Protecting the Health of St. Francis

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Abstract

This experiment is designed to see if the water that is being provided to the St. Francis Xavier Catholic School students and staff from the Gettysburg Municipal Authority (GMA) has the same values as Marsh Creek in which the water comes from. The hypothesis states that if Marsh Creek is the source water for the Gettysburg Municipal Authority, then the St. Francis water from the fountains and faucets, should have different levels of salt, pH, chlorine, phosphate, and nitrate because if they have close to the same levels, the testing would indicate that the GMA would be adding too much or too little of the chemicals used to treat drinking water. The independent variable is the location of the water testing. The dependent variables measured are the salt (ppt), chlorine (ppm), pH, nitrate (ppm), and phosphate (ppm) levels of Marsh Creek and SFXCS water. The controlled variables are the amount of water, time of testing, and the protocols. This experiment was conducted by using LaMotte water quality kits to test the quality of Marsh Creek, the SFXCS water fountain, and the SFXCS water faucet. The data did not support the hypothesis, because the data was close to the same levels of all of the dependent variables at all of the locations. This is because partially there is not enough data to fully go into the investigation, and also because the stream is healthy enough that the water is not treated as much so that would be why the stream has similar values to the SFXCS water. This project will be continued and more data, throughout the seasons will be collected and analyzed.

Keywords: Water Quality, GMA, Source

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Research Question and Hypothesis

This experiment is designed to see if the water that is being provided to the St. Francis Xavier Catholic School students and staff from the Gettysburg Municipal Authority has the same values as Marsh Creek in which the water comes from. The independent variable is the location of the water testing. The dependent variables measured are the salt (ppt), chlorine (ppm), ph, nitrate (ppm),and phosphate (ppm) levels of Marsh Creek and SFXCS water. The controlled variables are the amount of water, time of testing and the protocols. The hypothesis states that if Marsh Creek is the source water for the Gettysburg Municipal Authority, than the St. Francis water from the fountains and faucets, should have different levels of salt, pH, chlorine, phosphate, and nitrate because if they have close to the same levels, the testing would show that the GMA would be adding too much or too little of the chemicals used for water treatment.

Introduction

Water is a molecule called H2O that contains two atoms of hydrogen and 1 atom of oxygen. Water is a transparent, odorless liquid that you can find in lakes, rivers, and oceans. It falls from the sky as rain or snow. Fresh water is the result of the earth's water on the hydrologic cycle. Water is important to human life and other organisms. The quality of water can have an effect on those humans and organisms. Water is generally a liquid that takes the form of the shape of a container. It can be a solid or a gas as well (Lawrence, 2013). When water is in liquid form, it is possible to mix substances, in which some substances dissolve (Lawrence, 2013). Water quality is a measure of the physical, chemical, biological, and microbiological characteristics of water (Meyers, 2018). Why monitor water quality? Monitoring provides objective evidence necessary to make sound decisions on managing water quality (Meyers, 2018). Results from a 27,000 groundwater investigation stated that more than half of the groundwater sites could contain corrosive water (Meyer, 2018). Monitoring water quality in the 21st century is a growing challenge because of the large number of chemicals in our everyday lives and that they can make it into our water (Meyer, 2018). Water quality can be thought as a measure of water for a particular use based on selected physical, chemical, and biological characteristics. Natural water quality varies from place to place. Seasons, climate, and different types of soils and rocks through which the water moves, are all factors into why it varies. When water from rain or snow moves over the land, and goes into the ground. The water dissolves mineral in rocks and soils, filters through organic material such as roots and leaves, and reacts with algae, bacteria, and other microscopic organisms. Water carries debris, sand, silt, and clay to rivers and streams making the water look muddy. Each of these natural process change to water quality and potentially the water use. To determine water quality, scientists first measure and analyze characteristics of the water such as temperature, dissolved mineral content and, the number of bacteria. All characteristics are tested by state guidelines to determine the use (Cordy, 2014).

Most common substances in water are common constituents, plant nutrients, trace elements. Common constituents are not considered harmful to human health, but they can be affect the taste, smell, or clarity of the water. Common constituents include calcium, sodium, bicarbonate, and chloride. Plant nutrients, and trace elements in water are harmful to human health and aquatic life if they exceed standards or guidelines. Plant nutrients include nitrates and phosphorus and trace elements include selenium, chromium, and arsenic. Nitrogen and phosphorus fertilizers that are applied to crops and lawns, can be easily dissolved in rainwater, but excess nutrients carried streams and lakes can cause abundant growth of algae, which leads to leads oxygen and dead. Adequate oxygen levels in water as a necessity for a fish and other aquatic life. Radon gas can be a threat to human health when it exceeds drinking-water standards. Urban and industrial development, farming, mining, Combustion of fossil fuels, Steam channeled alterations, animal feeding operations, and other human activities can change the quality of natural waters.There are so many chemicals used today that determining the risk to human health and aquatic life is to complex task (Cordy, 2014).

The quality of our water cannot be assured by chemical analysis alone. Disease-causing Pathogans can enter our water from leaking septic tanks (Cordy, 2014). Efforts to improve water quality focus largely or reducing the amount of nutrients, sediments, and chemicals (CBF, 2019).

The Salt is a compound of sodium (Na+) and chlorine (Cl-). Salt is known as sodium chloride or NaCl (Kurlansky, 2014). Sodium chloride is the most common of the sodium compound (Jackson, 2017). Salt comes from eroded rocks. Rainwater carries salt and minerals to the rivers and the streams which carry them to the ocean (Leslie, 2015). When water warms up, it holds less oxygen. The sun’s heat evaporates the water but not the salt. When it is cool, there is plenty of oxygen and a low amount of salt. When it is warm there is less oxygen and more salt (Bredeson, 1999). This is due to the fact that when the sun warms the water, the oxygen molecules go up with the evaporated water but the salt does not. In water, salt grains fall apart until they are so small that they are unseen among the water molecules (Richards, 2008). This is important to the research because if the temp is high, the observer can inference what the result of the DO and salt are. Salt is the only rock eaten by humans. Human bodies have about

250 mg of salt, though it does need to be replenished. Without salt, human bodies would not be able to transport nutrients or oxygen which would leave our bodies not able to function at all (Kurlansky, 2014). Salt would be given to animals directly so farmers would not have to worry about putting salt on their meat (Kurlansky, 2014). Too much salt can lead to high blood pressure which causes heart problems, which can be caused by many things, including food and drink. Pollution reduces oxygen, which then increases salt in the water (Robson, 2001). Salt is a clear brittle material (World Book INC (S-SN), 2009). Following the record-breaking snowfall in 2014, many states remedied icy road conditions with greater amounts of road salt. According to a report, done by the USGS National Water Quality Assessment Program, since salt was introduced as a deicing agent, the application of salt has increased dramatically. While sodium chloride improves roads and road conditions by effectively melting ice, these salts are also ending up in our streams and rivers. Studies have shown the increasing saltiness of freshwater sources, also known as salmization. Water dissolves lots of sediment and it also breaks salt rocks. If salt levels rise above their recommended level, the DO will drop, causing more algae and less fish (StroundCenter, 2014). Road salt does not just disappear when the snow and ice melts. Researchers in Minnesota found that 70% of the road salt stays within the region's watershed. Road salt washes into the creek, rivers, streams, and lakes, and seeps into the groundwater supply (Rastogi, 2010). Salt makes the human body hold on to water. If someone eats to much extra salt, the extra water stored gets stored in the body which raises the blood pressure. The higher the blood pressure, the greater strain on the heart, arteries, kidneys, and brain. This can lead to heart attacks, strokes, dementia, and kidney disease (BloodPressure UK, 2008).

Chlorine is a highly reactive gas that does not form naturally. Chlorine is a poisonous gas with a strong and unpleasant odor. Chlorine dissolves when mixed with water (LennTech, 2019) It causes irritation to the throat, lungs, and nose (World Book INC (C-CH), 2009). Carl Wilhelm Scheele first made chlorine in Sweden 1774, but it was not discovered an element until Sir Humphry Davy determined it as a chemical element in 1810, England (World Book INC (C-CH), 2009). Chlorine kills bacteria in the water. It is commonly used to purify drinking water (World Book INC (C-CH), 2009). Chlorine causes environmental harm at low levels. Chlorine is especially harmful to organisms living in water and in soil (LennTech, 2019)

pH is a measure of how acidic/basic something is. pH is used to specify the acidity of a solution. pH is really a measure of the relative amount of free hydrogen and hyrodroxi ions in the water. The pH determines the solubility (amount that can be dissolved in the water), and biological availability (amount that can be used by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon. pH is a number used to determine the amount of hydrogen ions in a solution (Perlman, 2018). pH stands for "potential hydrogen." A pH below 7 is acidic and above 7 is basic. The scale is 0 to 14. Pure Water is neither so it is 7. A Netherland biochemist, Soren Sorensen, created the pH system. pH is either tested/measured with an electric pH meter or special dyes known as acidic-base indicators (World Book INC (P), 353). pH is important to water to make sure that the water is not too acidic or too basic for the humans and organisms that use it. This is because if humans and organisms drink too acidic water, that would be like drinking battery acid (which could be fatal). If someone drinks a too basic or alkaline water, that would be like drinking bleach (which could also be fatal), so it is important to drink water that is around the pH level of 7-8. Excessively high and low pHs can be detrimental for the use of water. High pH can cause a bitter taste, water pipes, and water-using appliances become encrusted with deposits and depresses the effectiveness of the chlorine there by causing the use of more chlorine when pH is higher. Low pH water will corrode or dissolve metals and other substances (Perlman, 2018).

Nitrate is a compound that contains the inorganic nitrate ion. Nitrates naturally exist within the environment at relatively low levels (TestAssured, 2016). There are two important kinds of nitrates, potassium and ammonium nitrates. Most people get nitrates from vegetables (World Book INC (N), 125). This is important because the amount of nitrates in the water the more sediment and vegetation gets into the drinking water source. Increased levels of nitrates can cause serious health issues, especially for pregnant women and children. The level of recommended nitrate is 10 ppm. High levels of nitrates can impact your Hemoglobin in your blood. Hemoglobin transports oxygen from one cell to another cell. Excessive levels change your Hemoglobin into your Methemoglobin (which reduces the blood's ability to transfer oxygen throughout the body). Your body normally contains 2.5% of Methemoglobin, but that rate is increased when nitrates are present Nitrate water contamination is particularly dangerous for pregnant women because pregnancy increases their levels of methemoglobin. Babies are also highly vulnerable to this type of water contamination because they have exceptionally high pH levels in their stomachs. Infants under six months old who drink contaminated water can become dangerously ill and, if untreated, may die (TestAssured, 2016).

The body needs phosphorus to build and repair bones and teeth, help nerves function, and make muscles contract. The kidneys help control the amount of phosphate in blood. The amount of phosphate in the blood affects the level of calcium in the blood. Phosphate enters water by human and animal waste, rich bedrock, laundry, cleaning, industrial effluents, and fertilizer runoff (WaterResearch, 2017).

Marsh Creek is a 77 square-mile watershed. It starts near South Mountain and Michaux State Forest. Marsh Creek is rated a CWF - Cold Water Fishes (fish maintenance and propaganda, or both, of fish species including the family Salmonide and additional flora and fauna which are indigenous to a cold water habitat) and a MF - Migratory Fish (Passage, maintenance and propagation of anadromow and catadromous fish and other fish which moves to or from flowing waters to complete their cycle in other waters)(Hallinan, 2018).

Materials and Methods

- Salt Kit - AquaChek® Pool and Spa Test Strips
    - Test for Salt
        - 1x10 strips
- Chlorine Kit - LaMotte Chlorine Kit (#3312-01)
    - Octa-Slide 2
    - 0.1-1.0 ppm
        - Test for Free and Total Residual Chlorine
        - 1x50 Chlorine DPD #1R Tablets (6999A)
        - 1x50 Chlorine DPD #3R Tablets (6905A)
        - 2 Test Tubes, 2.5-5-10 mL, plastic, w/caps
        - 1 Octa-Slide 2 Viewer
        - 1 Chlorine Octa-Slide
- pH Kit - LaMotte Precision pH Kit (#5858-01)

    - Octa-Slide 2
    - 3.0-10.5 pH
        - 2x30mL Wide Range pH Indicator
        - 2 Test Tubes, 2.5-5-10 mL, plastic, w/caps
        - 1 Wide Range pH Octa-Slide 2 Bar, 3.0-6.5
        - 1 Wide Range pH Octa-Slide 2 Bar 7.0-10.5
        - 1 Octa-Slide 2 Viewer
- Dissolved Oxygen - LaMotte Dissolved Oxygen Kit (#5860-01)
    - Water Quality Test Kit
        - 1x30mL Manganous Sulfate Solution
        - 1x30mL Alkaline Potassium Iodide Azide
        - 1x30mL Sulfuric Acid
        - 1x60mL Sodium Thiosulfate
        - 1x30mL Starch Indicator Solution
        - Direct Reading Titrator (0-10mL)
        - Test Tube, 5-10-12.9-15-20-25mL, glass, w/cap
        - Water Sampling Bottle, 60mL, glass
- Phosphate - LaMotte Phosphate Kit (#4408-01)
- Octa-Slide 2
- 1-10 ppm
- 2x30mL VM Phosphate Reagent
- 1x30mL Reducing Reagent

- 1 Pipet, dropping, plastic
- 1 Pipet, 1.0mL, plastic
- 1 Pipet, 0.5mL, plastic
- 2 Test Tubes, 2.5-10mL, plastic, w/caps
- 1 Phosphate Octa Slide Bar, 1-10ppm
- 1 Octa-Slide Viewer
- Nitrate - LaMotte Nitrate Nitrogen Tablet Kit (#3354-01)
- Octa-Slide 2
- 0 - 15ppm
- 1x50 Nitrate #1 Tablets
- 1x50 Nitrate #2 CTA Tablets
- 2 Test Tubes, 2.5-10.0mL, plastic, w/caps
- 2 protective sleeves
- 1 Nitrate Nitrogen Octa-Slide 2 Bar, 0 - 15ppm
- Octa-Slide 2 Viewer
- Temperature - Alcohol filled Thermometer
- Alcohol filled Thermometer
- String (30 cm)
- Rubber Band
- Transparency - Tube
- Plastic Tube
- LASCO PVC pipe ender

- Flexible meter strip (112cm)
- Packing tape
- Caulk
- Disposable Nitrile Gloves (Grease Monkey)
- Gorilla Grip
- Large
- Count 50 gloves
- AO Safety™ TourGuard III Safety Glasses
- Eye and Face Protection
- 11.4 L bucket
- 11.35mL container
- Distilled Water
- Clock, Watch, iPhone 8, or iPad
- Meter Stick
- 30cm Ruler
- Scissors (Westcott)
- Pen (BIC Round Stic M)
- George Rubber Boats
    - Size 11
- Driver (my father, mother, and grandfather)
- Vehicle (2012 Chevrolet Silverado, truck)
- Cardboard

- Duct Tape
- Hydrospheric Investigation Data Sheet

Collecting Water at SFXCS

Water Fountains

1. Grab an 11.4 L bucket
2. Walk down the hallway about 9.5m to the water fountains (near the Family Restroom)
3. Put the bucket up to one of the water fountains
4. Fill the bucket up about a ¼ of the way filled
5. Walk back to the Science Lab
6. Be sure not to mix the water from the sink with the water from the water fountain

Sink

1. Walk into the 8th grade homeroom/Science Lab
2. The observer must walk back to the sink in the back of the classroom (near the salt water tank)
3. Grab an 11.4 L bucket
4. Fill the bucket about ¼ of the way full
5. The observer is now ready to test
6. Be sure not to mix the water from the water from the fountain with the sink water

Collecting Water at Marsh Creek

Directions to Marsh Creek (@Sachs Covered Bridge)

1. Head southwest on Highland Ave toward Long Ln - (60.96 m)
2. Turn left onto Long Ln - (0.16 km)

3. Turn right onto US-15 BUS S - (1.93 km)
4. Turn right onto Millerstown Rd (continue on Pumping Station Rd) - (1.93 km)
5. Turn left onto Roberta Way - (0.32 km)
6. Turn right onto Waterworks Rd - (0.48 km)
7. The Observer has arrived at Sachs Covered Bridge, Waterworks Rd, Gettysburg, PA 17325

Collection of Water

1. Park vehicle
2. Grab 11.4 L bucket
3. Walk down the smaller ramp
4. Turn to the left and back
5. Walk over to Marsh Creek
6. Find the GMA pipe
7. Walk to the left of that on the concrete
8. Put the bucket in water (if the observer can not reach enough water, walk into the creek)
9. If the observer encounters any wildlife in the bucket, pour water back in the creek and redraw water from the creek (if constantly encountering wildlife, grab a tiny net and pull out wildlife)
10. Take the water back to the truck and set up a lab
11. The only tests that will be taken directly from Creekside are the DO and the Water Temperature (everything else will be taken from bucket collected water)

Preparing for Water Testing

Order of Testing

1. SFXCS - Water Fountain (be sure that once done, completely dry out)
2. SFXCS - Faucets (be sure that once done, completely dry out)
3. Marsh Creek - Creek (be sure that once done, completely dry out)

Safety

1. Take out the safety glasses and a pair of gloves
2. Place safety glasses on face (over glasses)
3. Place the safety gloves over the observer's hands
4. At SFXCS the observer does not have to put on rubber boats, but at Marsh Creek, take shoes off and place rubber boats on feet
5. The observer is now ready to test

Preparing Lab Setup

1. Clear the table or tailgate of all things
2. Clean and sanitize the area of all things
3. Place cardboard down
4. Tape the cardboard down to the table or tailgate
5. Set up a lab with the kits in a semicircle
6. Be sure to have materials needed with that kit

Water Testing

Salt - Procedure (as per GLOBE protocols)

1. Fill out the top portion of your Hydrosphere Investigation Data Sheet.
2. Grab a 10 mL beaker and fill it about 2.5 cm with sample water

3. Place the bottom side of the strip (with the #1) in the water
4. When the yellow strip at the top turns dark (3 to 4 mins) take the strip out of the water
5. Compare where the center brown line stops to the number to ppt ratio
6. Repeat Steps 2-5 using new samples of water. Record the salinity measurements as Test 2,3,4, and 5.
7. Calculate the average of the five measurements
8. Each of the five measurements should be within 2 ppt of the average. If one or more of the observations is not within 2.0 ppt, do the measurement again and calculate a new average. If the measurements are still not within 2.0 ppt of the new average, talk to the observer's teacher about possible problems.

Chlorine - Procedures

1. Insert Chlorine Octa-Slide 2 into Chlorine viewer
2. Fill test tube up to 5 mL line with the sample water
3. Add one DPD #1R tablet into the sample water
4. Place cap on test tube
5. Shake the tube until the tablet is disintegrated
6. Insert the test tube into the viewer
7. Match the sample watercolor to then Octa-Slide 2
8. Record as ppm free available chlorine
9. (if the observer are testing for the total residual chlorine, follow the same steps except insert tablet #3R in the pre-mixed test tube and record as ppm total residual chlorine)
10. Repeat the steps 2 more times

pH - Procedures (as per GLOBE protocols)

1. Fill out the top part of the Hydrosphere Investigation Data Sheet
2. Insert wide range pH octa-slide bar (2193-01 or 2196-01) into pH viewer
3. Fill test tube to the 10mL line with sample water
4. Add 10 drops of Wide Range pH indicator
5. Cap the test tube
6. Shake the test tube (until all mixed up)
7. Insert test tube into viewer
8. Match sample color to the color standard
9. Record as pH
10. If the one slide bar that is in does not match color, insert the other slide bar
11. Repeat 4 more times

Nitrate - Procedures (as per GLOBE protocols)

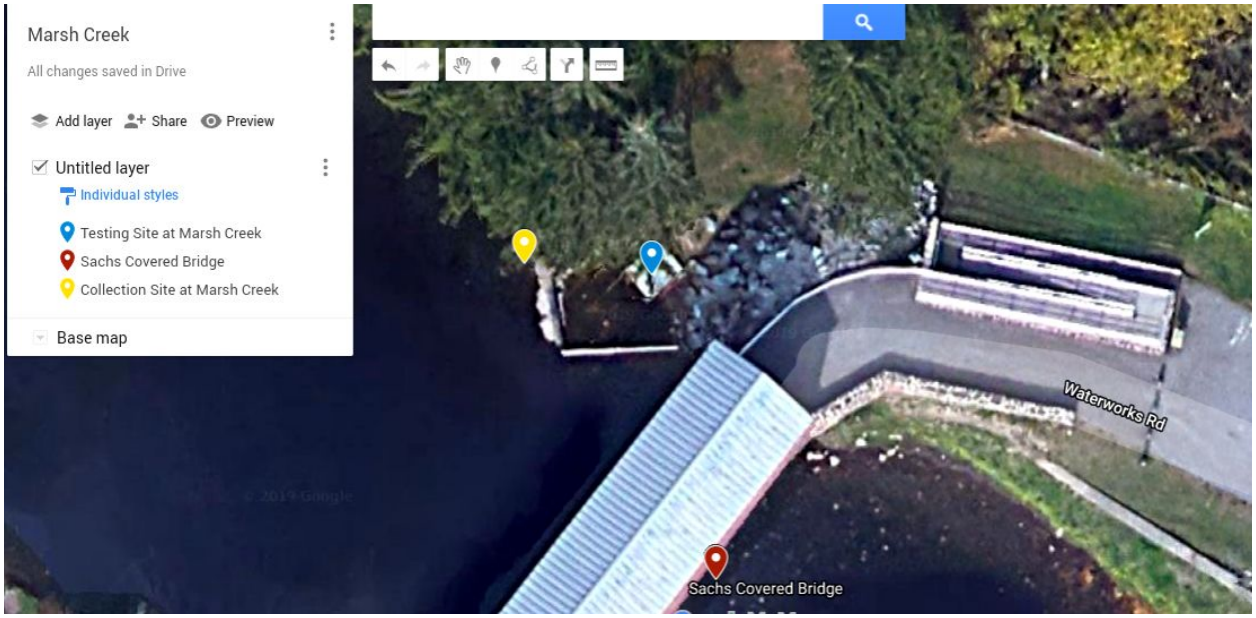
1. Fill out the top portion of the observer's Hydrosphere Investigation Data Sheet. In the Nitrate
section fill in the kit manufacturer and model.
2. Put on gloves and goggles.
3. Follow the instructions in the observer’s kit to measure the nitrate nitrogen. the observer should use the Low Range Test (0 – 1 mg/L) unless previous results indicate that the observer’s site typically has greater than 1 mg/L nitrate nitrogen. If using powdered reagents, use the surgical mask when opening these products. Use a clock or watch to measure the time if the observer kit requires the observer to shake the observer’s sample.

4. Insert Nitrate Octa-Slide 2 bar into Nitrate viewer
5. Fill test tube to the 5mL line with the sample water
6. Add one Nitrate #1 tablet
7. Put the cap on
8. Mix/Shake until the tablet disintegrates
9. Insert Nitrate #2 CTA tablet immediately
10. Immediately slide the test tube into the protective sleeve
11. Cap the bottle
12. Mix the solution for two minutes
13. Wait 5 minutes, remove tube from protective sleeve
14. Insert test tube into viewer
15. Match sample color to viewer
16. Record as ppm Nitrate Nitrogen
17. Match the color of the treated sample water with a color in the test kit. Record the value as ppm nitrate-nitrogen for the matching color. Do five other tests match a color with the treated sample water for a total of five observations. Record all five nitrate-nitrogen values on the Data Sheet.
18. Calculate the average of the five measurements.
19. Check to see if each of the five measurements is within 0.1 ppm of the average (or within 1.0 ppm of the average if using the high range test). If they are, record the average on the Data Sheet. If they are not, read the color measurements again (Note: do not read again if it has been more than 5 minutes). Calculate a new average. If the

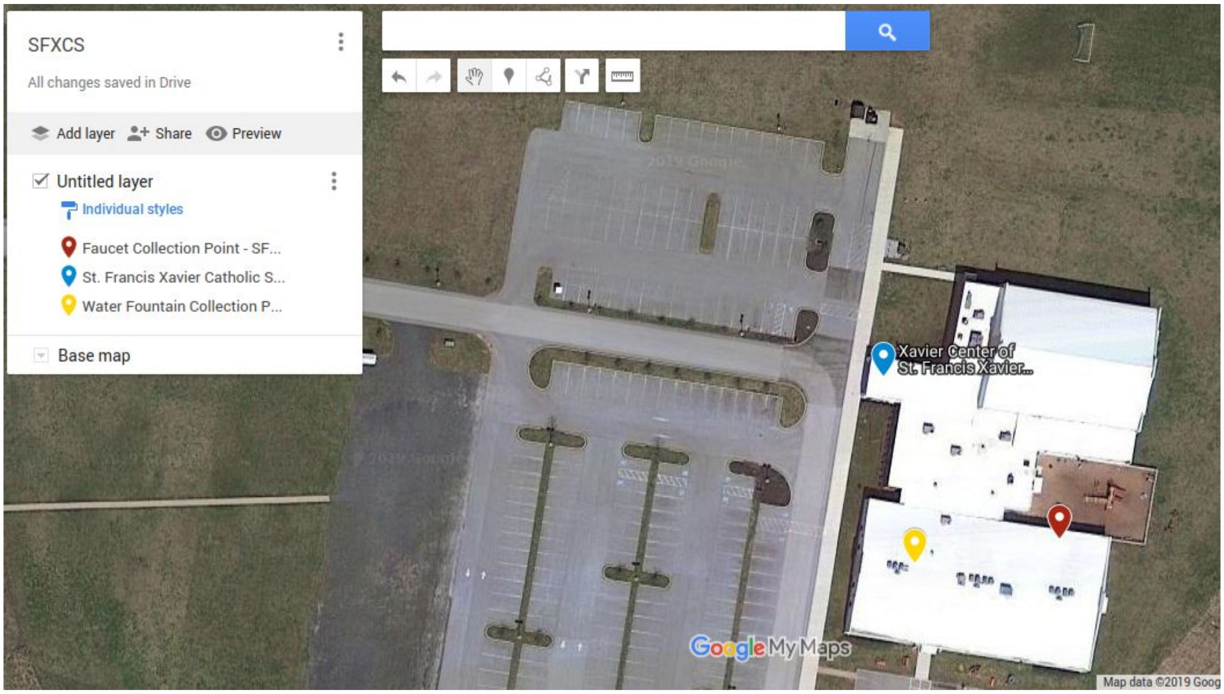
measurements are still not within range discuss possible problems with the observer's teacher.

Phosphate - Procedures

1. Insert the Phosphate Octa-Slide 2 bar into phosphate viewer
2. Fill test tube to 10 mL line with the sample water
3. Use the 1.0 mL pipet to add 1.0 ml of Phosphate Acid Reagent
4. Cap test tube
5. Invert tube several times (which mixes sample water)
6. Use 0.1 g spoon to add one level measure of Phosphate Reducing Reagent
7. Cap test tube
8. Mix sample water
9. Insert test tube into viewer
10. Match color to color standard
11. Record as ppm Phosphate



Map 1: This map shows the location of the testing site, collection site, and Sachs Covered bridge, all at Marsh Creek. If you were to go north, you would find the GMA Water Treatment building.



Map 2: This map shows the location of the faucet, water fountain, and the location, all out at the SFXCS building.

Data Summary

Marsh Creek	Salt (ppt)	Chlorine (ppm)	pH	Nitrate (ppm)	Phosphate (ppm)
Week 1	0.2	0.02	7.2	0.4	0.8
Week 2	0.12	0	7.4	0.8	0.2
Week 3	0	0	7.5	1.2	0.2
Week 4	0	0	7.3	1.6	
Week 5	0	0	7.6	1	
Week 6	0.08	0.1	7.3	2.4	
Week 7	0	0	7.2	1.4	0.4
Week 8	0	0	7.2	1.4	0.6
Week 9	0	0.06	7.4	1.8	0.2
Week 10	0.02	0	7.1	1.2	0.6

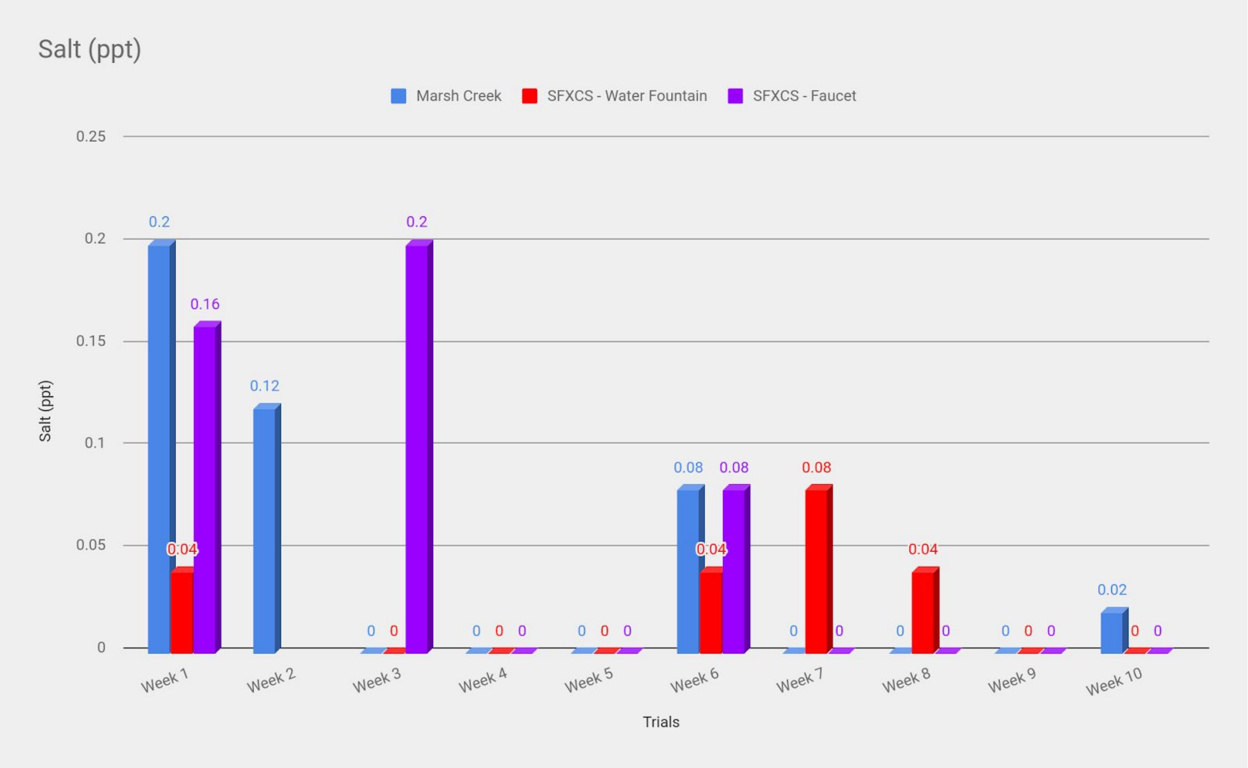
Table 1: This table shows the levels of salt, chlorine, pH, nitrate, and phosphate at Marsh Creek. There are 3 weeks that do not have phosphate, due to the fact that the kit ran out of materials in phosphate. Week 6, when the observer went out, and accidentally fell in the creek while testing. There were a few weeks were the observer did not go out and test, cause the observer had a hectic weekend, but the dates are as close as they can be.

SFXCS - Water Fountain	Salt (ppt)	Chlorine (ppm)	pH	Nitrate (ppm)	Phosphate (ppm)
Week 1	0.04	0	7.1	1.6	0.6
Week 2		0	7.5	0.8	0.2
Week 3	0		7.4	1.4	0.8
Week 4	0	0.1	7	1.6	
Week 5	0	0	7.3	1.6	
Week 6	0.04	0.1	7.3	1.6	0
Week 7	0.08	0	7.6	1.4	0.4
Week 8	0.04	0.06	7	0.8	0.2
Week 9	0	0.03	7.4	1	0.6
Week 10	0	0	7.5	1.8	0.4

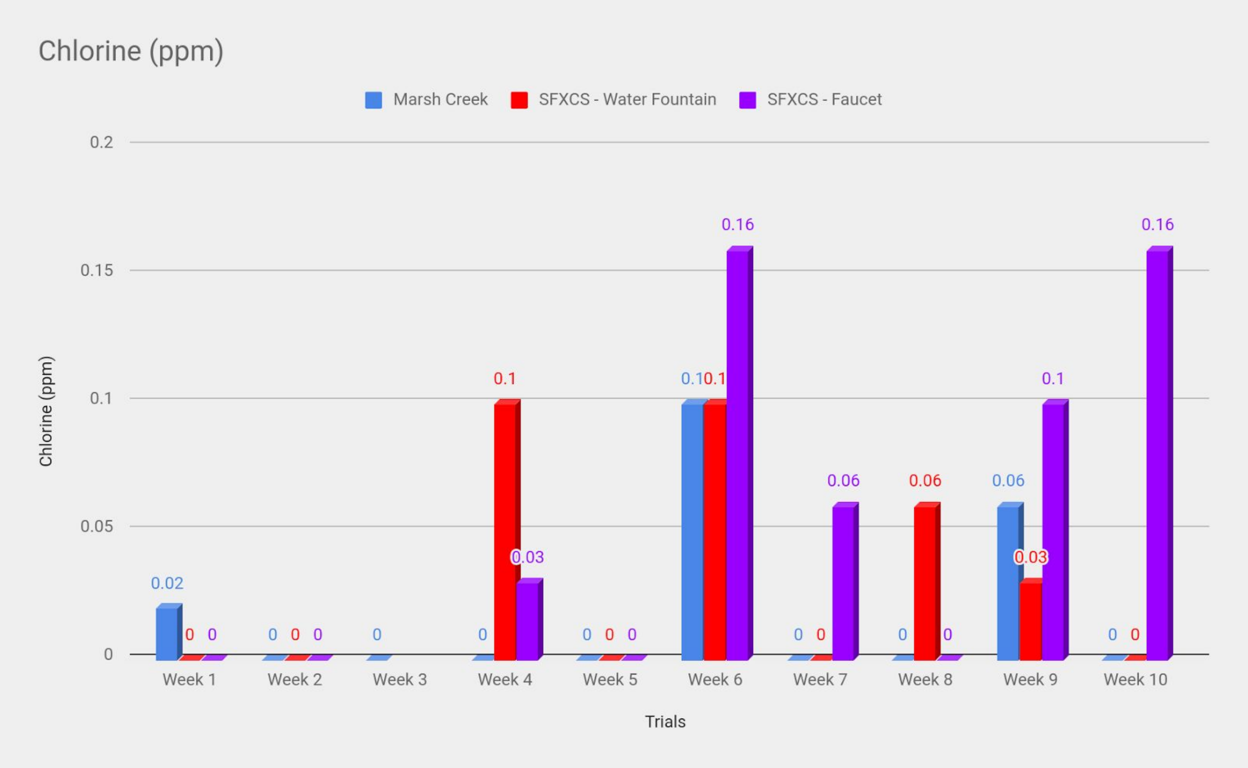
Table 2: This table shows the levels of salt, chlorine, pH, nitrate, and phosphate at the SFXCS water fountain. The week 2 salt is missing the average due to the fact that the material ran out while testing. The week 3 chlorine is missing the average due to the same reason of the materials running out. The Week 4 and 5 phosphate is missing cause of trying to order more material for the kit.

SFXCS - Faucet	Salt (ppt)	Chlorine (ppm)	pH	Nitrate (ppm)	Phosphate (ppm)
Week 1	0.16	0	7.4	0.8	0
Week 2		0	7.3	0.8	0.6
Week 3	0.2		7.5	1.8	0.4
Week 4	0	0.03	7.2	1	
Week 5	0	0	7.1	1.6	
Week 6	0.08	0.16	7.2	1.2	0
Week 7	0	0.06	7.1	1.2	0.8
Week 8	0	0	7.3	1	0.6
Week 9	0	0.1	7.2	1.8	0.2
Week 10	0	0.16	7.6	1.4	0.6

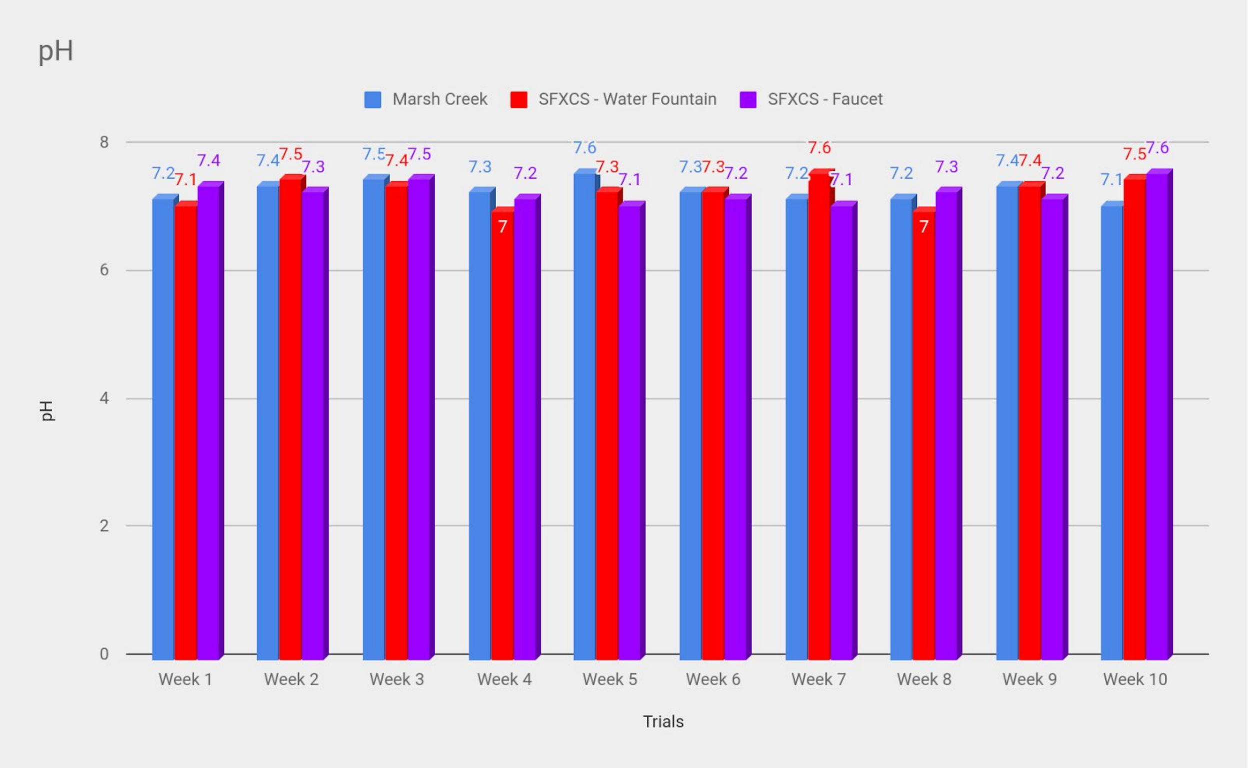
Table 3: This table shows the levels of salt, chlorine, nitrate, phosphate, and pH at SFXCS faucet. The week 2 salt is missing the average due to the fact that the material ran out while testing. The week 3 chlorine is missing the average due to the same reason of the materials running out. The Week 4 and 5 phosphate is missing cause of trying to order more material for the kit.



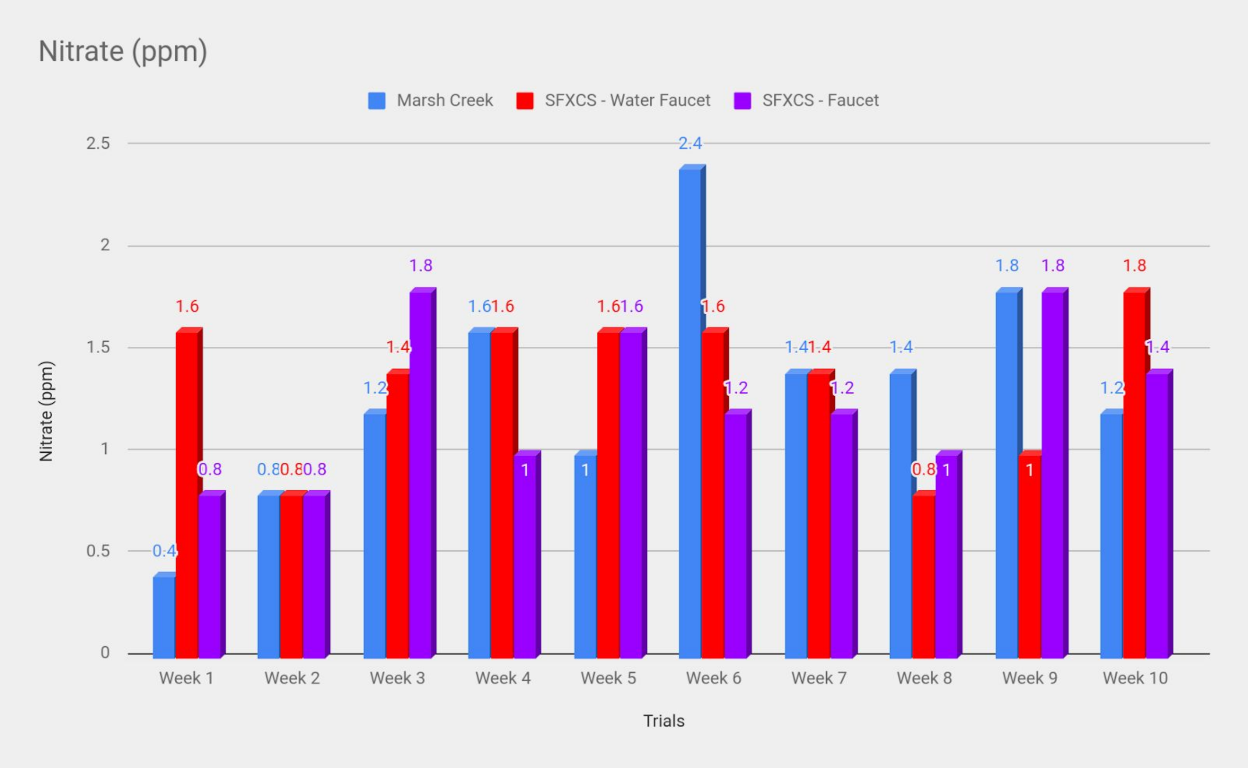
Graph 1: This graph shows the comparison of salt at each location.



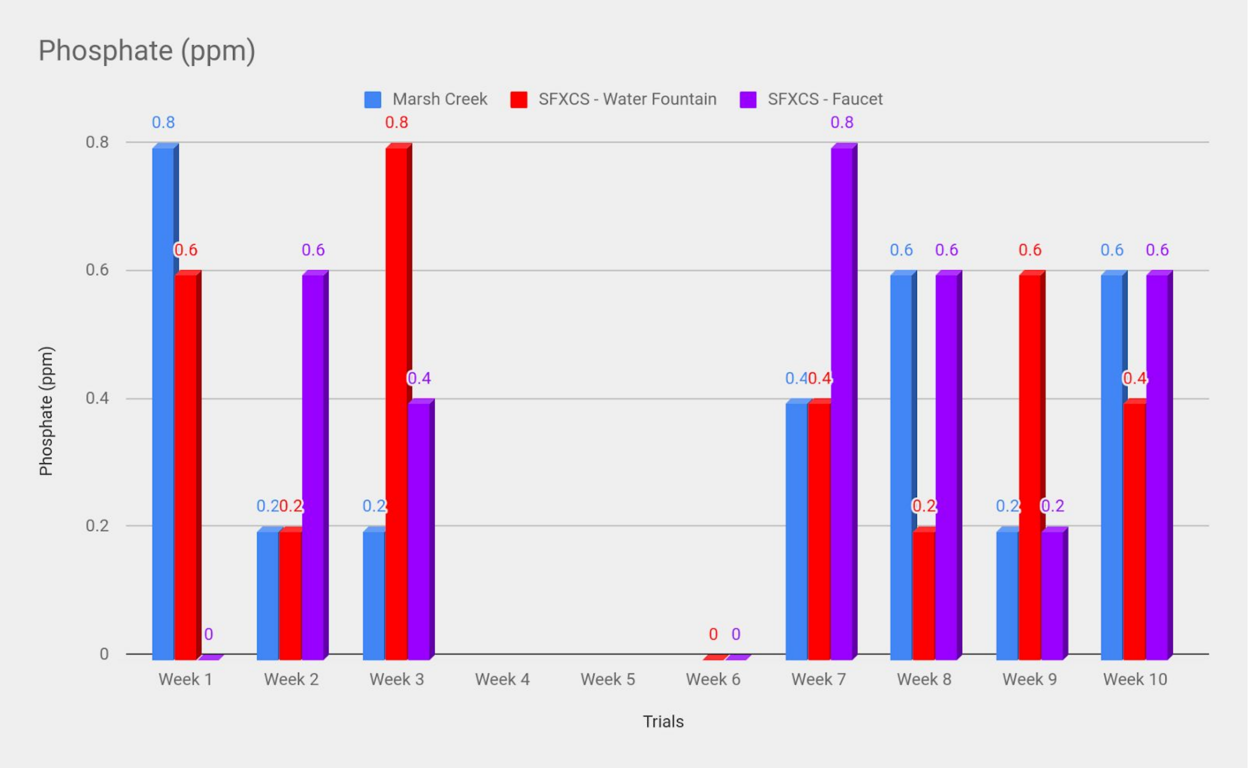
Graph 2: This graph shows the comparison of chlorine at each of the locations.



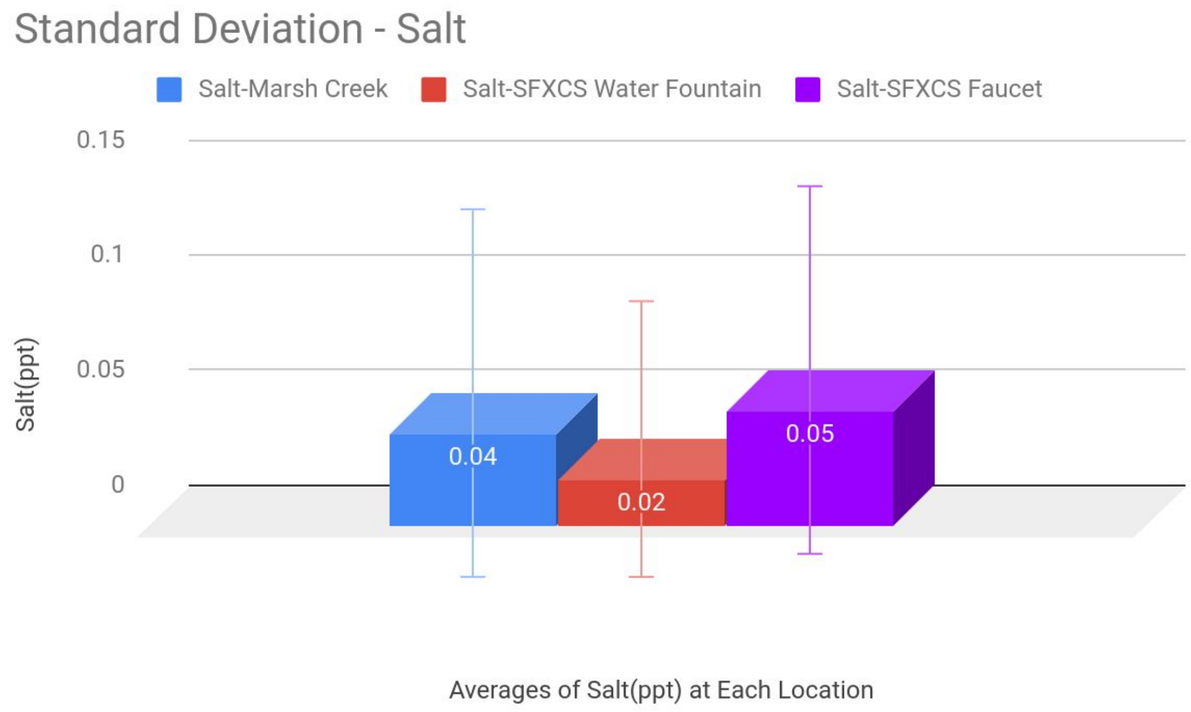
Graph 3: This graph shows the comparison of pH at each location.



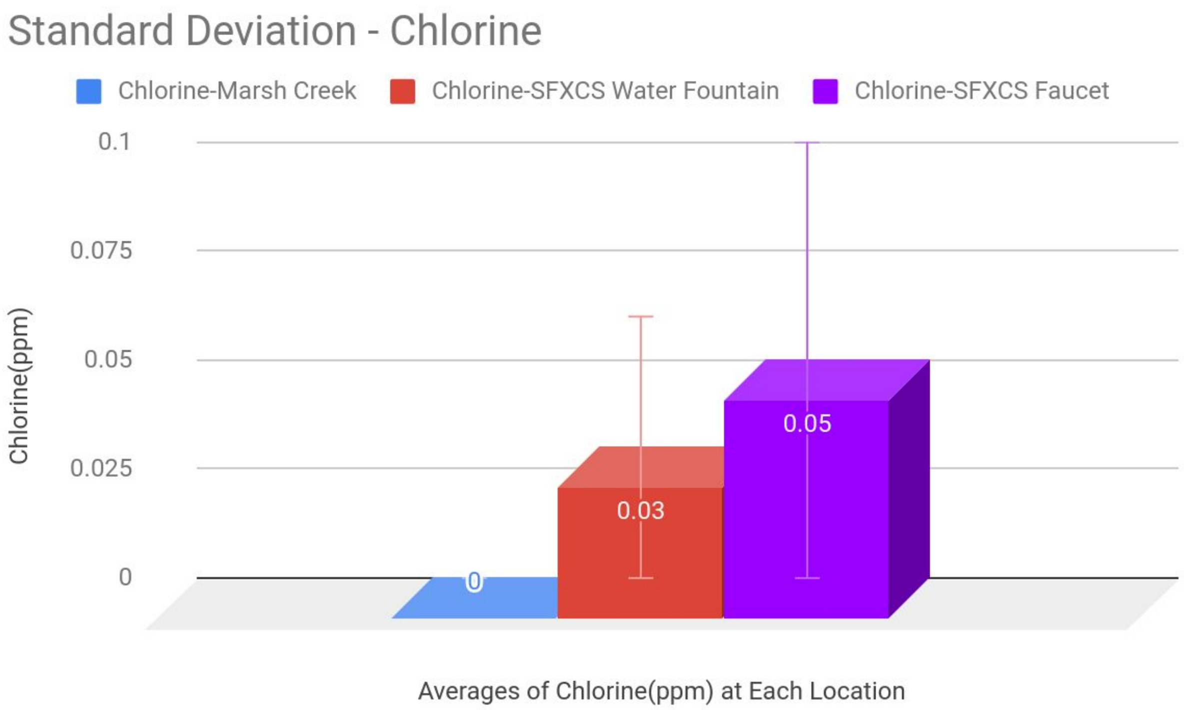
Graph 4: This graph shows the comparison of nitrates at each location.



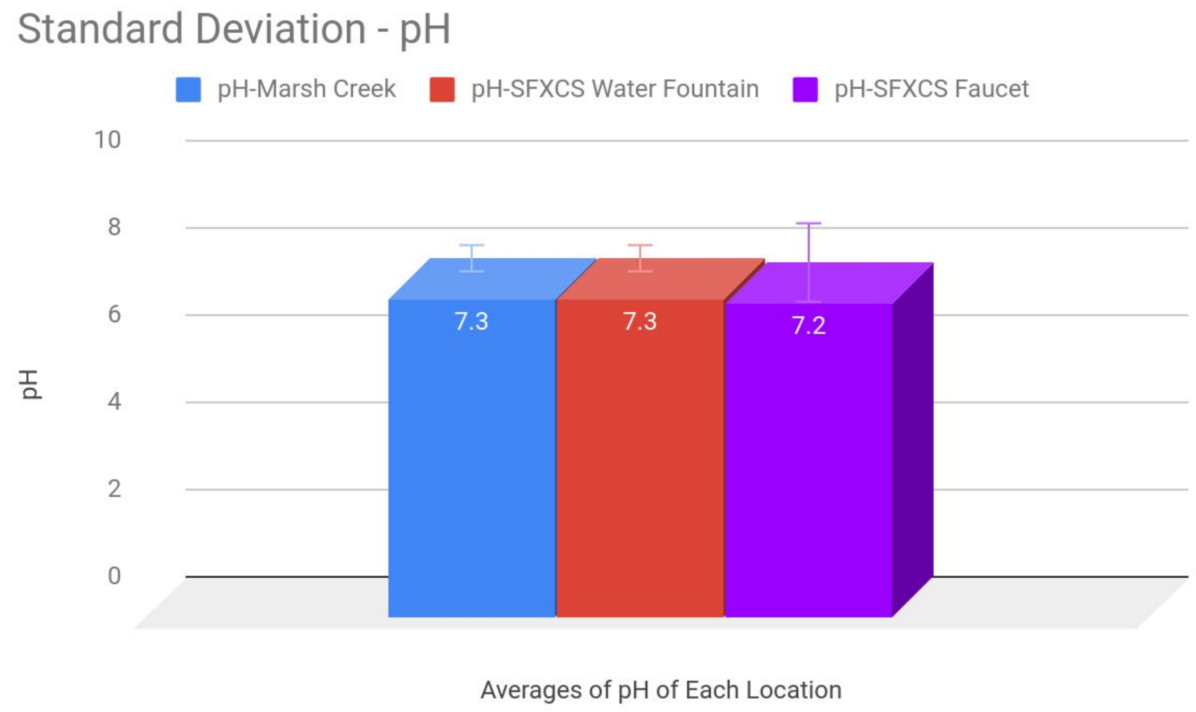
Graph 5: The graph shows the comparison of phosphate at each location.



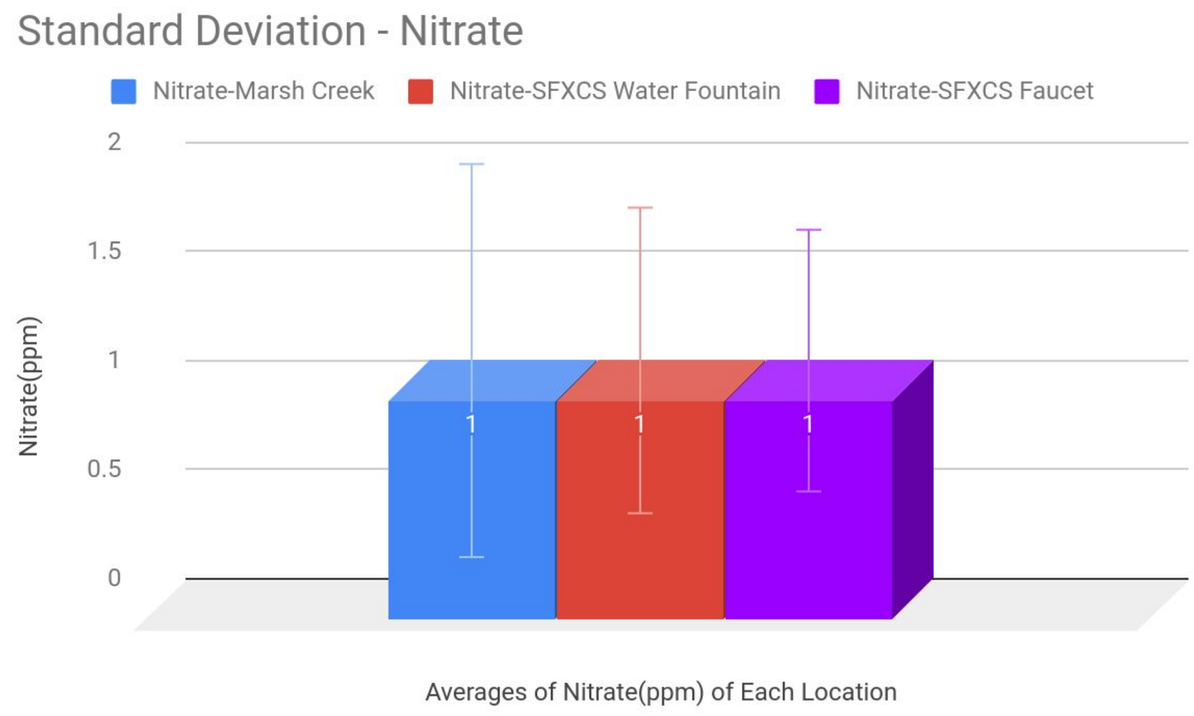
Graph 6: This shows the overall averages of salt at each location. The error bars show the variance of the row. This does not fall within the accepted values, because it goes into the negatives, but besides that, it does fall within the accepted values. The error bars are so big because the standard deviation includes the zeros from the raw data.



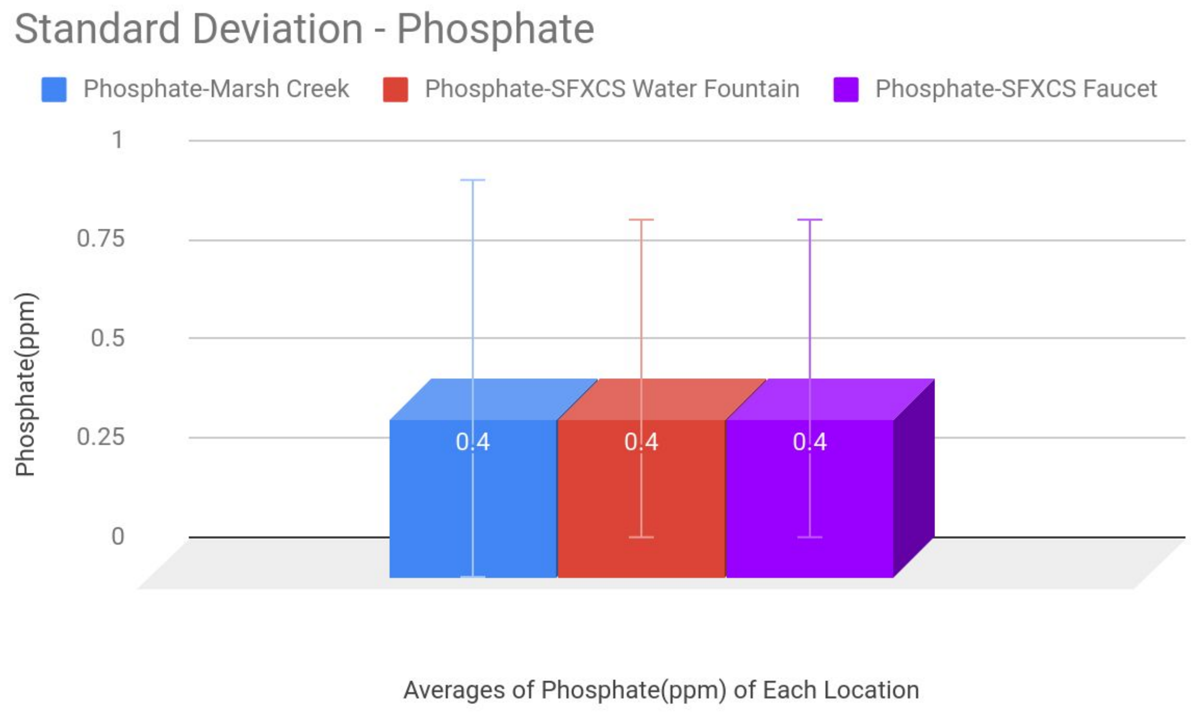
Graph 7: This shows the overall averages of chlorine at each location. The error bars show the variance of the row. This does fall within the accepted values, because it does not pass the 0.1ppm gridline, which is within the excepted values. The error bars are so big because the standard deviation includes the zeros from the raw data.



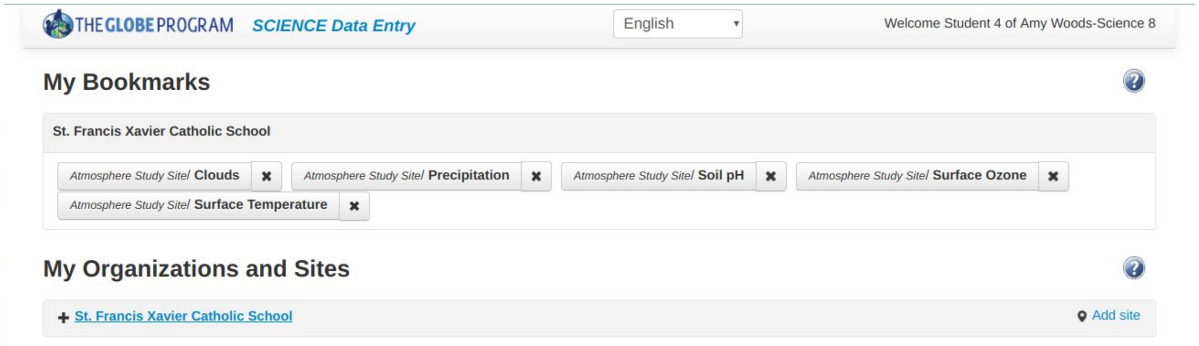
Graph 8: This shows the overall averages of pH at each location. The error bars show the variance of the row. This does fall within the accepted values, because the error bars fall in between 6.5 and 8, which is within the excepted values.



Graph 9: This shows the overall averages of nitrate at each location. The error bars show the variance of the row. This does fall a little over the accepted values, because it does passes the 1.5ppm gridline, which is a little over the excepted values. The error bars are so big because the standard deviation includes the zeros from the raw data.



Graph 10: This shows the overall averages of phosphates at each location. The error bars show the variance of the row. This does not fall within the accepted values, because it does pass the 0.75ppm gridline, which is out of the excepted values. The error bars are so big because the standard deviation includes the zeros from the raw data.



Welcome Student 4 of Amy Woods-Science 8

My Bookmarks

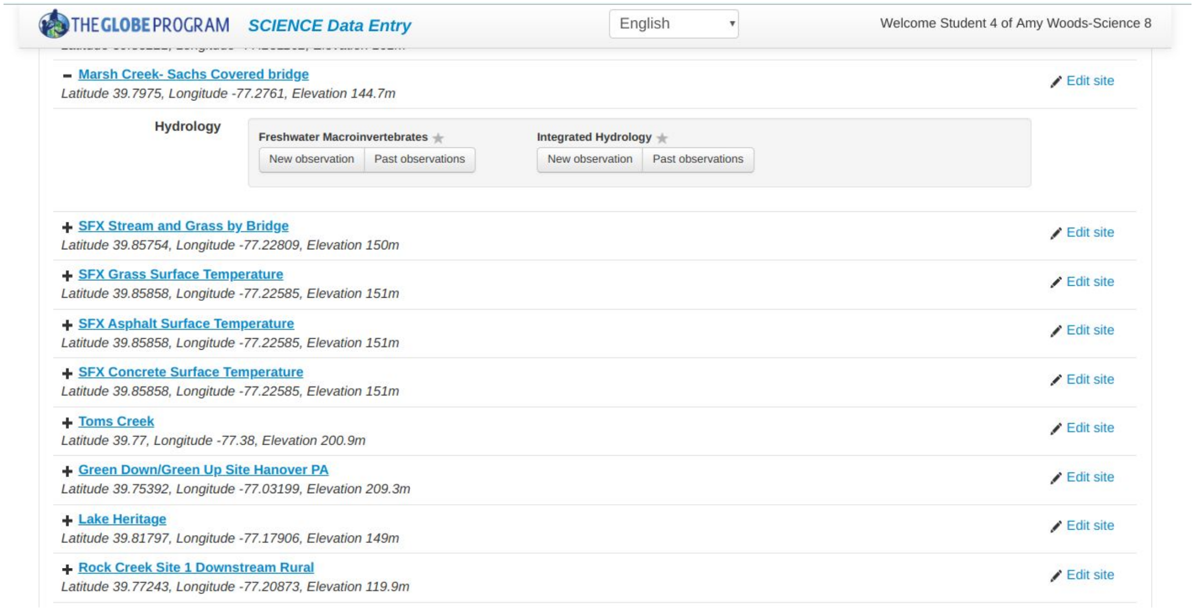
St. Francis Xavier Catholic School

Atmosphere Study Site/ **Clouds** ✖
Atmosphere Study Site/ **Precipitation** ✖
Atmosphere Study Site/ **Soil pH** ✖
Atmosphere Study Site/ **Surface Ozone** ✖
Atmosphere Study Site/ **Surface Temperature** ✖

My Organizations and Sites

+ St. Francis Xavier Catholic School

Picture 1: This shows the observer selecting the organization and site in the data entry site.


THE GLOBE PROGRAM SCIENCE Data Entry

English

Welcome Student 4 of Amy Woods-Science 8

- Marsh Creek- Sachs Covered bridge
Latitude 39.7975, Longitude -77.2761, Elevation 144.7m

Edit site

Hydrology

Freshwater Macroinvertebrates: New observation | Past observations

Integrated Hydrology: New observation | Past observations

+ SFX Stream and Grass by Bridge
Latitude 39.85754, Longitude -77.22809, Elevation 150m

+ SFX Grass Surface Temperature
Latitude 39.85858, Longitude -77.22585, Elevation 151m

+ SFX Asphalt Surface Temperature
Latitude 39.85858, Longitude -77.22585, Elevation 151m

+ SFX Concrete Surface Temperature
Latitude 39.85858, Longitude -77.22585, Elevation 151m

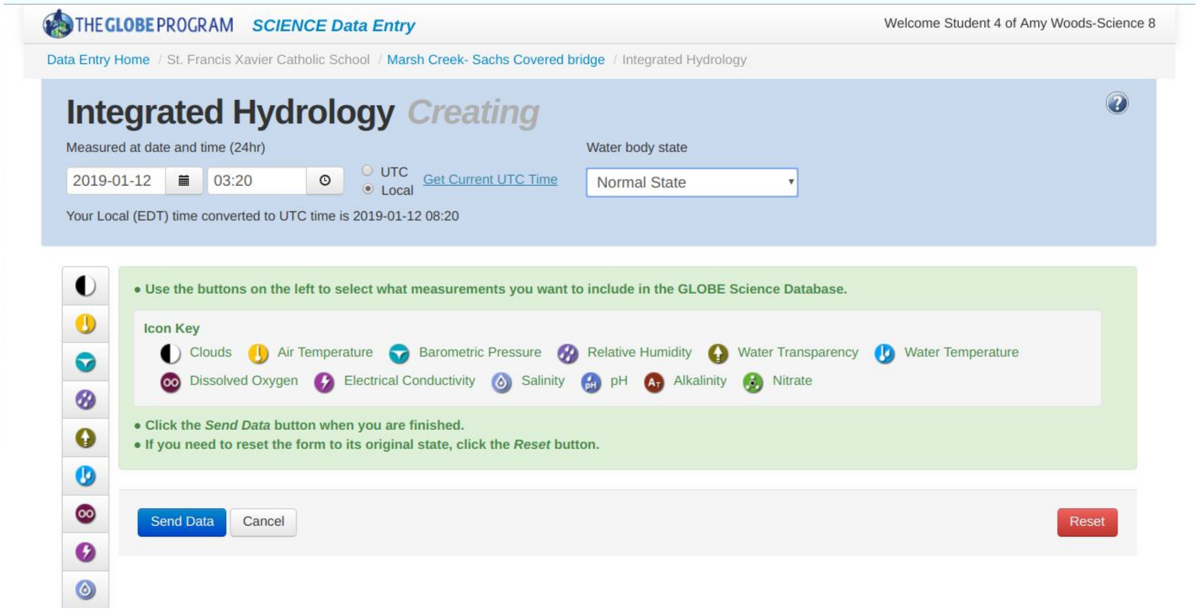
+ Toms Creek
Latitude 39.77, Longitude -77.38, Elevation 200.9m

+ Green Down/Green Up Site Hanover PA
Latitude 39.75392, Longitude -77.03199, Elevation 209.3m

+ Lake Heritage
Latitude 39.81797, Longitude -77.17906, Elevation 149m

+ Rock Creek Site 1 Downstream Rural
Latitude 39.77243, Longitude -77.20873, Elevation 119.9m

Picture 2: This is showing the observer starting to enter a new data observation. The observer selected “New observation” under Integrated Hydrology.


THE GLOBE PROGRAM SCIENCE Data Entry

Welcome Student 4 of Amy Woods-Science 8

Data Entry Home / St. Francis Xavier Catholic School / Marsh Creek- Sachs Covered bridge / Integrated Hydrology

Integrated Hydrology *Creating*

Measured at date and time (24hr): 2019-01-12 03:20 ○ UTC ● Local Get Current UTC Time

Water body state: Normal State

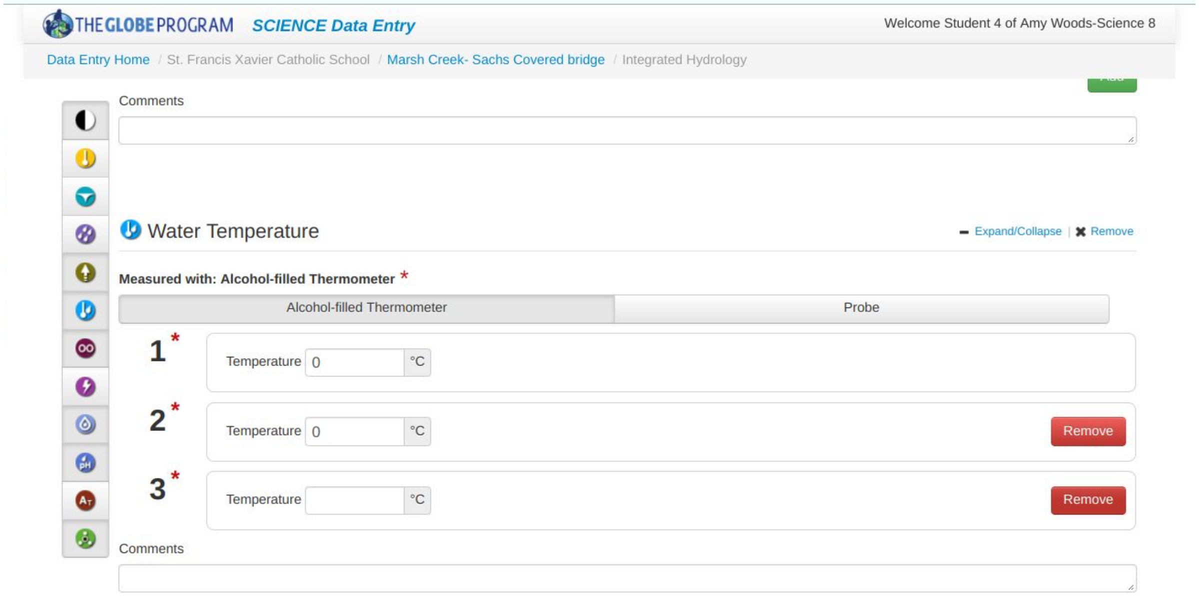
Your Local (EDT) time converted to UTC time is 2019-01-12 08:20

- Use the buttons on the left to select what measurements you want to include in the GLOBE Science Database.

Icon Key: Clouds, Air Temperature, Barometric Pressure, Relative Humidity, Water Transparency, Water Temperature, Dissolved Oxygen, Electrical Conductivity, Salinity, pH, Alkalinity, Nitrate

- Click the *Send Data* button when you are finished.
- If you need to reset the form to its original state, click the *Reset* button.

Picture 3: This shows the observer entering the date, time, and state of the water. This also shows the icon key, which helps identify what tests are entered.



THE GLOBE PROGRAM SCIENCE Data Entry

Welcome Student 4 of Amy Woods-Science 8

Data Entry Home / St. Francis Xavier Catholic School / Marsh Creek- Sachs Covered bridge / Integrated Hydrology

Comments

Water Temperature

Measured with: Alcohol-filled Thermometer *

1 * Temperature 0 °C

2 * Temperature 0 °C

3 * Temperature °C

Comments

Picture 4: This is showing the observer enter the temperature into the GLOBE Database.

Discussion

The results of the testing showed that the creek and the school water had close to the same levels, which seemed odd at first, but then made sense. Marsh Creek is a very healthy stream, so there is not a whole lot that the GMA has to do to make it pure for drinking. Most of the sources of pollution are from agricultural runoff and residential development. Though they are big sources, little pollution actually comes from them, thus making Marsh Creek healthy. Most of the levels of each of the dependant variables stayed close to their approximate levels guideline, which is a good sign that there is not a lot of salt coming off during the winter, or any source of extra nitrates or phosphates are evident.

Conclusion

In conclusion, the data did not support the hypothesis, it was quite the opposite of the hypothesis. The hypothesis is if Marsh Creek is the source water for the Gettysburg Municipal Authority, than the St. Francis water from the fountains and faucets, should have different levels of salt, pH, chlorine, phosphate, and nitrates because if they have close to the same levels, the testing would show that the GMA would be adding too much or too little of the chemicals used for water treatment. The revised and new hypothesis is Since March Creek is the source water to all over the Pennsylvania and Maryland counties, including Adams County, where St. Francis Xavier is, the levels of salt, chlorine, pH, nitrate, and phosphate should be close to the same due to the fact that if they were different levels, that would inference that something maybe be causing a source of contamination and maybe be sneaking by the GMA that could cause problems for the GMA and the people on the city plant, and may even put some people in danger if they drink certain parts of the contaminated water. The question is also being revised into "What is the relationship to the water we drink to it's source water" and the project title is being revised into "Is there a difference? - An Investigation on the Relationship of the Source and the Tap Water. This is because the title and question, actually did not have an impact or relevance to the project. The other addition of possibly testing bacteria of the water sites, is undergoing discussion with the GMA, and seeing if it is possible to test it. This has been an experience that is truly unforgettable! Thank You.

Acknowledgements

I would like to acknowledge the many people who have taken their time to help me with my project. First I would like to thank my father, Jonathan Stiles, my mother, Carol Stiles, and my grandfather, George Turek. They have been of many help to my project in assisting me to Marsh Creek and helping shake the multiple samples. I would also like to thank my fellow classmates, Jacob Fleming, Lily Shriner, Anna Willard, Piper Rohrbaugh, and Kaleb Repp. They

have also been of many help when I was figuring out my variables, helping shake, and setting me on a path to GLOBE. Thank the observer to my teachers, Mrs. Laura Hughes, Ms. Karen Kibler, Mr. Ronald Floess and Mrs. Sherry Grenchik. They have provided supplies and time with checking my paper and board, as well as helping check over my paper for pronouns and contractions and guiding me through using alternatives to that and who helped with the tough questions that I needed help answering. Thank you to Mr. Joe Hallinan, Mr. Mark Guise, Mr. Patrick Naugle, Mr. Patrick Bowling and Mr. Jeff Patterson. Mr. Hallinan has been of huge help to me with finding more help to my project and helping with more information about the GMA and Marsh Creek. Mr. Mark Guise and Mr. Jeff Patterson work at the GMA and are there for the questions and help I need to continue this project for future competitions. Mr. Patrick Naugle who has been there for any questions I may need to ask. And Finally a HUGE THANK YOU to Mrs. Amy Woods who has been the constant support and supplier to my project. She has been breathing down my back to help me do well, and I feel that it has paid off. She has been constantly helping and helping and it has been helpful. Thank you very much.

Badges

The Data Scientist Badge - I have collected a lot of data over multiple months from 3 different sources. I have analyzed and compared the data as well as discussed the results and impact with experts in the water field.

The Make an Impact Badge - I believe I fulfill the requirements of this badge because I have worked and spoke with experts from the Gettysburg Municipal Authority, SWEEP Educators from Chesapeake Bay Foundation, and the Adams County Conservation District. They have helped me understand my data and the opportunities that exist for this kind of research.

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