Name: _____ Period: ____ Date: _____

Ocean Acidification Lab: Effect on Coral Reefs

Background:

Increases in carbon dioxide to the atmosphere from the burning of fossil fuels and deforestation threaten to change the chemistry of the ocean. Evidence suggests that this increase in atmospheric carbon dioxide is lowering the pH of the ocean in a process called *ocean acidification*. When carbon dioxide is dissolved in water, carbonic acid is formed. If acidification continues at current rates, many marine species and ecosystems may not be able to tolerate the change.

Coral reefs are extremely diverse marine ecosystems, being host to over 4.000 species of fishes, many jellyfish, mollusks (shellfish), crustaceans (crabs, lobsters), and many other animals. Reefs are made up of calcium carbonate, which is secreted by corals. Corals are highly sensitive to environmental changes, including temperature and pH. Changes in pH can deteriorate calcium carbonate, which is the building block of coral as well as the main component in shells and skeletons of shellfish. Climate change has been linked to higher rates of calcium carbonate degradation, which is devastating to the ecosystem. A disruption in the coral reef ecosystem will affect the marine food web which, in turn, can impact human health.

Carbon dioxide and water forms carbonic acid: **CO_2 + H2O -------- > H_2CO_3**

When dissolved in water, carbonic acid releases hydrogen ions. ***The higher the concentration of hydrogen ions, the lower the pH of the ocean.*** The addition of carbon dioxide to seawater increases the amounts of hydrogen ions and creates bicarbonate ions. Shell building organisms can't use bicarbonate ions, it uses carbonate ions. As acidification increases, more carbonate ions become bicarbonate ions, making it more difficult for shellfish to build their shells. The health of the coral reef ecosystem will decline.

Objective:

In this activity, you will investigate the relationship between calcium carbonate and ocean pH.

Pre-lab Questions:

1. What is ocean acidification?

2. What are the reasons for the increasing levels of carbon dioxide in the atmosphere?

3. How (*describe*) does the addition of carbon dioxide lower the pH of the oceans?

4. Describe one way that a lower pH level can harm marine life?

Adapted from: ***ehponline.org/education (Ocean Acidification) & http://www.blueworldtv.com/images/uploads/lesson-plans/Lesson_plan_webisode41Acidification.pdf***

Name: _____ Period: ____ Date: _____

Materials:

- Water
- Liquid pH indicator
- 1 50mL beaker
- Crushed coral (calcium carbonate)
- Straw
- 1 prepared beaker (vinegar and crushed coral)

Procedure:

Part 1 – Effect of coral on pH

1. Fill a beaker with 40mL of salt water.
2. Add 3 drops of pH indicator to the salt water solution. Mix with a straw.
3. Record the color and pH of the solution in to the data table under INITIAL (**Table 1**).
4. Slowly exhale through the straw into the salt water solution until there is a color change. Record the color change and the pH of the solution in **Table 1** under CO_2 ADDED.
5. Add 1 teaspoon of crushed coral to your beaker. Slowly stir it around for 2 minutes.
6. Record the color and pH of the solution in **Table 1** under CORAL ADDED.

Part 2 – Effect of pH on coral.

1. Observe the prepared beaker with coral in it. This beaker contains vinegar (a strong acid) with coral.
2. Measure the initial pH of the solution and record it in **Table 2**. This beaker will be set aside for the next couple of days.
3. *After a couple of days*: remove the coral, carefully, and weigh the final mass (grams). Record this in **Table 2**.
4. Measure the final pH of the solution and record it in **Table 2**.
5. Calculate the percent of mass lost by the coral (use the formula below) and record it in **Table 2**.

Data:

Table 1 – pH change in saltwater solution

Solution	INITIAL Color	INITIAL pH	CO_2 ADDED Color	CO_2 ADDED pH	CORAL ADDED Color	CORAL ADDED pH
Saltwater						

Table 2 – Change in Mass of Coral

Solution	Initial pH	Initial Mass	Final Mass	Final pH	Change in Mass	% Change in Mass
Vinegar						

To calculate % Change in Mass:

$$\% \text{ Change in Mass} = \frac{(\text{initial mass} - \text{final mass})}{(\text{initial mass})} \times 100$$

Adapted from: ***ehponline.org/education (Ocean Acidification) & http://www.blueworldtv.com/images/uploads/lesson-plans/Lesson_plan_webisode41Acidification.pdf***

Name: _____ Period: ____ Date: _____

Discussion Questions:

1. What happened to the shell placed in the vinegar solution? How much mass did the shells lose?

2. What would you expect to happen if the pH of the vinegar solution was lower?

3. Relate what happened to the coral placed in the vinegar solution to what happens to coral reefs with changes in ocean pH?

4. What do you think would have happened if coral had been left in a solution of carbonated water over two days? Explain.

Adapted from: ***ehponline.org/education (Ocean Acidification) & http://www.blueworldtv.com/images/uploads/lesson-plans/Lesson_plan_webisode41Acidification.pdf***