Title of Project

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Abstract

In this project, we performed a series of tests to find answers to our research question, how does rainfall affect dissolved oxygen levels? We began by creating a hypothesis which is, that if precipitation levels increase then dissolved oxygen levels will also increase because rainwater absorbs oxygen from the atmosphere as it falls, therefore adding more oxygen to the water when it mixes in. Then, we recorded the amount of rainfall before collecting water samples and measuring its dissolved oxygen. Finally, we added our data into multiple different types of graphs, bar graphs and line graphs, and then analyzed the data and results. We came to the conclusion that our hypothesis was indeed correct as our data showed a positive correlation. As the precipitation levels increased, so did the dissolved oxygen levels.

Introduction:

How does rainfall affect dissolved oxygen? Looking at the data from dissolved oxygen it struck curiosity about the different factors that affected it. It showed with increased rainfall the nutrient and algal biomass components also increased the nutrients in the water, however limiting the algae growth, which led to the reduction of dissolved oxygen in the water. The water temperature also changes with the increase of rain, affecting the dissolved oxygen levels. With the increase in rainfall, the dissolved oxygen levels tend to rise because as the rain falls it gets saturated with oxygen. While with the cloudier and colder days, rain tends to bring the dissolved oxygen lower as well. This is an important topic to talk about because like how humans need oxygen to breathe aquatic animals and plants need dissolved oxygen to breathe. The Fondriest Environmental Learning Center states, “Fish and crustaceans obtain oxygen for respiration through their gills, while plant life and phytoplankton require dissolved oxygen for respiration when there is no light for photosynthesis.” Microbes like bacteria and fungi also require dissolved oxygen so they can decompose organic material at the bottom of a body of water. Without these aquatic animals and plants, dissolved oxygen levels could decrease making water quality unsafe for human use. So, depending on the DO levels, it is a direct indicator of how the aquatic resources are and the water's ability to support aquatic life. Dissolved oxygen is the amount of oxygen present in water, however it is not the oxygen that is of the water molecule. That would not be enough to support aquatic life. Oxygen gets into the water mainly from the atmosphere. According to USGS's (2018) article Dissolved Oxygen and Water "Bacteria water can

consume oxygen as organic matter decays. Thus, excess organic material in lakes and rivers can cause eutrophic conditions, which is an oxygen-deficient situation that can cause a water body to 'die.'" Aquatic life can have a hard time in stagnant water that has a lot of rotting, organic material in it, rainfall often will make the stagnant water move around, making the oxygen content higher. As the rain falls it gets contaminated by smoke, dust, and other particles that are in the air, these factors could affect the water it falls into. Soka University's article Effects of Invasive Species on Water Quality in Freshwater Ecosystems by Laura Heller '20,(2025) "Invasive or non-native species degrade water quality by decreasing water flows and reducing the transportation of nutrients or by increasing runoff and erosion leading to hyper-eutrophication." That in return decreases the DO because they take the nutrients for themselves and pollute the water even more. According to the University of California Museum of Paleontology (2025), “Various human activities and environmental phenomena influence precipitation patterns, including: the burning of fossil fuels, agricultural activities, and deforestation, which increase the concentration greenhouse gases in the atmosphere, and thus the Earth’s average temperature.” All these factors can cause more intense and frequent rainfalls and can cause issues like sediment runoff which can negatively impact dissolved oxygen levels. Also, the increase in water temperature leads to lower dissolved oxygen levels. Pollution can also decrease dissolved oxygen levels. It creates a food source for bacteria which can rapidly consume oxygen during the composition process. By limiting the amount of fossil fuels used, ending deforestation, and stopping pollution, humans can help increase dissolved oxygen levels, creating more safe water sources. The Fondriest Environmental Learning Center (2025) mentions, “While most

photosynthesis takes place at the surface (by shallow water plants and algae), a large portion of the process takes place underwater (by seaweed, sub-surface algae, and phytoplankton). This means that an example of an alternative to these negative activities could be growing underwater plants or algae. Underwater plants and algae can help increase dissolved oxygen levels in the water. The underwater plants would take in carbon dioxide and light that will in turn produce more oxygen underwater, thus increasing the dissolved oxygen levels. Overall, dissolved oxygen is extremely important for both aquatic life and human life. By limiting the amount of harmful activity, humans can help create safe habitats for aquatic animals and plants and in return, receive more, safe water sources.

Methods and Materials:

Procedure:

- Take a bucket and fill about halfway with water from a local freshwater source
- Grab a thermometer and put it in the bucket of water and grab a dissolved oxygen kit
- To test temperature:
- Make sure the end of the thermometer is clean
- Make sure to measure the temperature in Celsius
- Before placing the thermometer in the water, make sure it is set to 0 degrees Celsius
- Place the thermometer in the bucket of water at least 2 inches deep and let it sit for around 30 seconds
- Record the temperature
- To measure dissolved oxygen:
- Take a clean beaker and fill it to 25 mL
- Put it in the clear reactant-filled probe
- Push the small tip of the probe into the bottom of the filled beaker
- Once the tip breaks, let the fluid in the probe change color for 5 seconds
- Take the probe out of the water
- Put your finger on the open hole in the probe and tip the probe up and down for about 5-10 seconds to get a consistent color
- Use the provided testers to compare the saturation of the blue color
- Record the dissolved oxygen level
- Put the data from both the temperature test and dissolved oxygen test into a document stating the results from each test, what time you ran each test, how many times, the water source, the temperature outside.
- Do 4 trials each one week apart using the same water source each time.

First, grab around a 5-gallon bucket and make sure it is completely cleaned and dried out. Then, attach a rope to the handle part making sure that the rope is tightly tied around it. Then, go to a local freshwater source and carefully, while holding the rope, drop the bucket into the water making sure it is at least ⅓ - half of the way full. Next, bring the bucket of water back to your

lab/testing station. Next, grab a thermometer, specifically a laboratory thermometer, and make sure the tip of the thermometer is cleaned and dried. Also, make sure that the thermometer is being measured in Celsius and that it says 0 degrees Celsius before submerging it into the water. Make sure that the thermometer is at least 2 inches down in the water and wait at least 30 seconds before measuring the temperature. After the temperature is measured, take the thermometer out, clean it, and dry it off. Make sure to record the temperature in a document. In that same document, make sure to include the date, the time you took the test, the temperature outside, the state the water is in (frozen, flooded, foggy, clear, etc), and the freshwater source. The next test is the dissolved oxygen test so first grab a dissolved oxygen kit. Then, to measure the dissolved oxygen, take a clean and dry beaker and fill it with 25 mL of water from that same bucket. Next, take a clear reactant-filled probe and place the probe in the beaker until the bottom of the probe is touching the bottom of the beaker. Then, lightly push the probe tip into the side of the beaker making sure the tip breaks off. Be careful because the probe is made out of glass. Once the tip breaks, let the fluid in the probe change color for 5 seconds. After that, take the probe out of the water. Carefully put your finger on the open hole in the probe making sure not to cut yourself with the glass and gently tip the probe up and down for about 5-10 seconds to get a consistent color. After, use the provided testers to compare the saturation of the blue color. Next, record your data in the same document you recorded your temperature in. Then, take the beaker and slowly pour out the water making sure not to pour the probe tip down the drain. Next, dispose of the glass probe and tip into a glass trash can. Finally, rinse out the beaker, dry it, and put the kit and the thermometer away. Make sure to repeat these same steps and do 4 trials each one week apart using the same water source and materials.

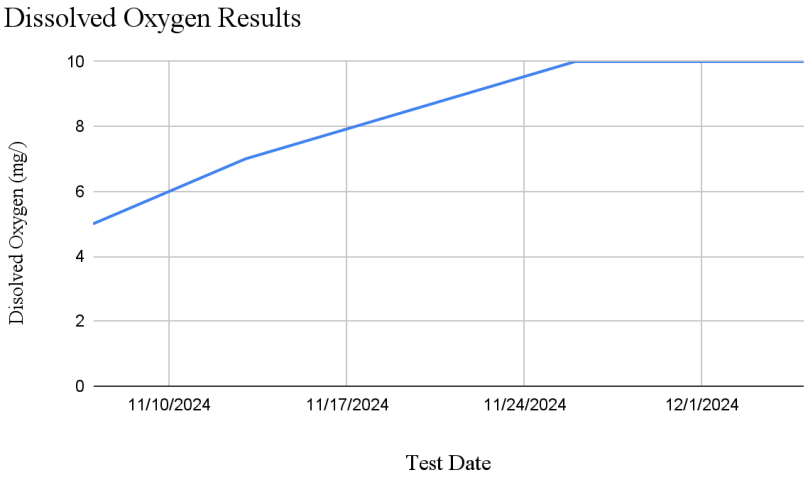
Water Temperature	
November 7, 2024	14.4 o C
November 13, 2024	10.0 o C
November 26, 2024	13.0 o C
December 5, 2024	1.1 o C
N = 4	7.1 o C

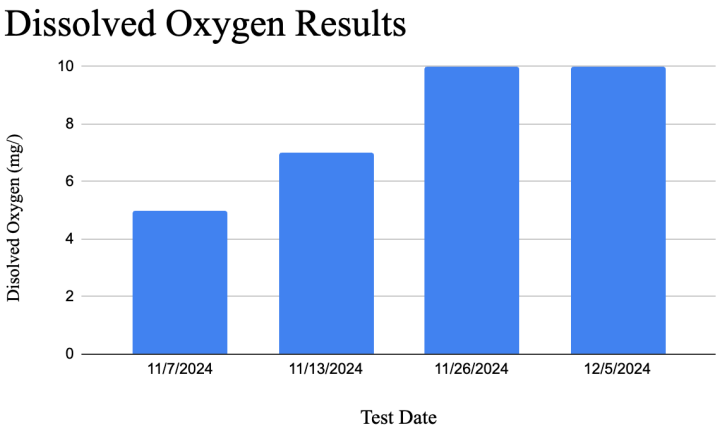
Water pH	
November 7, 2024	6.8
November 13, 2024	7.0
November 26, 2024	6.8
December 5, 2024	7.3
N = 4	7.0

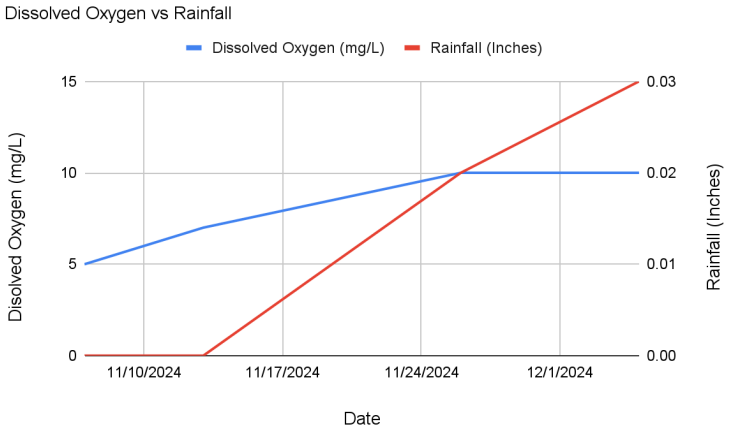
Dissolved Oxygen	
November 7, 2024	5 mg/L
November 13, 2024	7 mg/L
November 26, 2024	10 mg/L
December 5, 2024	10 mg/L
N = 4	8 mg/L

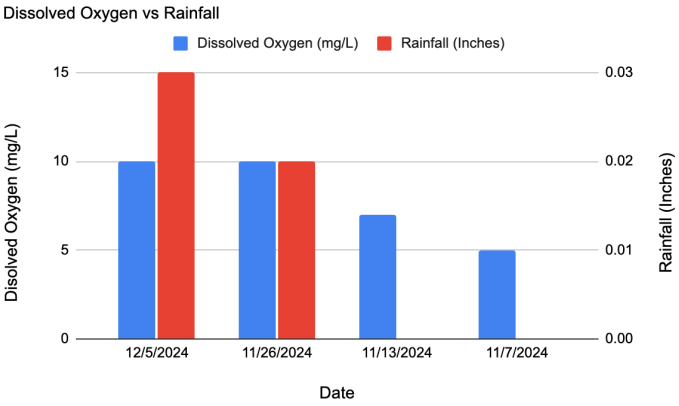
Presentation of Data and Results

Graphs:









Dissolved Oxygen Data Table:

Dissolved Oxygen	Dissolved Oxygen in mg/L
November 7, 2024	5 mg/L
November 13, 2024	7 mg/L
November 26, 2024	10 mg/L
December 5, 2024	10 mg/L

Rainfall Data Table:

Test Date	Rainfall
November 7, 2024	0 in
November 13, 2024	0 in

November 26, 2024	0.02 in
December 5, 2024	0.03 in

Looking at the results, we saw a trend that when there was rainfall, the dissolved oxygen levels increased. This could be, because as the rain falls it absorbs oxygen, leading to the bodies of water having higher dissolved oxygen. Data shows on November 7th and 13th, when there was no rainfall the dissolved oxygen levels were 5 mg/L and 7 mg/L, compared to November 26th when there was 0.02 inches of rainfall, and December 5th with 0.03 inches of rain the levels increased to 10 mg/L. Looking at the graph there is a general increase which could show how the dissolved oxygen and rainfall levels increase simultaneously. While on November 7th and 13th, the rainfall levels were the same they had slightly different dissolved oxygen levels. That led us to think about the other variables that could affect the levels, which could be a difference in time that the data was taken, the difference in an area where the data was taken which could differ if the area where our data was taken didn't experience rainfall while the area that collected the rainfall data did.

Analysis and Results

This study demonstrates how important rainfall is to dissolved oxygen, and how humans would make an effort to increase healthy rainfall. One could do that by decreasing their litter and even driving an electric car. We found that as precipitation levels increase so does the dissolved oxygen levels. On November 7th and 13th, there was 0 inches of rainfall and the dissolved oxygen level was 5 mg/L then 7 mg/L, this happened because there wasn't any rainfall to absorb the oxygen in the air. Then on November 26th, there was 0.02 inches of rainfall that increased the dissolved oxygen level to 10 mg/L. Later on December 5th, there was 0.03 inches of rainfall leading to the dissolved oxygen levels being 10 mg/L as well. These have a higher level of DO because as rain falls onto the ground and river water it absorbs oxygen that is in the surrounding air, leading to the increase of DO in the water. This affects the ecosystem and marine life in it because most underwater animals don't come up to the surface for oxygen making it necessary for there to be some amount of oxygen in the water. Our hypothesis said if precipitation levels increase then dissolved oxygen levels will also increase because rainwater absorbs oxygen from the atmosphere as it falls, therefore adding more oxygen to the water when it mixes in, this did reflect in our data, even though we only had a little bit of rainfall in the days of our data collection. We could have improved our data by finding days that are identical to the temperature and time the data was taken, having the only variable be the amount of rainfall. We also would have improved it by taking more data points throughout a longer period of time,

especially during the rainy periods of the month, so we could see if we have greater outliers.

Conclusion

Overall, our experiment found that there is a correlation between dissolved oxygen and rainfall. After testing our water source's dissolved oxygen levels and rainfall in the area, over a period of time, we were able to conclude that as rainfall increases so do dissolved oxygen levels. Theoretical values led us to conclude that our first two days are an average level of DO in natural waters (7-9 mg/L). The last two had levels of 10 mg/L which is above average and often appears in clear and cold streams. All of the data points were to be expected, due to them matching with the rainfall. It was expected that if there was more rainfall, the dissolved oxygen levels would increase because as the rain falls, oxygen saturates it.

Discussion

If we were to repeat this project, here are some possible improvements that could be made. One thing we could do differently would be to perform this experiment over a longer period of time. This would allow us to look at all seasons and factors that could affect rainfall which in result affects dissolved oxygen. This could improve the data by having more tests that could show outliers or more extreme data points. It could also improve accuracy of our test points as there would be more data available. These improvements to this experiment could allow other scientists to use our data and better understand our environment. New solutions could help improve underwater ecosystems such as animal population and plant

life. Some extensions for further study include temperature, water visibility, and ph. Scientists at Cambridge University also studied dissolved oxygen with the factor being rainfall. They found that rainfall is a main factor of controlling bacterial activity. This gives more importance to the quality of rainfall. By planting trees and other vegetation, we can increase and assure a healthy rainfall.

Acknowledgements

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