Turtle Pond Lab

***The effects that pH has on the ammonium level of the water in the turtle pond.***

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ESS pd. 7

**Aim:**

**Research Question:** How does the pH affect the ammonium level (NH3) of the water in the turtle pond at FDR?

**Hypothesis:** If the pH increases, then the ammonium level will increase as well because the abundance of hydroxyl ions from a higher pH will cause more ammonia (NH3+) to be ionized by these ions and undergo the chemical reactions of sharing electrons, causing it to become ammonium (NH4+) at higher rates.

**Background Info:**

Nitrogen is an element that is found through out the pond due to several contributions that increase their level of such element. This component goes through the ‘Nitrogen Cycle’ in which the elements first appear as nitrogen oxides due to their interaction with the oxygen ions. Then, the nitrogen begins to react due to high temperature, combustion reaction or combustion engines. Eventually, Nitric oxide (NO) and Nitrogen dioxide (NO2) will be formed and begin to react with water to form nitric acid (HNO3). This nitrogen, still in the air, goes through the process of **nitrogen fixation**, where plants (such as clover, alfafa, etc.) form *nodules* on the roots and convert it into ammonia (NH3). The bacteria will then use this as fertilizers for growth and proteins. Not only that, but the animal will undergo the process of metabolism where food will be digested and released as nitrogen waste.

Furthermore, the cycle completes by a process called **denitrification** in which nitrate converts to nitrogen gas and is removed from the pond (in this case) as greenhouse gases.

Ammonia is very toxic to, not only the turtles, but the aquatic life itself because of the diseases that it can bring *(refer to conclusion).* Thereby, as pH increases, the amount of hydrogen ions does as well; as it reacts with the ionized ammonia (NH3), there is an abundance of hydroxyl ions causing it to un-ionized and creating ammonium (NH4+) and raising the overall ammonium level.

**Materials:**

* 1 turtle pond
* 1 pH prod
* 1 Ammonium prod
* 1 vernier

**Procedure**

1. The Ammonium probe & pH probe where calibrated
2. Both the ammonium and ph probe where plugged in the Vernier
3. The Ammonium Probe was turned on and inserted 1/3 inside of the pond (non-shaded area) for 2 minutes. Number given on the Vernier screen was recorded
4. Step 3 was repeated twice
5. Steps 3 & 4 where repeated with the pH probe
6. Steps 1 -5 were repeated continuously every 2 days.

**Variables**

*Independent Variable:*

* pH

*Dependent Variable:*

* Ammonium level

*Control Variable:*

* Pond used
* Area of inserted probes
* # of turtles
* Time of the day

***Data Collection:***

 **Qualitative:**

Through out this lab I noticed that the time of the day was a control variable that needed to be closely followed in order to obtain reliable results. With that, this was information received after the performance of the lab, altering the data that was collected. (Refer to *Evaluation* section) Moreover, there was a huge impact between when the water was changed and when the data was collected. The change of water impacted both the pH level and the ammonium level, causing the information collected to rely on how long ago the water was changed. This alteration was able to prove the information collected with the results of the lab, causing this a very successful laboratory work

**Quantitative:**

***Data Tables***

**Raw Data Table**

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| Table 1: The effect of pH on Ammonium Level |
| Days | pH  | Ammonium Level (NH4+) |
| Day 1 | 10.1 | 15.45 | 16.3 | 16.01 |
| Day 2 | 7.02 | 0.32 | 0.58 | 0.43 |
| Day 3 | 10.2 | 16.37 | 17.43 | 16.85 |
| Day 4 | 7 | 0.71 | 0.52 | 0.75 |

All data was collected on an open system with a variation of temperature. Data gathered on a period of 14 days by Carla Frias by utilizing both the Nitrogen and pH probe provided by FDR. Calibration of both probes allowed information to reveal the relationship between ammonium level and pH within all aqautic systems.

**Processed Data Table**

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| --- |
| Table 2: average Ammonium Level vs pH |
| pH | Ammonium Level (NH4+) |
| Trials | Avg. | Standard Deviation |
| Trial 1 | Trial 2 | Trial 3 |
| 7 | 0.71 | 0.52 | 0.75 | 0.66 | 0.12 |
| 7.02 | 0.32 | 0.58 | 0.43 | 0.44 | 0.08 |
| 10.1 | 15.45 | 16.3 | 16.01 | 15.92 | 0.20 |
| 10.2 | 16.37 | 17.43 | 16.85 | 16.88 | 0.33 |
| All data was collected on an open system with a variation of temperature. Data gathered on a period of 14 days by Carla Frias by utilizing both the Nitrogen and pH probe provided by FDR. Calibration of both probes allowed information to reveal the relationship between ammonium level and pH within all aqautic systems. |
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**Graphs**

The graph represents the relationship between pH and Ammonium level through the collection of data of an open system within a period of 14 days by Carla Frias. The trend line describes how both show a positive correlation where as pH increases, so does ammonium level, revealing their dependency between both abiotic factors.

**Discussion**

 The data collected supported the hypothesis as well as the scientific justification as to why the results ended this way. By taking a look at Graph 1, we noticed that when the pH was 7, the ammonium level was very low, giving you a NH4+ of 0.66 o 0.44. On the other hand, when the pH rose to 10.1 or 10.2, the ammonium level raised to 16.01 and 16.85. This demonstrated that both the ammonium level and the pH positive correlated such that as one increases, so did the other. Both abiotic factors showed a relation within one another allowing the understanding on how pH affects the level of ammonium and overall environment of the turtles in the turtle pond.

 The data collected was impacted immensely by how long ago the water of the pond had been changed. This is because the longer the water had been on the pond; the more nitrogen waste was being accumulated. Due to the metabolism of the turtles, they decompose and undergo the process of protein catabolism where the proteins of their body are released from amino acid as ammonia. Thereby, the longer the water has not been changed, the greater the turtles have been enduring protein catabolism and the higher the contribution of ammonium level. This explains why, by taking a look at Table 2, the ammonium level was either 16.01 or 16.85 when the water had not been changed for a long period of time (5-6 days) while when the pH was 7.01 or 7, the water had been recently changed. (0-1 days)

Not only was the water receiving ammonium from the waste of the turtles, but also through the pH of the water. The pH, meaning the hydrogen potential of the water, depends on the molar concentration of hydrogen (H) and hydroxyl (OH+) ions; the higher the H+ or OH-, the higher the pH. Thereby, as the pH of the water in the pond increases, the alkalinity increases, more unionized ammonia is formed and a higher potential of hydroxyl ions are being used to chemically react with the ammonia that was already in the pond. An ammonia molecule reacts with a water molecule to form a new ammonium and hydrogen ion. Ammonia (NH3+) gains hydroxyl ions that the high pH has (in H20), making ammonia still present but in a different form. Ammonia is becoming ammonium at higher rates due to the ionization of hydroxyl ions passed through to one another.

NH3 + H2O 🡪 NH4+ + OH

**Conclusion**

During this lab, the addressed research question was ‘How does the pH affect the ammonium level (NH3) of the water in the turtle pond at FDR?’ Through research, it was clear that if the pH increased, then the ammonium level would increase as well because the abundance of hydroxyl ions from a higher pH would cause more ammonia (NH3+) to be ionized by these ions and undergo the chemical reactions of sharing electrons, causing it to become ammonium (NH4+) at a higher rate.

The way the ammonium level increased as the pH increased allowed the understanding of the relationship of both abiotic factors and how they altered each other. Hydroxyl ions, an fundamental element shared by both abiotic factors, caused the sharing of electrons to change the forms of ammonia by increasing their hydrogen concentration, causing it to become ammonium (NH4+). Moreover, by taking a look at Graph 1, the trend line describes how if the pH keeps on increasing, so will the ammonium level.

The pH was has a huge effect on the environment in which the turtles lived. As the ammonium level kept on increasing due to the pH, it caused the risk of Ammonia Toxicity to increase. Ammonia toxicity occurs when there is an accumulation of excess ammonia in an organism, causing an alteration in the metabolism or increase of the pH of the body. This can lead to turtles increasing their oxygen uptake, respiratory activity and overall causation of comas, deaths or convulsions. Likewise, the amount of ammonia portrayed through the pH of the water should be regulated in order to avoid ammonium levels to increase and ammonia toxicity to escalate.

The turtles living in the FDR pond should be living in an environment, which is virtuous and positive to their way of life. Despite ammonium level not being very high (reaching a max of 16.01), the scarcity of improvement towards a neutral pH to avoid high levels of ammonium could cause potential setbacks. Ammonia toxicity is a serious issued which must and can be issued through fixing of errors made by the school when attending the turtles. Rather than waiting for the ammonium to accumulate and changing the water once every week, 10% of the water should be changed 3 times a week. This will allow intestinal bacteria, responsible to filtrate the waters ammonium level, decrease the ammonium concentration and get the quality under control. The filter will also allow the pH of 7 which was recorded, referring to Table 1, on day 1 and 3, be constant.

Another element that should be changed is the way they monitor factors, which alter the turtles. A weekly or monthly check on the pH, temperature of the water, ammonium concentration, nitrogen concentration, etc. should be made in order to conduct research and evaluate possible errors being made by the staff. This will allow improvements for the living of turtles to be made constantly improving their environment and the way they live.

**Evaluation**

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| **Error** | **How it affected my results** | **Improvement** |
| The data collected through out the lab did not follow a pattern (such that every 2 days data is measured) | By not following a trend, it did not allow my data to be based on how the level of ammonium increased and pH increased as the days passed by. Instead, the data was collected every now and day allowing the results to be explained due to the change of water that the janitors made to the pond, not on the natural increase/decrease of the pond. | Define the procedure before starting the lab. This means research in depth what would make best the results collected. |
| Water being changed without previous noticed | Because the water was changed every now and day, this impacted and altered my results hugely. My lab was not only about how the ammonium level increased through the pH, but about all the factors contributing to this changed. The change in water is fundamental to understand why or why not the pH keeps on increased and thus, the ammonium level. | Allow all staff members know the lab that is going to be performed so that any third party does not alter the results  |
| The calibration of the probes was unclear  | The calibration of the probe is essential for obtaining precise and accurate results. With this, by not knowing how to calibrate the probe I slowed down the process of data collection. I depended on a science teacher to check that my materials are ‘ready to go.’  | Make sure that I am comfortable with the tools I will be using through out the lab to enforce independency and successfulness. |