Cap
- 1.5 meters piece of string

- 1 LaMotte Phosphate Kit (4408-01)
- 1 Transparency Tube
- 1 Small Bucket
- Computer with access to GLOBE Advanced Data Access Tool

Carrying Out Investigations

GLOBE protocols for pH, DO, phosphate, transparency, and water temperature were followed. The GLOBE ADAT was used to find other nearby locations to compare water quality, although not all parameters were found. Testing was done once a week, although, schedules, flooding, and the egg laying season for Canadian Geese prevented testing often. Testing was done with the help of classmates.

Dissolved Oxygen (as taken from GLOBE protocols)

1. Get situated at the pond and get all the necessary materials out.
2. Fill in the top of the Hydrosphere Investigation Data Sheet.
3. Put on the gloves and goggles.
4. Rinse the sample bottle and hands with sample water three times.
5. Place the cap on the empty sample bottle.
6. Submerge the sample bottle in the sample water.
7. Remove the cap and let the bottle fill with water. Move the bottle gently or tap it to get rid of air bubbles.
8. Put the cap on the bottle while it is still under the water.

9. Remove the sample bottle from the water. Turn the bottle upside down to check for air bubbles. If there are air bubbles, discard this sample. Collect another sample.
10. Follow the directions in the Dissolved Oxygen Kit to test the water sample.
11. Remove the cap from the bottle.
12. Immediately add 8 drops of Manganous Sulfate Solutions and add 8 drops of Alkaline Potassium Iodide Azide.
13. Cap the bottle and mix by inverting several times. A precipitate will form.
14. Allow the precipitate to settle below the shoulder of the bottle.
15. Add 8 drops of Sulfuric Acid, 1:1.
16. Cap and gently invert the bottle to mix the contents until the precipitate and the reagent have totally dissolved. The solution will be clear yellow to orange if the sample contains dissolved oxygen.
17. Fill the titration tube to the 20 mL line with the fixed sample. Cap the tube.
18. Depress plunger of the Titrator.
19. Insert the titrator into the plug in the top of the Sodium Thiosulfate titrating solution.
20. Invert the bottle and slowly withdraw the plunger until the large ring on the plunger is opposite the zero line on the scale.
21. Turn the bottle upright and remove the Titrator. If the sample is a very pale yellow, go to step 25.
22. Insert the tip of the Titrator into the opening of the titration tube cap.

23. Slowly depress the plunger to dispense the titrating solution until the yellow-brown color changes to a very pale yellow. Gently swirl the tube during the titration to mix the contents.
24. Carefully remove the Titrator and cap. Do not disturb the Titrator plunger.
25. Add 8 drops of Starch Indicator Solution. The sample should turn blue.
26. Cap the titration tube. Insert the tip of the Titrator into the opening of the titration tube cap.
27. Continue titrating until the blue color disappears and the solution becomes colorless.
28. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as ppm Dissolved Oxygen.
29. Record the dissolved oxygen in the water sample on the Data Sheet as Trial 1.
30. Repeat the steps four more times using a new water sample each time.
31. Record that data on the Data Sheet as Trials 2-5.
32. Calculate the average of the five measurements.
33. Each of the five measurements should be within 1 mg/L of the average. If one of the measurements is not within 1 mg/L of the average, find the average of the other four measurements. If these measurements are within 1 mg/L of the new average, record this average.
34. Discard all used chemicals into the waste container. Clean the dissolved oxygen kit with distilled water.
35. Enter the data into the GLOBE data entry site.

Water Temperature

1. Get situated at the pond and get all the necessary materials out.
2. Fill out the top portion of the Hydrosphere Investigation Data Sheet.
3. Put on the gloves.
4. Slip the rubber band around the wrist so that the thermometer is not accidentally lost or dropped into the water.
5. Check the alcohol column on the thermometer to make sure there are no air bubbles trapped in the liquid. If the liquid line is separated, notify the teacher.
6. Put the bulb end of the thermometer into the sample water to a depth of 10 cm.
7. Leave the thermometer in the water for three minutes.
8. Read the temperature without removing the bulb of the thermometer from the water.
9. Let the thermometer stay in the water sample for one more minute.
10. Read the temperature again. If the temperature has not changed, go to Step 10. If the temperature has changed since the last reading, repeat Step 8 until the temperature stays the same.
11. Record the temperature on the Hydrosphere Investigation Data Sheet.
12. Repeat the measurement four more times each time with new water samples.
13. Calculate the average of the four measurements.

14. All temperatures should be within 1.0˚ C of the average. If they are not, repeat the measurement.
15. Enter the data into the GLOBE data entry site.

pH

1. Get situated at the pond and get all the necessary materials out.
2. Fill out the top portion of the Hydrosphere Investigation Data Sheet.
3. Put gloves on.
4. Rinse the beaker with sample water three times.
5. Follow the directions on the pH test kit procedures.
6. Insert Wide Range pH Octa-Slide 2 Bar into the Octa-Slide 2 Viewer.
7. Fill the test tube to the 10 mL line with sample water.
8. Add 10 drops of Wide Range pH Indicator.
9. Put the cap on the test tube and mix.
10. Insert the test tube into the Octa-Slide 2 Viewer.
11. Match the sample color to the color standard of the pond.
12. Record the data in the Data Sheet for Trial 1.
13. Repeat the steps four more times each time using a different water sample.
14. Record the measurements on Data Sheet as Trials 2-5.
15. Calculate the average of the five measurements.
16. Check to make sure that each observation is within 1.0 pH units of the average. If they are not within 1.0 units of the average, repeat the measurements. If the

measurements are still not within 1.0 pH units of the average, discuss possible problems with the teacher.

17. Discard all used chemicals and put them into the waste container. Wash all materials with distilled water.
18. Enter the data into the GLOBE data entry site.

Phosphate

1. Get situated at the pond and get all necessary materials out.
2. Fill out the Hydrosphere Investigation Data Sheet below Nitrates.
3. Put on gloves and goggles.
4. Follow the instructions in the Phosphate kit.
5. Insert the Phosphate Octa-Slide 2 Bar into the Octa-Slide 2 Viewer.
6. Fill a test tube to the 5 mL line with sample water.
7. Use the 1.0 mL pipet to add 1.0 mL of VM Phosphate Reagent. Cap and mix by inverting several times. Wait 5 minutes.
8. Use the plain pipet to add 3 drops of Reducing Reagent. Cap and mix. Color will develop in 10 seconds.
9. Insert the test tube into the Octa-Slide 2 Viewer. Match sample color to a color standard.
10. Record the Phosphate on the Data Sheet as Trial 1.
11. Repeat the steps four more times each time using a different water sample.
12. Record that data as Trials 2,3,4,5 on the data sheet.
13. Calculate the average of all five trials.

14. All of the measurements should be within 0.1 ppm of the average
15. If they are, record the average on the Data Sheet. If they are not, read the color measurements again (do not read again if it has been more than 5 minutes). Calculate a new average. If the measurements are still not within range discuss possible problems with the teacher.
16. Discard all used chemicals into the waste container. Clean all materials with water.
17. Enter the data into the GLOBE data entry site.

Transparency

1. Get situated at the pond and get all necessary materials out.
2. Fill in the top portion of the Hydrosphere Investigation Data Sheet.
3. Put on gloves.
4. Collect a surface water sample.
5. Stand with back to the sun so that the transparency tube is shaded.
6. Pour sample water slowly into the tube using the cup. Look straight down into the tube with an eye close to the tube opening. Stop adding water when there is not a way to see the pattern at the bottom of the tube.
7. Rotate the tube slowly and look to make sure the pattern is not seen.
8. Record the data on the Hydrosphere Investigation Data Sheet to the nearest cm. Pour the water from the tube back into the sample
9. Repeat the steps 4 more times each time using a different water sample.
10. Record that on the Hydrosphere Investigation Data Sheet.

11. Calculate the average of the 5 measurements.

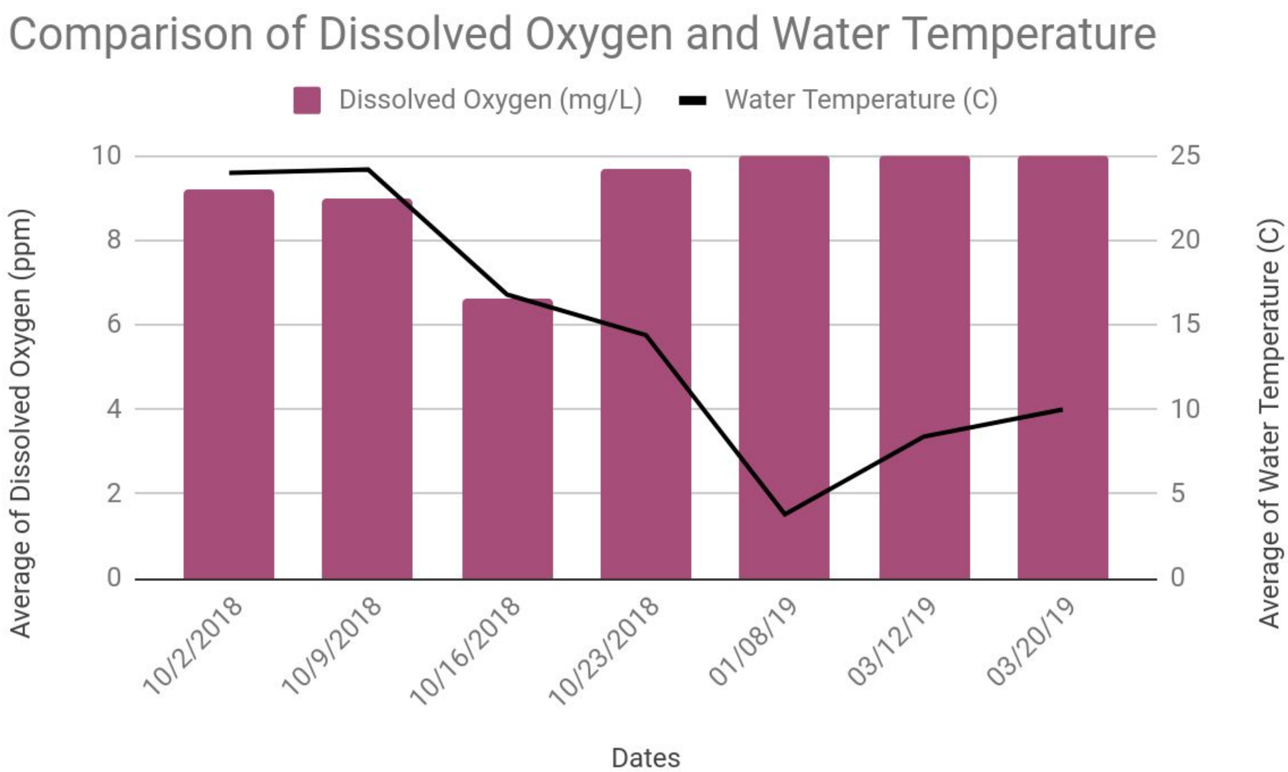
12. Clean up area and materials.

13. Enter the data into the GLOBE data entry site.

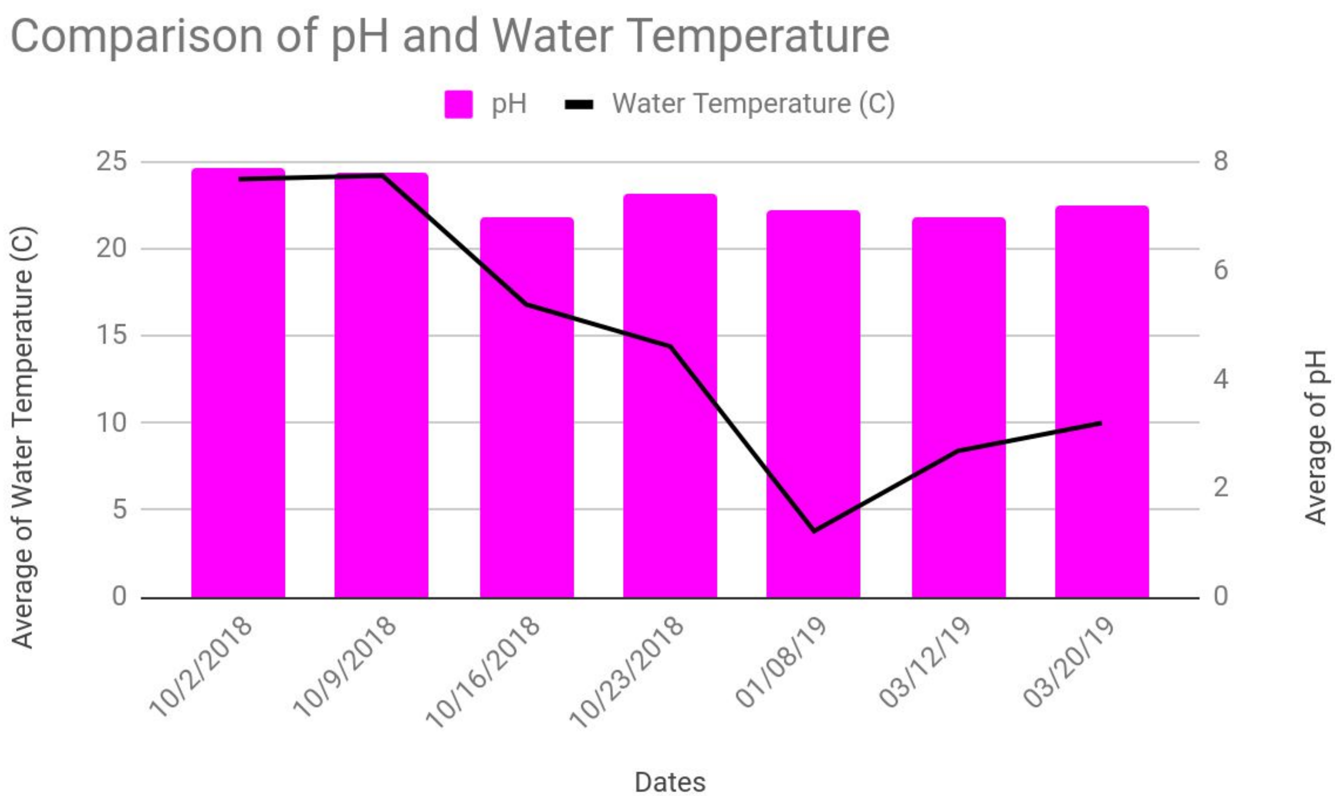
Data Summary

Dates	Dissolved Oxygen (mg/L)	pH	Water Transparency (cm)	Water Temperature (C)	Phosphate (ppm)
10/2/2018	9.2	7.9	58.1	24	1
10/9/2018	9	7.8	38.9	24.2	1.2
10/16/2018	6.6	7	60.5	16.8	1.2
10/23/2018	9.7	7.4	89.1	14.4	
01/08/19	10	7.1	63.1	3.8	
03/12/19	10	7	47.7	8.4	0
03/20/19	10	7.2	45.3	10	1

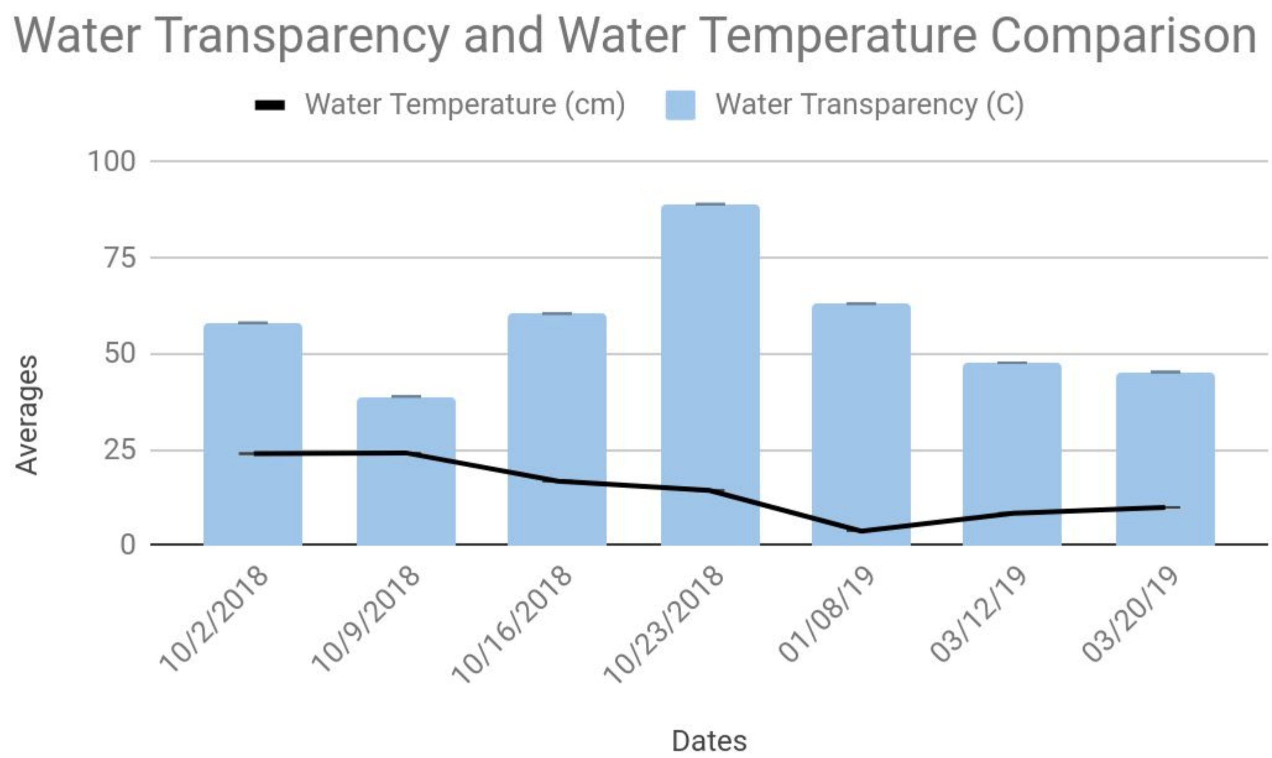
Table 1: This table shows the averages of pH, dissolved oxygen, phosphate, water temperature, and water transparency for the 7 weeks that were tested. The amount of DO was constant probably because of the water temperature levels being so cold. When the water temperature is colder, the dissolved oxygen is higher which might be why the dissolved oxygen levels were 10 mg/L. My kit maxed out at 10 mg/L, so if it was higher, I was unable to tell what that higher value was. Rain definitely could have caused the transparency levels to decrease because when it rains, Rock Creek and our school pond collide. Rock Creek collects runoff as well as the pond so runoff is another factor. However, it did not rain before October 9th. Wind and geese may have caused the transparency to be lower or it could have been we made a mistake when getting out reading.



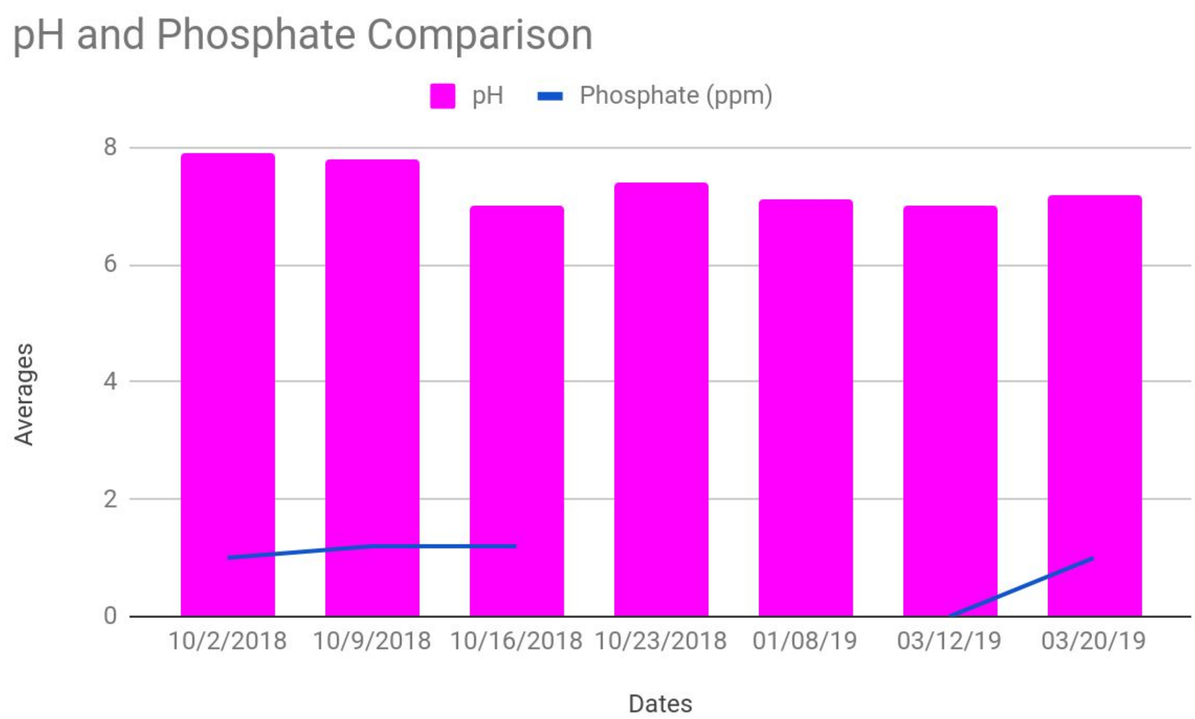
Graph 1: This graph shows the dissolved oxygen and water temperature averages for the 7 weeks that were tested. When the temperature was higher, the dissolved oxygen was lower and when the dissolved oxygen rose, the temperature dropped.



Graph 2: This graph shows the pH and water temperature averages for the 7 weeks that were tested. When the pH levels are higher, the water temperature levels are higher as well. When the pH dropped, the water temperature dropped as well.

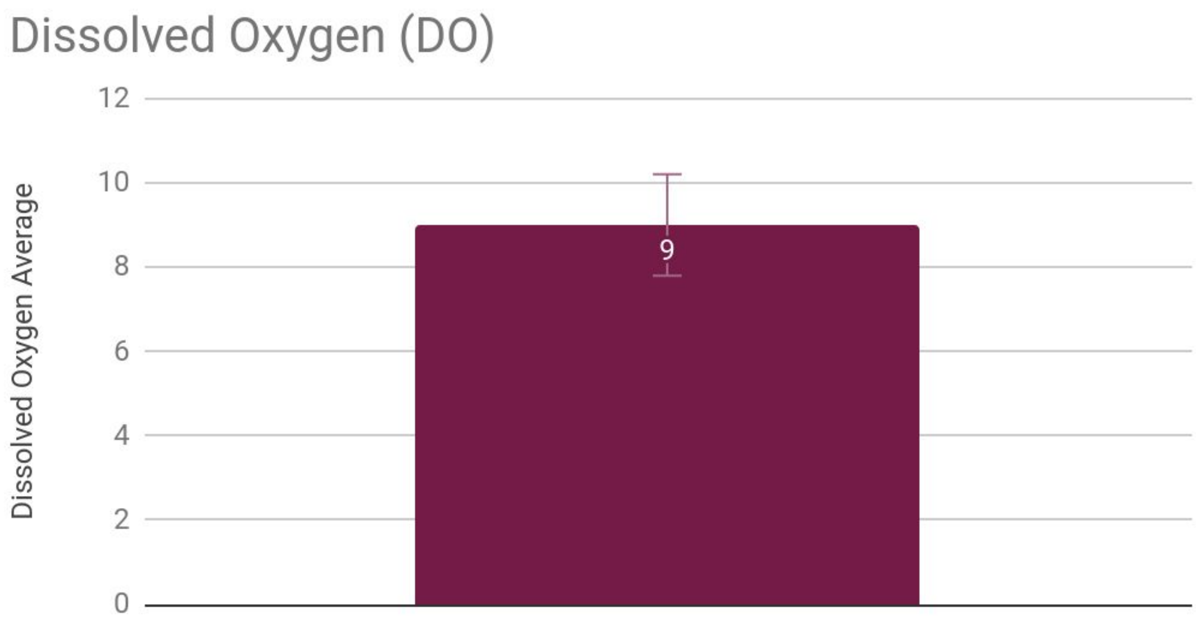


Graph 3: This graph shows the water transparency and water temperature averages for the 7 weeks that were tested. When the transparency levels are high, water temperature levels are low.

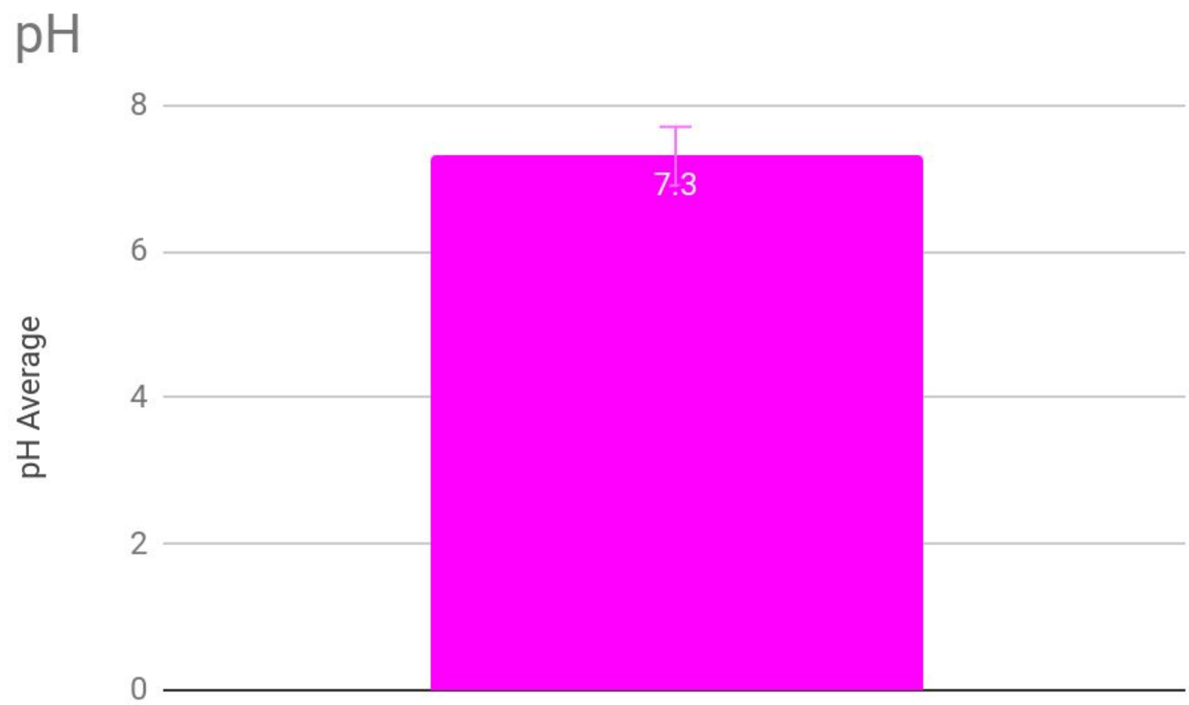


Graph 4: This graph shows the pH and phosphate averages for the 7 weeks that were tested.

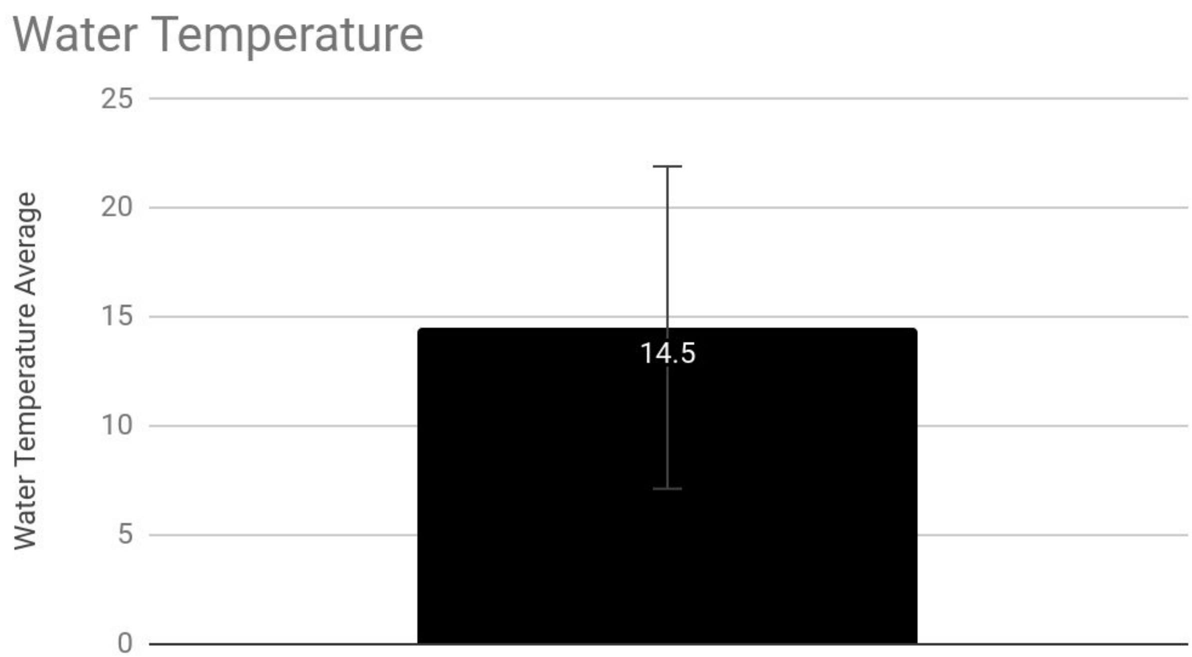
When the pH levels are high, the phosphate levels are low.



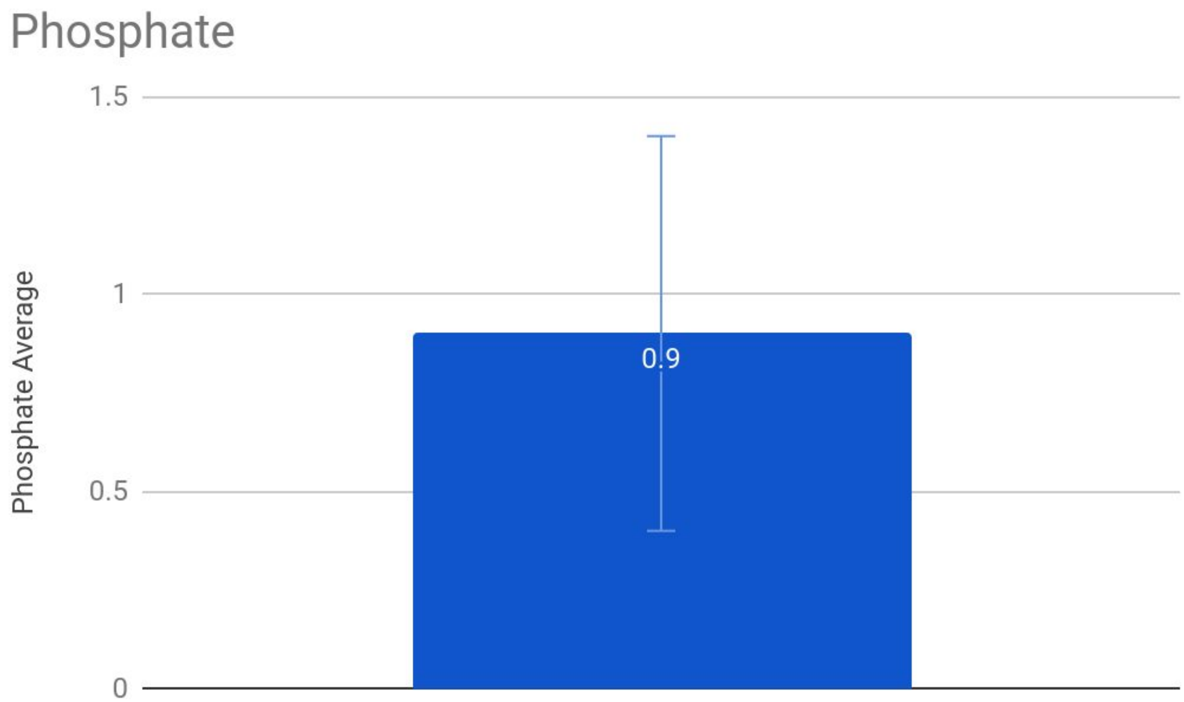
Graph 5: This graph shows the standard deviation average for dissolved oxygen and the error bars. The average was 9 and the error bar based on the standard deviation of the raw data was 1.2. Through research, the average DO (with variance) has remained within the recommended DO levels because a healthy dissolved oxygen level is between 4.0 mg/L to 10.0 mg/L.



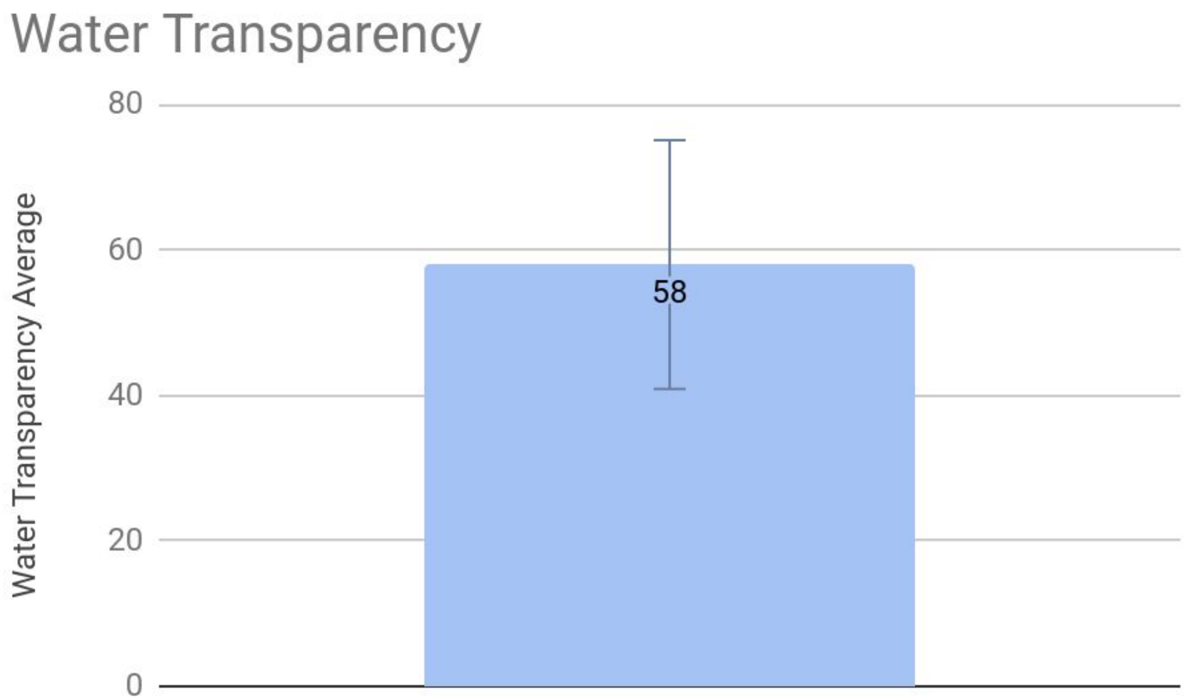
Graph 6: This graph shows the standard deviation average for pH and the error bar. The average was 7.3 and the error bar based on the standard deviation of the raw data was 0.4. Through research, the average pH (with variance) has remained within the recommended pH levels because a healthy pH level is between 6 and 8.



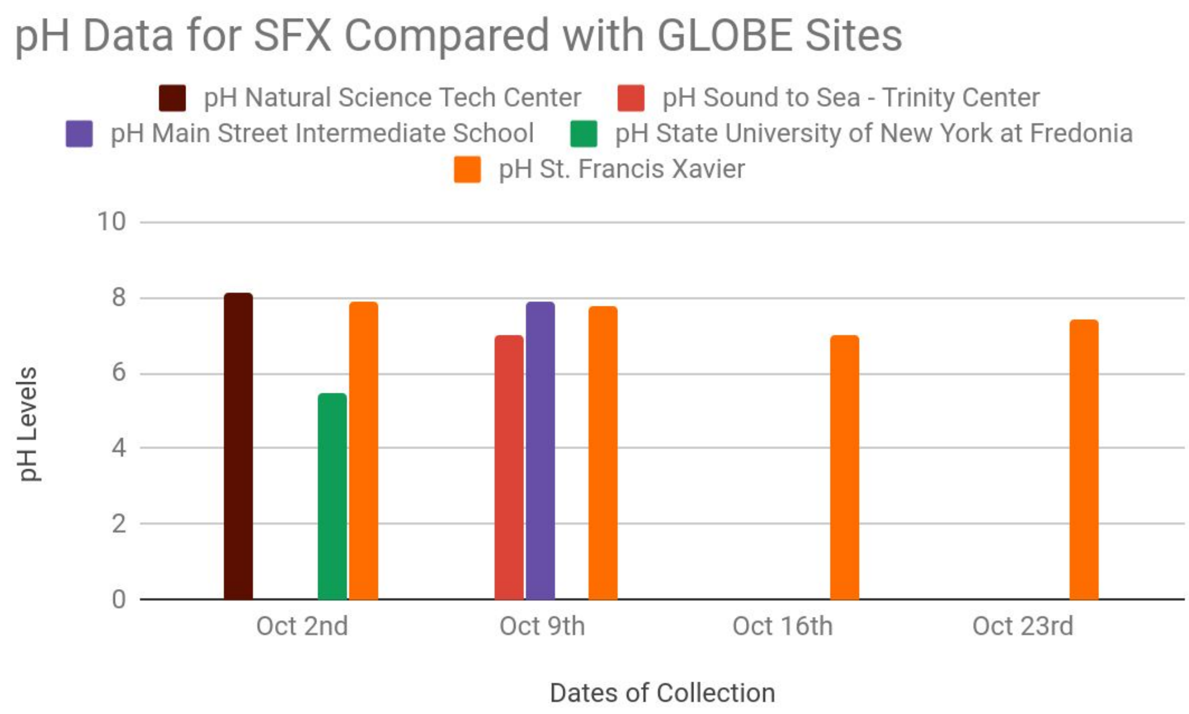
Graph 7: This graph shows the standard deviation average for water temperature and the error bar. The average was 14.5 and the error bar based on the standard deviation of the raw data was 7.4. Through research, the average water temperature (with variance) has remained within the recommended water temperature levels because a healthy water temperature level is between 0℃ and 32℃. The variance is higher because the temperature changes with seasons.



Graph 8: This graph shows the standard deviation average for phosphate and the error bar. The average was 0.9 and the error bar based on the standard deviation of the raw data was 0.5. Through research, the average phosphate (with variance) has not remained within the recommended phosphate levels because a healthy phosphate level is anything below 0.1ppm.

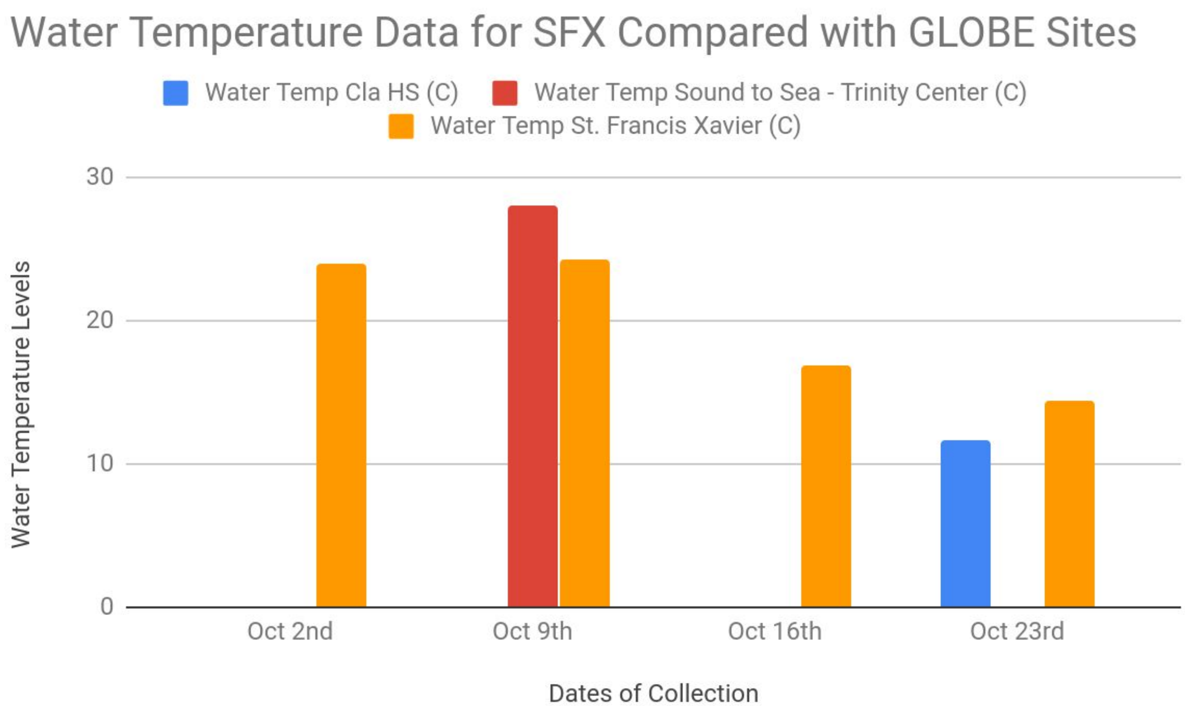


Graph 9: This graph shows the standard deviation average for water transparency and the error bar. The average was 54 cm and the error bar based on the standard deviation of the raw data was 17.1. Through research, the average water transparency (with variance) has remained within the recommended water transparency levels because a healthy water transparency level is anything below the top of the tube.

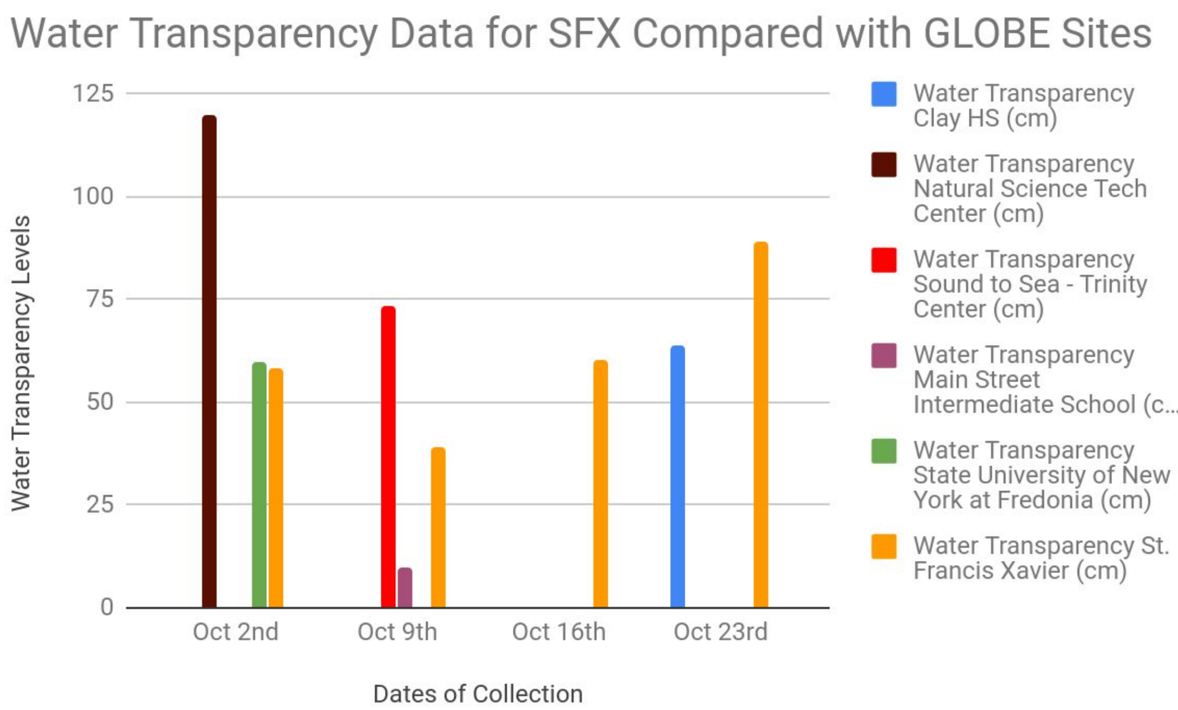


Graph 10: This graph shows the pH data from SFX compared with GLOBE sites on the dates that were collected at the SFX pond. On October 2nd, the pH data from the Natural Science Tech Center was the highest pH level compared to the State University of New York at Fredonia and the SFX pond. On October 9th, the pH data from Main Street Intermediate School was the highest pH level compared to the Sound to Sea Trinity Center and the SFX pond. On October

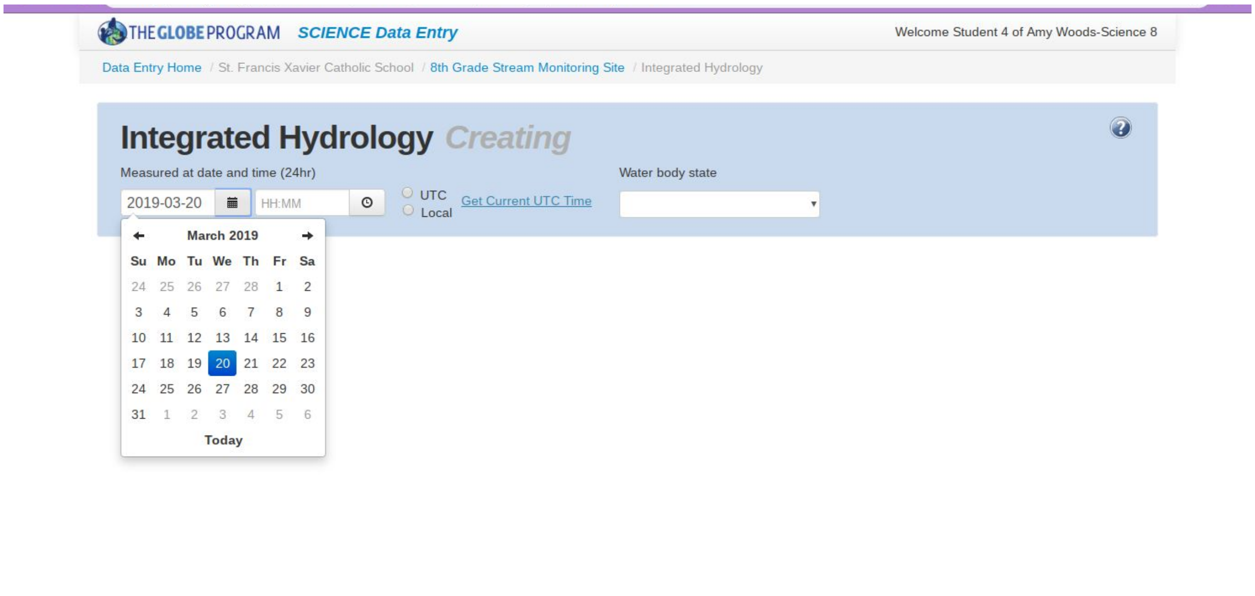
16th and 23rd, the SFX pond was the only data taken.



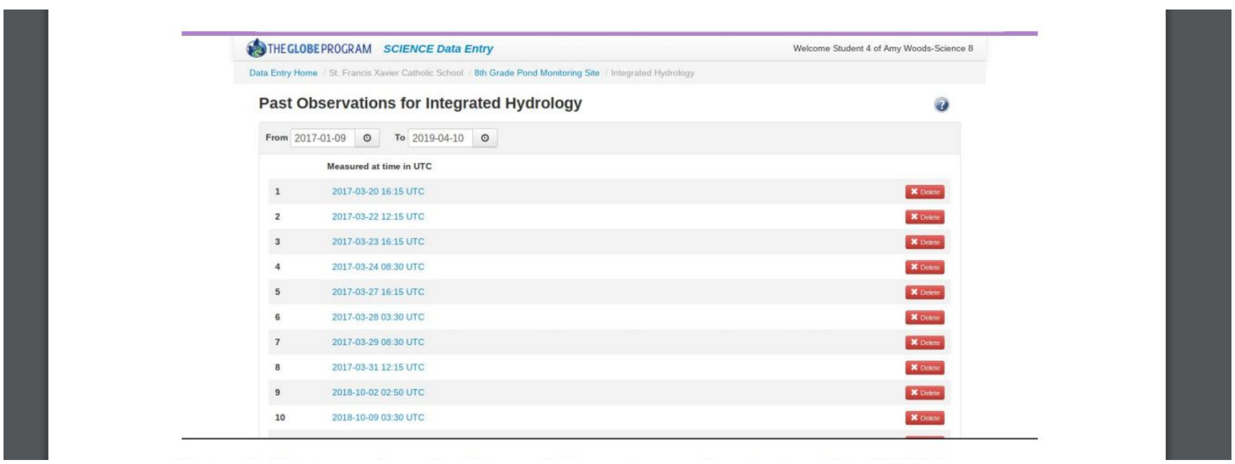
Graph 11: This graph shows the water temperature levels for SFX compared with GLOBE sites on the dates that were collected at the SFX pond. On October 2nd and 16th, the SFX pond was the only data taken. On October 9th, the Sound to Sea Trinity Center was the highest water temperature level compared to the SFX pond. On October 23rd, the SFX pond was the highest water temperature level compared to the Clay High School.



Graph 12: This graph shows the water transparency data for SFX compared with GLOBE sites on the dates collected from the SFX pond. On October 16th, the SFX pond was the only data collected. On October 2nd, the Natural Science Technology Center was the highest water transparency level compared to the State University of New York at Fredonia and the SFX pond. On October 9th, the Sound to Sea Trinity Center was the highest water transparency level compared to the Main Street Intermediate School and the SFX pond. On October 23rd, the SFX pond was the highest water transparency level compared to Clay High School.



Picture 1: This image shows the data being entered into GLOBE. Data was entered for each of the days of observation.



Picture 2: This image shows the history of observations made and entered into GLOBE.

Analysis and Results

The trend of pH in this data shows that the pH continuously came out at around 7 or 8. The trend of the dissolved oxygen in this data shows that the DO came out in the nines and tens, but did drop down to the sixes on October 16. The trend of the water temperature in this data shows that the water temperature ranged between 3℃ and 25℃. The trend of the water transparency in this data shows that the water transparency ranged between 37 cm and 99 cm. The trend of the phosphate in this data shows that the phosphate continuously was recorded between 1 ppm to 2 ppm.

In the first graph, the dissolved oxygen and water temperature shows that when the dissolved oxygen is low, the water temperature is high. When the dissolved oxygen rose, the water temperature dropped. Through research, the dissolved oxygen should be higher when the water temperature is colder because colder water can hold more oxygen. However, if there is a rapid temperature change in the water the dissolved oxygen will stay higher until the levels balance in the water which was the case on October 16. In the second graph, the pH and water temperature shows that when the pH was high, so was the water temperature. When the pH dropped, the water temperature dropped as well. Through research, when the water temperature increases or decreases the pH will shift as well. When the temperature increases, the pH will increase as well. In the third graph, the water temperature and water transparency shows that when the transparency levels are high, the water temperature levels are low. Through research, when the transparency levels are high, that means that the temperature levels should be low because there could be less rain and runoff and there is not much algae growing. In the fourth graph, the pH and phosphate shows that when the pH levels are high, the phosphate levels are low. Through research, when the pH levels are high, that means that the phosphate is not as toxic because it is less soluble. The data showed that the dissolved oxygen levels were good because a healthy dissolved oxygen level is between 4.0 mg/L and 10.0 mg/L, and the dissolved oxygen averages were between 6 mg/L and 10 mg/L. In the fifth graph, it shows the standard deviation average and the error bar for dissolved oxygen. The average was 9 and the error bar based on the standard deviation of the raw data was 1.2. Through research, the average DO (with variance) has remained within the recommended DO levels because a healthy dissolved oxygen level is between 4.0 mg/L to 10.0 mg/L. The pH levels were good because healthy pH levels are between 6 and 8, and the pH averages were between 7 and 8. In the sixth graph, it shows the standard deviation average and error bar for pH. The average was 7.3 and the error bar based on the standard deviation of the raw data was 0.4. Through research, the average pH (with variance) has remained within the recommended pH levels because a healthy pH level is between 6 and 8. The water temperature levels were good because a healthy range is between 0℃ to 32℃, and the water temperature averages were between 3℃ and 25℃. In the seventh graph, it shows the standard deviation average and error bar for water temperature. The average was 14.5 and the error bar based on the standard deviation of the raw data was 7.4. Through research, the average water temperature (with variance) has remained within the recommended water temperature levels because a healthy water temperature level is between 0℃ and 32℃. The phosphate levels were not good because a healthy level is 0.1 ppm and lower. The phosphate levels were between 0 and 1.2. In the eighth graph, it shows the standard deviation average and error bar for phosphate. The average was 0.9 and the error bar based on the standard deviation of the raw data was 0.5. Through research, the average phosphate (with variance) has not remained within the recommended phosphate levels because a healthy phosphate level is between 0.1 and below. The water transparency levels were good because a healthy level is normally closer to the top, and the water came up between 30 cm and 90 cm. In the ninth graph, it shows the standard deviation average and the error bar for water transparency. The average was 58 and the error bar based on the standard deviation of the raw data was 17.1. Through research, the average water transparency (with variance) has remained within the recommended water transparency levels because a healthy water transparency level is anything below the top of the tube. In the tenth graph, it shows the pH data from SFX compared with GLOBE sites on the dates that were collected at the SFX pond. On October 2nd, the pH data from the Natural Science Tech Center was the highest pH level compared to the State University of New York at Fredonia and the SFX pond. On October 9th, the pH data from Main Street Intermediate School was the highest pH level compared to the Sound to Sea Trinity Center and the SFX pond. On October 16th and 23rd, the SFX pond was the only data taken.

In the eleventh graph, it shows the water temperature levels for SFX compared with GLOBE sites on the dates that were collected at the SFX pond. On October 2nd and 16th, the SFX pond was the only data taken. On October 9th, the Sound to Sea Trinity Center was the highest water temperature level compared to the SFX pond. On October 23rd, the SFX pond was the highest water temperature level compared to the Clay High School.

In the twelfth graph, it shows the water transparency data for SFX compared with GLOBE sites on the dates collected from the SFX pond. On October 16th, the SFX pond was the only data collected. On October 2nd, the Natural Science Technology Center was the highest water transparency level compared to the State University of New York at Fredonia and the SFX pond. On October 9th, the Sound to Sea Trinity Center was the highest water transparency level compared to the Main Street Intermediate School and the SFX pond. On October 23rd, the SFX pond was the highest water transparency level compared to Clay High School.

Discussion

The data showed that the dissolved oxygen levels were good because a healthy dissolved oxygen level is between 4.0 mg/L and 10.0 mg/L, and the dissolved oxygen averages were between 6 mg/L and 10 mg/L. The pH levels were good because healthy pH levels are between 6 and 8, and the pH averages were between 7 and 8 . The water temperature levels were good because a healthy range is between 0℃ to 32℃, and the water temperature averages were between 3℃ and 25℃. The phosphate levels were not good because a healthy level should be no more than 0.1 ppm, and the phosphate levels were between 0 ppm and 1 ppm. There was also an excessive growth of water plants and algae. The water transparency levels were good because a healthy level is normally closer to the top, and the water came up between 30 cm and 80 cm . This data was expected because the research that was done was reflected from the pond levels that were shown. The research showed that the levels should be in a certain range to be considered healthy and they fell in that range.

The data supports the hypothesis except for phosphate. The average of the phosphate for 5 weeks is 0.88 ppm which rounds to 1 ppm. There was an excessive growth of of water plants and algae which shows that the phosphate levels are not good. There was a mistake when writing it down, but was realized and fixed.

Conclusion

The research showed that the levels should be in a certain range to be considered healthy and they fell in that range, for our school and the schools that I found values for using the GLOBE ADAT. There would be a variety of all kinds of macroinvertebrates because of the good water quality levels. Some of them include stonefly nymphs, mayfly nymphs, and caddisfly. Weather and kits running out of different materials were a common problem during this project. This project applies to the real world because the quality of the water is important to every living thing. This is important because if the water quality is not good, then the things living in it and using it will suffer. In the future, I would continue to compare my data to GLOBE data, compare my data to Lake Heritage data, take atmosphere testings and compare my data to that, test alkalinity and conductivity, talk to people like farmers to see what they are using and figure out if that has an effect.

Acknowledgements

I would like to thank Mrs.Woods for all the help she has given me to make my project successful. Also Arlene Sandoval and Matthew Grenchik who helped test the pond with me. Finally, I would like to thank my parents who have supported me throughout this entire project and will continue to support me as I compete in GLOBE.

GLOBE Student Research Badges

Data Scientist

My project was testing the water quality of the school pond and comparing my data to other GLOBE data. I think I qualify for this badge because I used other data to see whether my data is good compared to other data from the US and to see what we need to work on to improve the pond's health. I learned that our pond is healthy compared to other data but we still need to keep it healthy. I collected data over many months, analyzed, used the ADAT system to retrieve data from other GLOBE schools and added my data to the record for our school tracking the health of the pond.

Make an Impact

I believe I qualify for this badge because I wanted to help the pond's health and I wanted to see if there is anything that I can do to improve or help it. The pond is surrounded by farms and houses and I wanted to see if these had an impact on the health of the pond. I am going to try to find a way to help the phosphate levels decrease and by doing that the pond will start to become healthier. My research is also being presented to the Chesapeake Bay Foundation because our water flows into the Chesapeake Bay.

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