

## Science Investigation Report Form: Hot Topic One Effect of Global Warming

(utilizing the I2I Stanford University Virtual lab Acid Ocean)

form developed by Vicki Soutar; Oconee Co. High School

Name(s) \_\_\_\_\_ Date \_\_\_\_\_ Period \_\_\_\_\_

Global warming is a hot topic! Atmospheric increases in levels of greenhouse gases such as carbon dioxide have led scientists to investigate the impact these increases are having on the world ocean and its inhabitants. You will be investigating the impact that CO<sub>2</sub> has on seawater pH and on sea urchins.

**Purpose in your research:** To determine if CO<sub>2</sub> can alter the pH of seawater and affect organisms living in the ocean.

**Back ground information:**

**Read the following background information then begin:**

Carbonic acid (H<sub>2</sub>CO<sub>3</sub>) is a relatively weak naturally occurring acid. Carbonic acid is formed when water reacts with carbon dioxide. In the air as rain mixes with CO<sub>2</sub> carbonic acid is formed then falls to the ground and infiltrates to form ground and is stored as ground water. Acidic groundwater containing carbonic acid can dissolve the carbonate mineral Calcite (CaCO<sub>3</sub>) or calcium carbonate found in the rock limestone. Limestone is produced when organisms with calcium carbonate shells die and their shells sink to the bottom of shallow seas or lakes to collect over time. As overlying layers are added the pressure increases on underlying layers and the shell sediments become compressed, compacted and cemented producing the sedimentary rock limestone. Acidic groundwater that circulates through the limestone chemically weathers or dissolves the limestone creating caves with their associated stalagmites and stalactites, caverns and sink holes due to the carbonic acid.

Log on to the website <http://i2i.stanford.edu/AcidOcean/AcidOcean.htm> to continue gathering background information.

Part 1- *Carbon in the Air*

1. What does the graph show?
2. According to the graph what was the independent variable in the Mauna Loa investigation of CO<sub>2</sub> levels in the atmosphere? \_\_\_\_\_

3. What was the dependent variable? \_\_\_\_\_

*pH of Liquids*

4. What is pH? \_\_\_\_\_

5. What numbers indicate acids? \_\_\_\_\_ Neutral? \_\_\_\_\_ Bases? \_\_\_\_\_

6. What is the pH of ammonia? \_\_\_\_\_

7. What is the pH of Coke? \_\_\_\_\_

*pH Ocean*

8. What is the estimated pH of the ocean in the year 2100? \_\_\_\_\_

*Carbon in the Air/ chemistry*

$\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$  is the chemical equation showing the reaction that occurs. Here is the equation in words:

Carbon dioxide + water produces carbonic acid

9. What are the reactants? \_\_\_\_\_ What are the products? \_\_\_\_\_

10. Is the above chemical equation balanced? \_\_\_\_\_ Why or why not?  
\_\_\_\_\_

11. Carbonic acid dissociates or breaks down readily to produce what 2 negative ions?  
\_\_\_\_\_ What is another name for "negative" ion? \_\_\_\_\_

12. What positive ion is released which in turn changes the pH? \_\_\_\_\_ What is another name for a positive ion? \_\_\_\_\_

The reaction shifts due to excess hydrogen ions to produce increasing amounts of bicarbonate which "ties" up the carbonate that the organisms need.

13. Why do the organisms need the carbonate and the calcium?  
\_\_\_\_\_

*Exploring carbon levels and effects:* Move the slider bar for the years up and down and watch the changes in levels as well as in organism then make a prediction below:

14. As the slider is moved into the future, predicted levels of \_\_\_\_\_ and \_\_\_\_\_ increase while levels of \_\_\_\_\_ decrease and \_\_\_\_\_ decreases indicating more acidic conditions.

15. Select each of the 3 scenarios and list the maximum pH for each:

Scenario A: \_\_\_\_\_ Scenario B: \_\_\_\_\_ Scenario C: \_\_\_\_\_

*Diversity in the sea:*

16. List 3 calcifiers: \_\_\_\_\_

17. List 3 noncalcifiers: \_\_\_\_\_

18. Is the sea urchin a calcifier? \_\_\_\_\_

19. List the 5 stages represented in the sea urchin life cycle from earliest or youngest to oldest:

20. Why do you think the sea urchin was chosen to test the effect of changes in pH?

---

**Research questions:**

Does seawater that absorbs more carbon dioxide become more acidic?

1<sup>st</sup> hypothesis ( if/then):

---

Which types of animals will be most affected if the oceans become more acidic? (is/then)

2<sup>nd</sup> hypothesis: \_\_\_\_\_

If a sea urchin is exposed to sea water that has a lower pH; in other words is more acidic, how will it be affected?

3<sup>rd</sup> hypothesis: \_\_\_\_\_

**Part 2 Perform the experiment:** You may be able to go to this part by hitting the forward arrow button but if you have difficulties then use this link to get back on track <http://i2i.stanford.edu/AcidOcean/AcidOcean2.htm>

**Analysis:**

1. How did you lower the pH in the solution with the embryos?
2. What was the purpose in adding the algae to the flasks with the sea urchins?
3. List the pH of the control group
4. List the pH of the experimental group
5. What did you do to determine the effects of the lower pH on larval growth?
6. What happened to experimental group as compared to the control group?
7. Why was it important to have a control group?

8. Why is it important to make numerous slides for each group?

9. **Draw a conclusion:**

**Accept or reject each of your hypotheses above and explain the evidence you are basing your decisions upon:**

-----  
-----  
-----  
-----  
-----  
-----  
-----

10. What do your findings indicate about the possible impact of ocean acidification on other animals?

11. What would be your next step in this research if conducted under controlled laboratory conditions?

**Refining and Extending:** Describe how you would conduct an investigation in the field to determine the effects of ocean acidification.