Brandon Tran
Per. 1
9/17/14

The Ocean Acidification Lab

IV: CO_2 Concentration/Type of Water
DV: Shell Strength/Color of Water

Introduction

The situation of the ocean's rising pH levels due to the sea's excessive absorption of carbon has been a rising problem in recent events. Because of our industrial growth, greenhouse gas emissions caused by industrialization have contributed to a variety of global changes, such as global climate change, and, of course, rising ocean acidity. This rising acidity in the world's oceans has posed a risk to marine organisms by hindering their ability to create shells for themselves and to survive altogether.

In the water, CO_2's absorption creates carbonic acid (H_2CO_3) when fused with H_2O or hydrogen ions (H^+) and carbonate (CO_3^{2}). This absorption process prevents calcium carbonate (what shells are comprised of) from developing, and the carbonic acid that is produced can easily dissolve shells that are created by shellfish and other marine animals, such as plankton: a vital food source in the ocean. Other sea life appear to be affected because of their inability to live in such harsh places, where ecosystems such as coral reefs also become weak. When these organisms die from their living conditions, bacteria decompose them, and even more CO_2 is released.

Experimental Question

This problem has been presented to our attention. In order to prove its risks, two labs have been conducted to find out the effects of carbon dioxide saturation in the world's oceans: One experiment aims to find the rate of acidification in varying types of water, and one aims to find the effects of a calcium carbonate shell during prolonged exposure to acid.

The first lab will be conducted on 4 types of water, or the independent variables: hot, cold, tap, and control (salt). These 4 types will be poured into beakers of equal volume and supplemented with 4 drops of color indicator, which measures CO_2 levels in water. The beakers will be covered in saran wrap, and a straw will be inserted. A person will then blow into the straw for 2 minutes, and the color, or dependent variable, will be recorded according to the color chart every 30 seconds.

The second lab will be comprised of two shells: one submerged in vinegar or any other weak acid, and one in plain sea water. These shells will first be weighed and compared to 2 control shells that will be supplied prior. After 30 minutes of submersion (with observations recorded during the 15 minute

mark), both shells will be taken out of their beakers and weighed again, then they will be tested for durability by stacking books on them until they shatter. This durability test will also be repeated for the control shells. The number of books used will be recorded, and weights will be compared for all shells.

Bubbles Lab

Pre Lab Questions

1. What gas are you blowing into the water?

-We are exhaling CO_2 into the water.

2. What happens to the gas when you blow it into the water?

-The gas will become saturated in the water, making it more acidic.

3. How are you measuring change in the water during this lab?

-We are measuring change by using a universal indicator, which indicates pH.

4. What does measuring the pH of the water tell us?

-The measure of pH tells us the acidity of the water, with 1 being strong acid and 14 being strong alkaline.

5. After studying the reactions above, how do you think carbonic acid will affect the pH of saltwater?

-I think the carbonic acid will slightly lower the pH value of the saltwater.

Hypothesis

I predict that the salt water will take in the most CO_2 compared to the hot, cold, and tap water samples.

Protocol

The test will be conducted on 4 types of water, or the independent variables: hot, cold, tap, and control (salt). One type will be poured into a beaker measuring 100ml and supplemented with 4 drops of color indicator, which measures CO_2 levels in water. The beaker will be covered in saran wrap, and a straw will be inserted. A person will then blow into the straw for 2 minutes, and the color, or dependent variable, will be recorded according to the color chart every 30 seconds. This process is to be repeated 3 more times, using the 3 other types of water.

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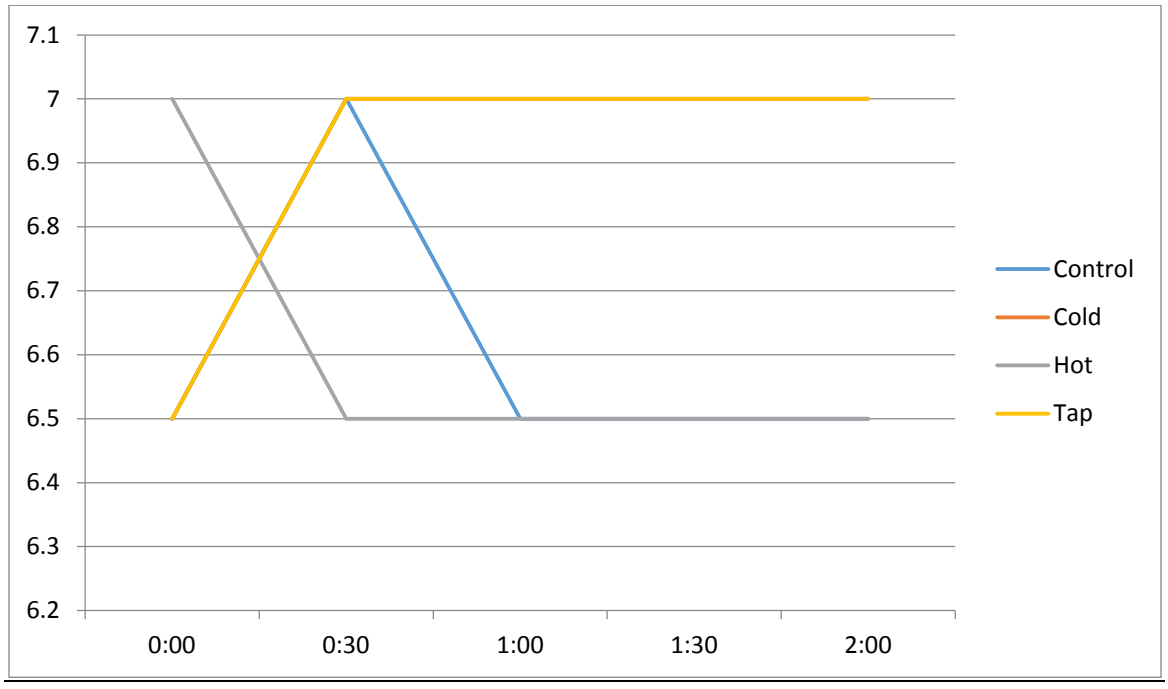
Data Table

	Property	0:00	0:30	1:00	1:30	2:00
Control	pH	6.5	7	6.5	6.5	6.5
	Color	Light Green	Light Green	Light Green	Light Green	Light Green
Cold	pH	6.5	7	7	7	7
	Color	Light Blue	Light Green	Light Green	Light Green	Light Green
Hot	pH	7	6.5	6.5	6.5	6.5
	Color	Light Green	Light Green	Light Green	Light Green	Light Green
Tap	pH	6.5	7	7	7	7
	Color	Light Blue	Green	Green	Green	Green

Graph



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Post Lab

1. As you blew through the straw, what were you adding to the water and how did that change the pH?

-As I blew, I added CO_2 to the water, which was absorbed to create carbonic acid (H_2CO_3). This production of acid increased the pH of the water.

2. What did the universal indicator tell us about the water?

-The universal indicator told us that the acidity of the water only increased slightly, most likely due to our weak attempts at blowing.

3. What does this tell us about the effects of carbonic acid in ocean water?

-This tells us that carbonic acid and excess carbon definitely acidifies the world's oceans, despite the small change we observed in our experiment.

4. Based on the results of your experimental protocol, which factor affects the pH of the water most, temperature or salt?

-According to my observations, high temperature factored in more than salt in the rising rate of acidity.

Conclusion

According to the experiment's outcome, my hypothesis was disproved: salt water did not absorb the most CO_2, the hot water did. During our experiment, the color indicator that was administered into the hot water sample changed more gradually than the sea, cold, and tap water. Although my hypothesis was deemed incorrect, I have learned that the temperature of water affects CO_2 absorption greatly, especially in higher temperatures.

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Shells Lab

Pre Lab Questions

1. How do organisms make their shells? What are shells made of?

-Organisms make their shells by accumulating calcium carbonate in the ocean.

2. What do you expect to happen to the shell in an acidic solution such as vinegar?

-I think the shell will become weaker in an acidic solution such as vinegar.

3. What are sources of carbon dioxide and which of these sources are most likely to affect ocean pH?

-Sources of carbon dioxide such as industrial sites and automobile emissions are most likely to affect ocean pH.

Hypothesis

I predict that the shell in the acidic solution (vinegar) will weaken and become more brittle, and that the shell in seawater will remain relatively unchanged.

Protocol

This lab will be comprised of two shells: one that will be submerged in vinegar, and one that will remain in plain sea water. These shells will first be weighed and compared to 2 control shells that will be supplied prior. After 30 minutes of submersion (with observations recorded at the 0 and 15 minute mark), both shells will be taken out of their beakers and weighed again, then they will be tested for durability by stacking books onto them until they shatter. This durability test will also be repeated for the control shells, which may be performed during the trials. The number of books used will be recorded, and listed weights will be compared for all shells.

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Data Table

Shell	Observations	Initial Mass (g)	Final Mass	Difference	
Control (Sea water)	White Underside, Deep Black Outside, Shiny	2.0 g	2.1 g	.1 g	
Experiment (Vinegar)	Black, Greyish Underside, Shiny	2.1 g	2.1 g	0 g	
High	Flakey, Brown, Ugly, Uneven	2.031 g	1.4 g	.631 g	
Low	Very Flakey, Deep Brown, Ugly	2.107 g	1.4 g	.707 g	

Control – 15 Books

Experiment – 14 Books

High – 1 Book

Low – 5 Books

Observations, 0 – Vinegar shell starting to bubble.

Observations, 15 min. mark – Intense bubbling, control is sitting idly.

Post Lab Questions

1. When you immersed the shells in vinegar how did you know that a reaction was happening?

-I knew a reaction was happening when I could see the vinegar bubbling around the shell.

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2. How did observing the shells in vinegar relate to how animals are affected by a lower pH of ocean water?

-Observing the shells in water related to the development of shells on organisms such as zooplankton and shellfish, because these organisms produce their shells using calcium carbonate like the shells used in the experiment.

3. How would shelled organisms be affected by a lower pH of ocean water?

-Shelled organisms would be affected by lower pH because the acidity has the ability to dissolve their shells, as shown in the experiment.

4. What are the primary functions of shell for these animals?

-Primary functions of a shell include protection from predators, and sometimes movement (in scallops).

5. Does it cost the animal energy to rebuild or repair their shell?

-Yes, energy is used when creating or repairing a shell.

Conclusion

My hypothesis, according to the outcome of the experiment, was proven to be correct, because the shell immersed in vinegar bubbled and became more brittle than the control shell. The vinegar shell also stayed the same in terms of mass, but the control grew .1 grams possibly due to the calcium carbonate in the salt water solution. This experiment proved that acid problematic to the development of shells, and that salt water without acidic properties could even promote growth.