Name: _____ Period: _____ Date: _____

Acid Ocean Virtual Lab[1]

Objective:

- Describe the effect of the concentration of gases on marine organisms.

Background:

Carbonic acid (H_2CO_3) 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_2 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 ($CaCO_3$) 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.

Part 1: Our Acidifying Ocean

1. Open the Virtual Urchin lab at: http://virtualurchin.stanford.edu/AcidOcean/AcidOcean.htm

2. According to the graph, what was measured at the Mauna Loa Observatory from 1958 - 2008?

3. What do each of the lines represent?

    a. Blue: _____

    b. Purple: _____

4. Describe the change in atmospheric CO_2 since 1958.

5. What is the pH of each of the following:

    coke _____ drain cleaner _____

    drinking water _____ the ocean _____

6. According to the graph, how will the pH change in the next 90 years?

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[1] Adapted from an activity developed by Vicki Soutar, Oconee Co. High School using the Stanford University Virtual Lab Acid Ocean and the Stanford produced activity, Acid Ocean.

$$H_2O + CO_2 \text{ ---> } H_2CO_3$$

7. What are the reactants of the above reaction? _____

8. What are the products of the above reaction? _____

9. According to the diagram *Carbon in the Water*, how does an increase in acid (decrease in pH) in the ocean affect some organism?

10. Use the Exploring Carbon Levels and Effects diagram to answer these questions:

    a. How old will you be in 2050? _____

    b. The most pessimistic scenario predicts a pH level of _____ in 2050.

    c. The most optimistic scenario predicts a pH level of _____ in 2050.

    d. Which scenario do you think is most likely? Explain your answer.

11. Predict the effect of increasing acidification on sea urchin larvae development. (This will be your hypothesis for the following experiment.)

Part 2: Acidification Lab — Method Analysis

Perform the pre-lab to learn how to manipulate the lab equipment. This virtual lab mirrors what is done in the actual lab in order to study the effect of decreasing pH on sea urchin development. Then answer the following questions about the methods you are using.

12. Why was a sea urchin chosen as the model organism for this lab?

13. Why are the pH's 8.1 and 7.7 used in this lab?

14. Why did you add carbon dioxide to the flask labled 7.7?

15. Why did you add algae to the flasks with the sea urchin larva?

16. Why did you put the jars with the algae and sea urchin mixture on the shaker table?

17. Why did you test the pH in the jars on day 3?

18. Why did the pH in the 7.7 jar increase, but not in the 8.1 jars?

19. Why must you clean the filtration unit between tests?

20. Why did you need to filter the water out of the jars?

21. Why is it important to take slides from all six jars?

Data:

pH	Replicate A (length in µm)	Replicate B (length in µm)	Replicate C (length in µm)	Average (length in µm)
7.7				
8.1				

Conclusion:

Write a conclusion for your results below. This should be a paragraph that includes all of the following:

- an answer to the investigative question
- the relevant data
- how the data supports or rejects your hypothesis
- a scientific explanation for why you got the results you did

So what?

1. Why are the lengths of the sea urchin larvae arms important?

2. Using the food web below, predict the effect of ocean acidification on the other organisms in the ecosystem.

A. With sea otters, kelp forest food web