Dissolved Oxygen

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LAB TITLE: Dissolved Oxygen

INTRODUCTION:

Mr. Ward, the author of "Impact From The Deep" theorizes that several of the Earth's mass extinctions are the result of toxic levels of H_2S gas (hydrogen sulfide) building up in the oceans and eventually, in the air depriving living organisms of oxygen. This increase in H_2S is the result of increased temperatures caused by the greenhouse effect that we studied last week. So what does all this have to do with today's lab?

This week we will be studying how gases dissolves in water and how temperature and some other factors affect the amount of gas that the water can "hold". We will be focusing on oxygen because it is vital to the existence of most aquatic and terrestrial life and according to Mr. Ward, it is a lack of oxygen that caused several mass extinctions. We will take this opportunity to study 2 systems: a "real life system" (our wetland) and controlled system (tap water).

PURPOSE:

To answer the following questions –

1. To dissolve means to make a solution. What is a solution and how does it differ from a mixture and a suspension?
2. How does temperature affect the amount of oxygen that water can "hold" in solution?
3. What other factors affect the amount of dissolved oxygen in a particular water source?
4. How might the greenhouse effect affect the amount of dissolved oxygen in our oceans?

HYPOTHESIS:

1. I hypothesize a solution is a similar kind of two or more substances, frequently (but not necessarily) a liquid solution. But a mixture is a substance consisting of two or more substances mixed together (not in fixed proportions and not with chemical bonding), and a suspension is a mixture in which fine particles are suspended in a fluid where they are supported by buoyancy (buoyancy is an upward force on an object immersed in a fluid (i.e. a liquid or a gas), enabling it to float or at least to appear to become lighter. If the buoyancy

exceeds the weight, then the object floats; if the weight exceeds the buoyancy, the object sinks. If the buoyancy equals the weight, the body has neutral buoyancy and may remain at its level), that's how they are different.

2. I hypothesize that an increase in the temperature of the water increases the amount of dissolved oxygen in the water because it opens up the molecules giving the dissolved oxygen more space to come in. If the water were cooled the molecules would compress giving the oxygen less space to come in.

3. I hypothesize two factors affect the dissolved oxygen in the water. One is the movement of the water, and two is the amount of available oxygen there is for the water to obtain.

4. I hypothesize that the increase in greenhouse gases would spread the oxygen out more giving the oceans less Dissolved Oxygen, and there would be even less Dissolved Oxygen because the increase in heat would give the oceans more space to absorb outside molecules such as carbon dioxide.

MATERIALS & EQUIPMENT:

Part 1: Dissolved Oxygen in a controlled system:

- ❒ Water sample fresh from our water fountain
- ❒ 250 ml beaker
- ❒ Small vial with screw cap
- ❒ Test tube holder
- ❒ 2 Dissolved Oxygen Test Tablets
- ❒ Dissolved Oxygen Color Chart
- ❒ Thermometer
- ❒ Alcohol burner
- ❒ Support stand
- ❒ Ring Stand
- ❒ Wire mesh

Part 2: Dissolved Oxygen in our wetland:

See attached (Dissolved Oxygen Test 5)

PROCEDURE:

Part 1: Dissolved Oxygen in a controlled system:

1. Collect a water sample from our water fountain directly into a 250 ml beaker.

2. Measure the temperature of the water and record your result.
3. Submerge the small vial into the 250ml beaker.
4. Carefully remove the tube from the water sample keeping the tube full to the top.
5. Drop 2 Dissolved Oxygen Test Tablets into the tube. NOTE: water will overflow when the tablets are added.
6. Screw the cap on the tube. NOTE: more water will overflow when the cap is screwed down. Make sure there are no air bubbles in your sample.
7. Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.
8. Wait 5 more minutes for the color to develop.
9. Compare the color of the sample to the Dissolved Oxygen color chart. Record the results as ppm Dissolved Oxygen.
10. Clean your glassware carefully.
11. Collect a fresh sample in the 250ml beaker from the water fountain.
12. Warm the water over the alcohol burner until the temperature increases to 30°C. DO NOT OVERSHOOT
13. Use the test tube holder to submerge the small vial into the 250ml beaker.
14. Carefully remove the tube from the water sample keeping the tube full to the top.
15. Drop 2 Dissolved Oxygen Test Tablets into the tube. NOTE: water will overflow when the tablets are added.
16. Screw the cap on the tube. NOTE: more water will overflow when the cap is screwed down. Make sure there are no air bubbles in your sample.
17. Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.
18. Wait 5 more minutes for the color to develop.
19. Compare the color of the sample to the Dissolved Oxygen color chart. Record the results as ppm Dissolved Oxygen.

DATA TABLES AND OBSERVATIONS:

These are the data tables that I made for the first procedure.

1. First measurements of water from the fountain.

Dissolved Oxygen MG/L: 7 MG/L

Water Temperature C: 11 C

Atmospheric pressure: 763 MMHG

100% dissolved oxygen (the maximum amount of DO water can hold in this

temperature): 11.09 MG/L

Percent Saturation: 63%

These are the data tables I made for my second procedure.

2. Second measurements of water from the fountain then heated to 30 C

Dissolved Oxygen MG/L: 6 MG/L

Water Temperature: 30 C

Atmospheric pressure: 763 MMHG

100% dissolved oxygen (the maximum amount of DO water can hold in this temperature): 7.67 MG/L

Percent Saturation: 78%

Dissolved Oxygen in our wetland:

See attached (Dissolved Oxygen Test 5)

CALCULATIONS:

Water quality is frequently monitored using a measurement called % saturation. % saturation refers to the dissolved oxygen reading in ppm divided by the 100% dissolved oxygen (DO) value for water (at the same temperature and pressure). 100% saturation indicates excellent water quality while anything below 60% is considered poor.

Calculate the % saturation for your three samples using the formula below:

$$\% \text{ saturation} = \frac{\text{dissolved oxygen in ppm}}{\text{100\% DO value}}$$

NOTE: You can find the 100% DO value for water at different temperatures and pressures in Table 3 of the wetland water procedure.

1. First we take the Dissolved Oxygen MG/L which equals: 7 MG/L and we divide it by the 100% dissolved oxygen which in this case is: 11.09 MG/L and we end up with:

7 MG/L ÷ 11.09 MG/L = 0.6311 which we round to 0.63 then we multiply by 100:

0.63 × 100 = 63 and we mark as percent: 63% and that is our answer.

2. First we take the Dissolved Oxygen MG/L which equals: 6 MG/L and we divide it by the 100% dissolved oxygen which in this case is: 7.67 MG/L and we end up with: 6 MG/L ÷ 7.67 MG/L = 0.7822 which we round to 0.78 then we multiply by 100: 0.78 × 100 = 78 and we mark as percent: 78% and that is our answer.

DATA ANALYSIS:

What I measured and why I measured it: I measured the DO in the water fountain water and the wetland water. I did this because if we plan to add any aquatic organisms to our wetland we can look back on our data and decide which animals could acclimate to our environment. These measurements allowed me to better understand what DO is and why it is important. I also learned two ways to measure the DO in any water, but the easiest way in my opinion is to do it using a DO tablet and a few other things.

How my data helped me understand this topic: My data told me how to calculate the percent saturation from the 100% dissolved oxygen and the Dissolved Oxygen MG/L. My data tables mean that the water fountain had more DO in its water than the wetland however the wetland did have plants and other properties that could keep the water nutritious for the water fountain water did not. My data also meant that the percent saturation increased when the water was heated.

Possible sources of error: It is worth noting that the DO may fluctuate do to rain that may or may not have had a higher DO level adding or subtracting to or from the DO, and on this day it was had not rained that much in the past week or so and maybe we could take a measure of DO in our wetland every month for the past year and at the end of the year we could find the average DO of our wetland. Other sources of error may include: A change in DO as we were walking back from the wetland to our classroom.

QUESTIONS TO CONSIDER:

1. Compare the % saturation values for your samples. Which sample has the lowest % saturation? Highest? Why?

My results showed that the saturation was highest in the second procedure by a difference of 15% to the lowest. I think that the water that was heated it cleaned the water giving my results a higher saturation. And in the tank for the water fountain the water probably was cooled for a better taste and the water was still, making it even cooler until it was pumped out. The small wetland directly behind our classroom that had no fountain was moving around more from wind and bugs giving it a higher temperature. And the wetland with the fountain would also warm the water.

2. Why did you heat the water fountain water and measure the dissolved oxygen again?

I heated the water to see if there was a difference in dissolved oxygen when water was heated and I found out that the percent saturation increased but at this temperature water can hold less dissolved oxygen then the normal water fountain temperature.

3. Will the level of dissolved oxygen in our wetland support aquatic life? What types?

Well if animals find their way to our wetland either by exploring or us bringing them there some of the aquatic life that can life in this dissolved oxygen environment are Trout, Smallmouth bass, Caddisfly larvae, Catfish, Carp and Mosquito larvae.

4. Explain why dissolved oxygen is important to aquatic life and discuss the factors that affect it.

In an aquatic environment DO is an important indicator of the environment's water quality. And DO is also what the fish breathe, so it is very important to check an environment's DO before adding aquatic organisms.

Conclusion:

I conclude that my hypothesis was correct. My hypothesis and my results are quite alike.

I learned how to: Measure the DO in two ways, improve each labs data tables and data analysis and I also learned how to calculate the percent saturation.

WEB LINKS:

http://waterontheweb.org/under/waterquality/oxygen.html

http://nerrs.noaa.gov/Monitoring/WaterOxygen.html