Investigating Water Quality in the St. Francis Xavier Stream

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Table of Contents

Abstract

The research question states: How does dissolved oxygen (D.O.), transparency, and temperature relate in the St. Francis Xavier Stream? The hypothesis states that when the transparency levels are lower, the temperature will be higher because there are not as many particles to collect and scatter the light, therefore the water will be warmer because there is more light entering the water. Also, the D.O. levels will be lower because colder water dissolves more oxygen in the water, so if the water is warmer because of the transparency there will not be as much dissolved oxygen in the water. Water was collected from the stream on SFX property and tested either beside the stream or back in the classroom following GLOBE protocols. The data partially supports the hypothesis. Since D.O. is high and the temperature is low, it seems like the stream has good water quality, but more data will need to be taken and more variables will need to be measured.

Keywords: water, dissolved oxygen, temperature, transparency

Investigating Water Quality in the St. Francis Xavier Stream

Research Question and Hypothesis

The research question states: How does dissolved oxygen (D.O.), transparency, and temperature relate in the St. Francis Xavier Stream? The hypothesis states that when the transparency levels are lower the temperature will be higher because there are not as many particles to collect and scatter the light, therefor the water will be warmer because there is more light entering the water. Also, the D.O. levels will be lower because colder water dissolves more oxygen in the water, so if the water is warmer because of the transparency there will not be as much dissolved oxygen in the water.

Introduction

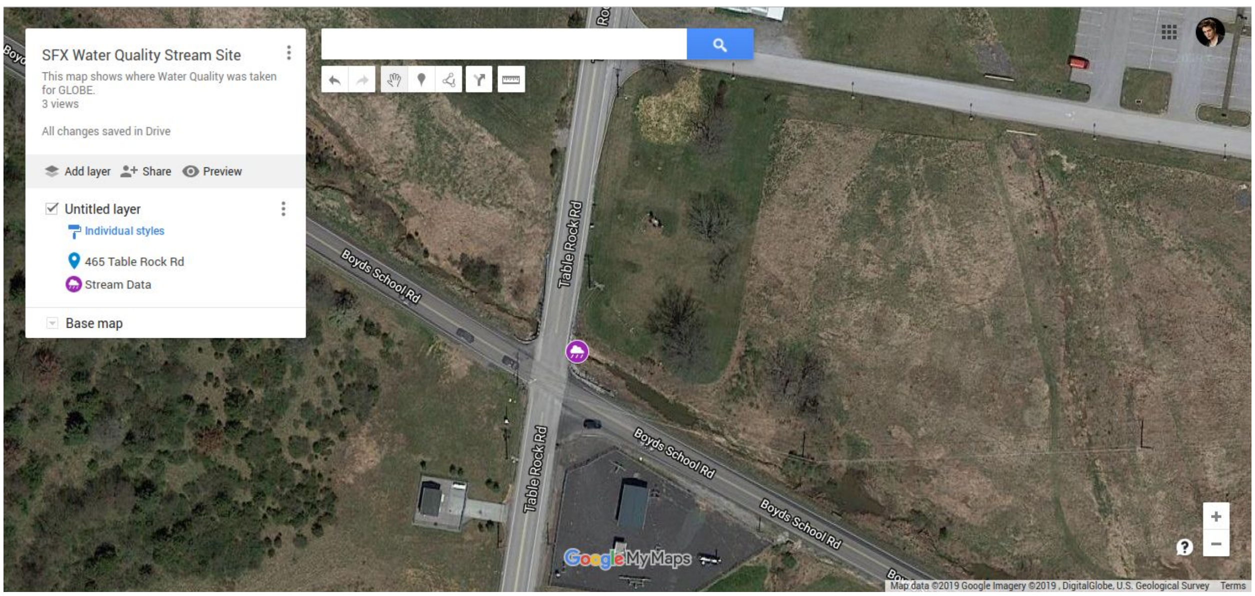
Temperature is important because it shows whether it is hot or cold. Temperature keeps things functioning well, but if it is too hot or too cold, the organisms will suffer. Temperature relates to D.O. and transparency because all three affect the life in the water, both plants and animals (GLOBE).

Dissolved Oxygen is the amount of oxygen that is dissolved in the water. Dissolved Oxygen is important because it is what the fish use to breathe and if there are small amounts in the water the fish will start to die. Dissolved Oxygen can relate to temperature because if the temperature is hot the less D.O. is in the water and the colder it is, the more D.O. is in the water. Dissolved Oxygen can relate to transparency because the clearer the water is, the more D.O. is in the water and if it is clouded the less D.O. is in the water (GLOBE)

Transparency is measuring the amount of suspended particles in the water. Transparency is important because it will decrease the amount of molecules that will absorb or scatter light in the water. Transparency and temperature are related because the less light that can enter the body of water the cooler the water will be and the temperature will change. Transparency is related to D.O. because if there are more molecules and particles in the water there is less room for the dissolved oxygen levels in the water and will prevent the animals in the water from breathing. The less transparent the water the less sunlight gets to the plants and animals at the bottom of the water body (GLOBE).

Materials and Method

Planning Investigations



Map 1: This Map shows the site where the data was collected. The green star indicates the testing site.

Photograph 1: This shows a photograph of the actual testing site.

The site is at the edge of a bridge in an unnamed stream that joins Rock Creek beside our school. It is a rocky stream bed with unmowed, vegetated banks on our property. There are some areas close to mowed grass. 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 39.85728, -77.22855 with an elevation of 148.7m.

GLOBE atmosphere protocols for cloud coverage will be used. GLOBE hydrosphere protocols for D.O., water temperature, transparency, pH, phosphate, and nitrate plan to be used. Training on how to collect data with kits will be done in class. Mr. Toth from NASA Goddard provided a LaMotte kit, so LaMotte kits were purchased so data is easy to compare between projects. Data is to be collected once a week during class or after school at the Stream Study Site.

Materials

- Transparency Tube (DIY GLOBE version)

- Dissolved Oxygen Water Testing Kit-LaMotte Dissolved Oxygen Kit (5860-01)
- Vernier Water Temperature Probe
- Cloud Viewer (from UCAR)
- Clipboard/ Pen
- GLOBE Hydrosphere Data Sheet

Method

All procedures taken from GLOBE Hydrosphere Protocols.

Dissolved Oxygen

As stated from GLOBE Protocols:

1. Fill in the top of the Hydrosphere Investigation Data Sheet.
2. Put on the gloves and goggles.
3. Rinse the sample bottle and hands with sample water three times.
4. Place the cap on the empty sample bottle.
5. Submerge the sample bottle in the sample water.
6. Remove the cap and let the bottle fill with water. Move the bottle gently or tap it to get rid of air bubbles.
7. Put the cap on the bottle while it is still under the water.
8. Remove the sample bottle from the water. Turn the bottle upside down to check for air bubbles. If there is air bubbles, discard this sample. Collect another sample.
9. Follow the directions in the dissolved oxygen kit to test the water sample.

    Instructions for LaMotte Dissolved Oxygen Test Kit

    a. Remove cap from the bottle.

b. Immediately add 8 drops of Manganous Sulfate Solution and add 8 drops of Alkaline Potassium Iodide Azide.
c. Cap the bottle and mix by inverting several times. A precipitate will form.
d. Allow the precipitate to settle below the shoulder of the bottle.
e. Add 8 drops of Sulfuric Acid.
f. 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.
g. Fill the titration tube to the 20 mL line with the fixed sample. Cap the tube.
h. Depress plunger of the Titrator.
i. Insert the Titrator into the plug in the top of the Sodium Thiosulfate titrating solution.
j. . Invert the bottle and slowly withdraw the plunger until the large ring on the plunger is opposite the zero line on the scale.
k. Turn the bottle upright and remove the Titrator.
l. Insert the tip of the Titrator into the opening of the titration tube cap.
m. 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.
n. Carefully remove the Titrator and cap. Do not to disturb the Titrator plunger.
o. Add 8 drops of Starch Indicator Solution. The sample should turn blue.

p. Cap the titration tube. Insert the tip of the Titrator into the opening of the titration tube cap.

q. Continue titrating until the blue color disappears and the solution becomes colorless.

r. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as ppm Dissolved Oxygen. Each minor division on the Titrator scale equals 0.2 ppm.

10. Record the dissolved oxygen in water sample on the Data Sheet.
11. Calculate the average of the three measurements.
12. Each of the three 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 two measurements. If both of these measurements are within 1 mg/L of the new average, record this average.
13. Discard all used chemicals into the waste container. Clean dissolved oxygen kit with distilled water.
14. Enter data into the GLOBE data entry site.

Water Temperature

As stated from GLOBE Protocols:

1. Fill out the top portion of the Hydrosphere Investigation Data Sheet.
2. Put on the gloves.
3. Slip the rubber band around the wrist so that the thermometer is not accidentally lost or dropped into the water.

4. 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.
5. Put the bulb end of the thermometer into the sample water to a depth of 10 cm.
6. Leave the thermometer in the water for three minutes.
7. Read the temperature without removing the bulb of the thermometer from the water.
8. Let the thermometer stay in the water sample for one more minute.
9. 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.
10. Record the temperature on the Hydrosphere Investigation Data Sheet.
11. Calculate the average of the three measurements.
12. All temperatures should be within 1.0˚ C of the average. If they are not, repeat the measurement.
13. Enter data into GLOBE data entry site.

Water Temperature

As stated from GLOBE Protocols:

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.

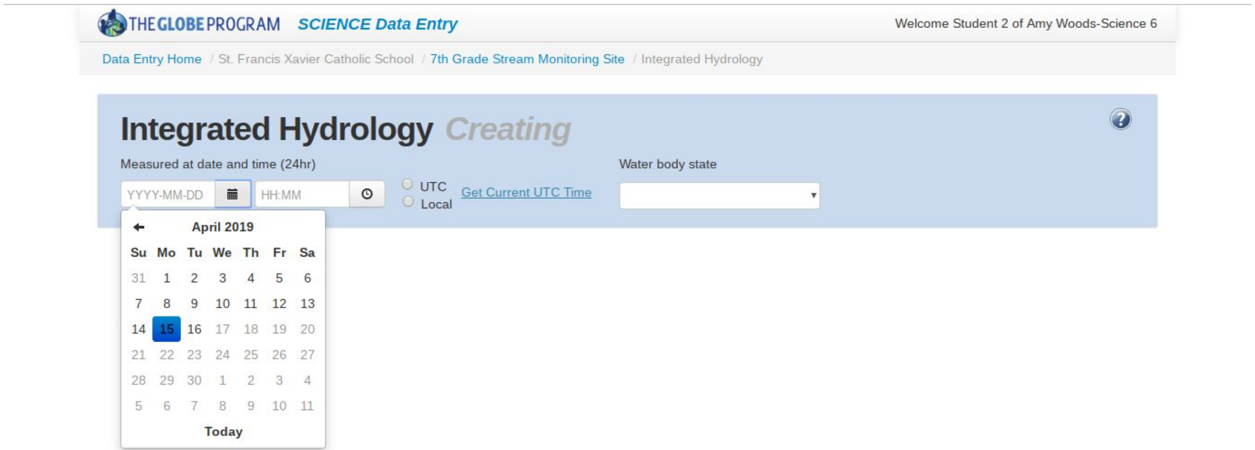


Image 1: This image shows Water Quality Data being entered into the GLOBE Data Entry Site.

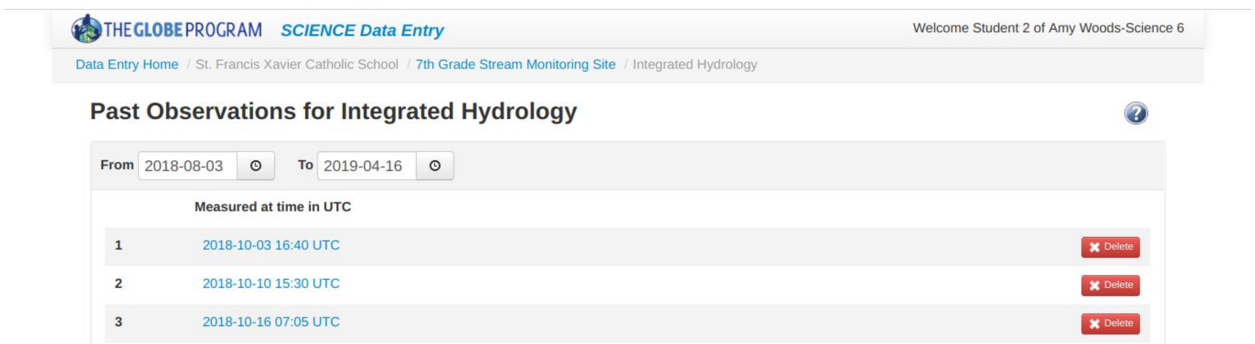
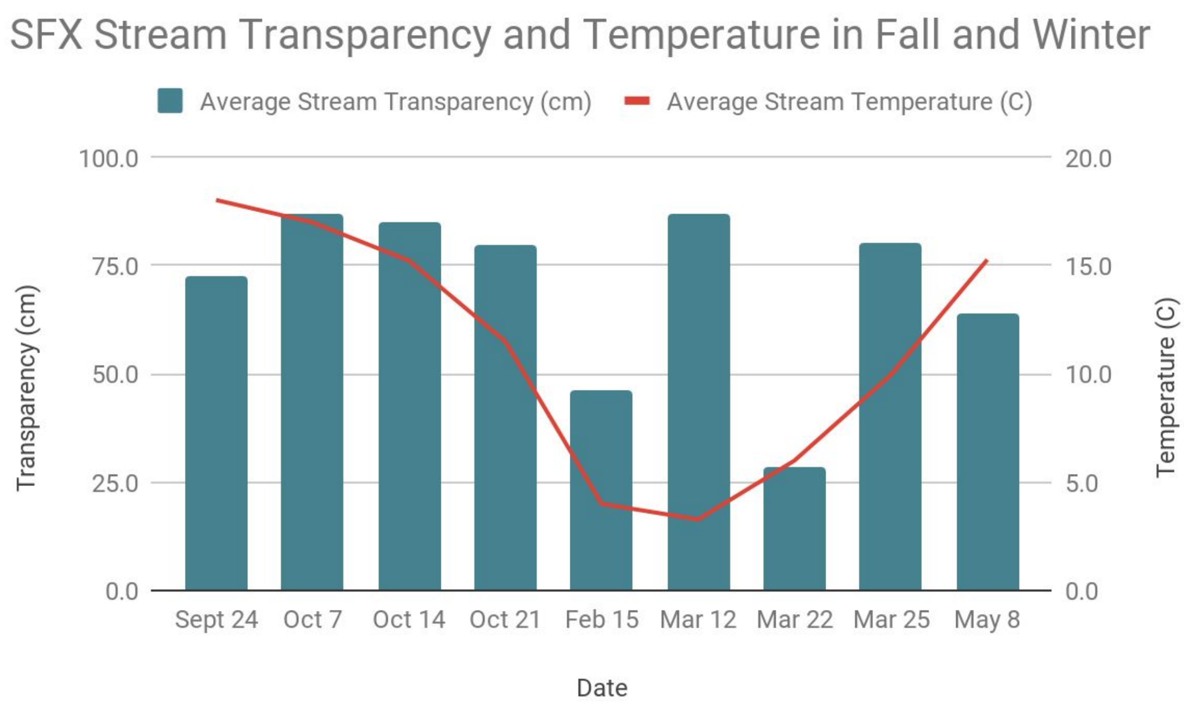


Image 2: This image shows past observations entered into the GLOBE Data Site.

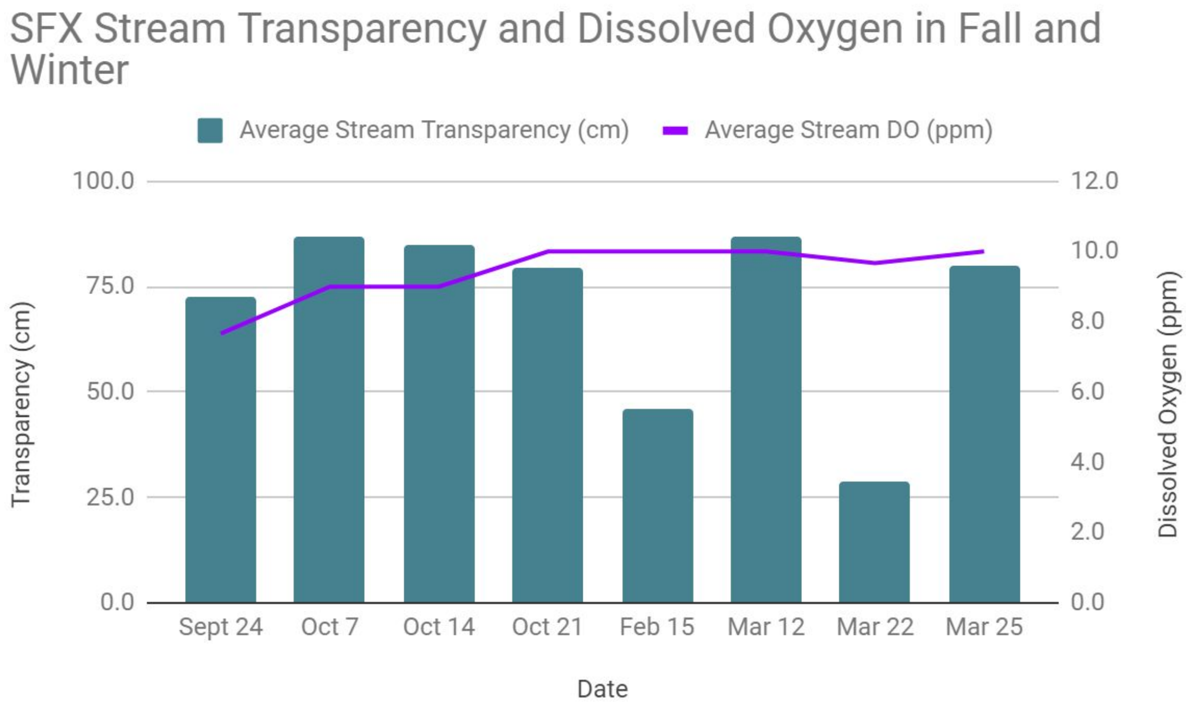
Data Summary

Date	Average Stream Temperature (C)	Average Stream Transparency (cm)	Average Stream DO (ppm)
Sept 24	18	72.5	7.7
Oct 7	17	87	9
Oct 14	15.2	85	9
Oct 21	11.5	79.7	10
Feb 15	4	46.1	10
Mar 12	3.3	87	10
Mar 22	6	28.6	9.7
Mar 25	10	80	10

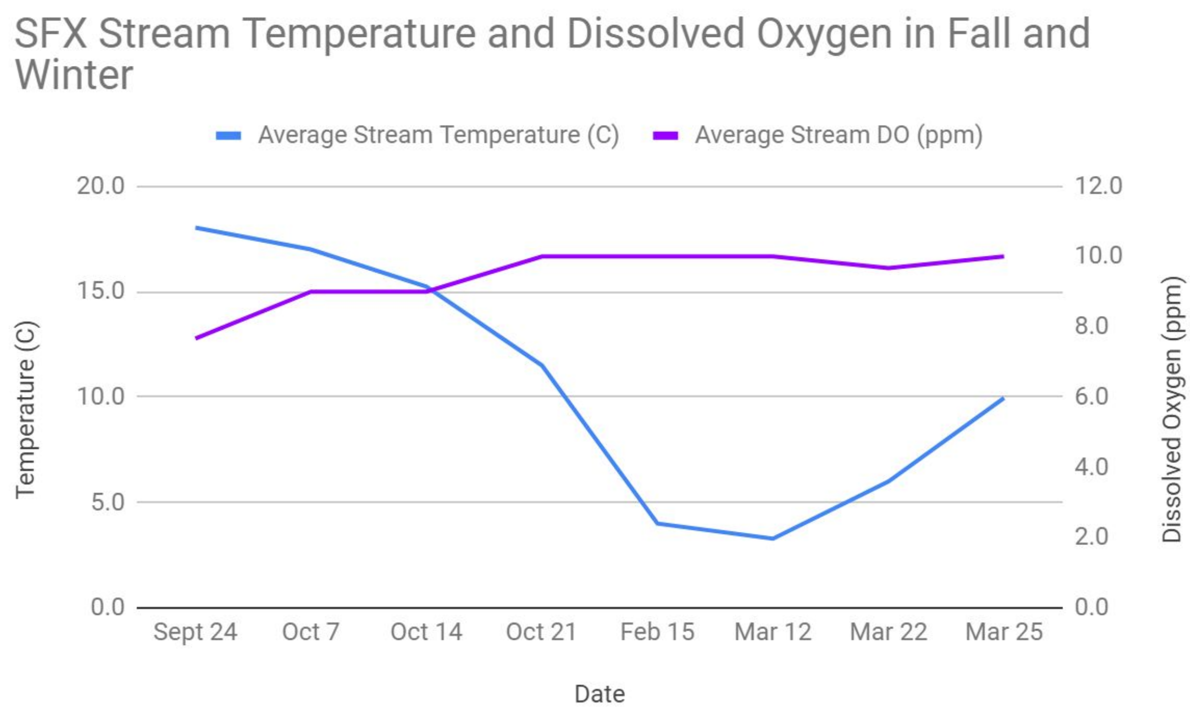
Table 1. This table shows the average stream D.O., transparency, and temperature.



Graph 1: This figure shows that when the transparency decreases, the temperature decreases as well.



Graph 2: This figure shows that it is unclear how transparency and dissolved oxygen relate.



Graph 3: This figure shows that it is unclear how transparency and dissolved oxygen relate.

Analysis and Results

When the transparency decreases, the temperature decreases as well. It seems unclear how transparency and dissolved oxygen relate without more data.When the temperature decreases, the dissolved oxygen increases. Possible sources of error are adding too much or too little of the chemical in the different kits, incorrectly entering data and making a mistake in averaging in the trials. The group tried to check each other to keep the errors from occuring.

Discussion

The data show when the transparency decreases, the temperature decreases as well, it is unclear how transparency and dissolved oxygen relate, and when the temperature decreases, the dissolved oxygen increases.This partially supports the hypothesis which states when the transparency levels are lower the temperature will be higher because there are not as many particles to collect and scatter the light, therefor the water will be warmer because there is more light entering the water. Also, the D.O. levels will be lower because colder water dissolves more oxygen in the water, so if the water is warmer because of the transparency there will not be as much dissolved oxygen in the water.

Conclusion

If this experiment could be repeated more data would be collected and more research would be gathered. On Tuesday, May 14, 2019 we went to Strawberry Hill, Fairfield for our Trout release. While we were there, we hoped to be taking water samples, but were unable to dut to scheduling. Next year, we will also be able to take samples from other locations such as the Susquehanna River and eventually the Chesapeake Bay to help compare and get a better understanding.Water quality is important because it tells us whether this water that we are testing is good for aquatic plants and animals or harming them. In the future, other protocols like pH of the soil and trees would be studied..

Acknowledgements

We would like to thank Mr. Toth for the weather station and the IR thermometers. We would also like thank GLOBE for all the resources it provides. We would like to thank our science teacher, Mrs. Woods, for guiding and helping us, and staying up late to check our projects.

GLOBE Research Badges

Collaborator

We are applying for this badge because each step and piece of this project was divided up so each group member was doing something for all parts of the project. We got this idea during the GLE when we tested the streams in Ireland. During testing, we took turns so all of us did each step at least once. The report and logbook was also divided up equally. We also shared our data with 8th grade students and worked with the entire 6th grade when we did our water tests.

Impact

We hope that our research makes a community impact because we are continuing to monitor our stream and share our data with the Chesapeake Bay Foundation and the PA Department Conservation of Natural Resources to help show that Adams County is continuing to contribute healthy water down to the Chesapeake Bay

References

EPA. (16, December 17). Climate Change Indicators: Stream Temperature. Retrieved from www.epa.gov/climate-indicators/climate-change-indicators-stream-temperature.

GLOBE. (2014). Dissolved Oxygen Protocol. Retrieved September 7, 2018, from https://www.globe.gov/documents/11865/f9946a8c-7aa9-4634-a39d-d0f876b00c35

GLOBE. (2014). Water Temperature Protocol. Retrieved September 7, 2018, from https://www.globe.gov/documents/11865/0fd40183-f2ea-480f-82b6-8d62180d9291

GLOBE. (2014). Water Transparency Protocol. Retrieved September 7, 2018, from https://www.globe.gov/documents/11865/0fd40183-f2ea-480f-82b6-8d62180d9291