Happy as a Clam… or Not? - Ocean Acidification Experiment

Overview

This experiment is designed to teach kids at home about the effects of decreasing pH in the ocean, commonly called Ocean Acidification.

Introduction

The oceans of the world absorb CO_2, a gas in the atmosphere that humans breathe out, plants breathe in, and that is released in large amounts into the atmosphere from activities like burning fossil fuels. It is normal for the oceans to absorb this gas, but when too much CO_2 enters the ocean it can be harmful to marine life, particularly organisms that make calcium carbonate shells. Some of these animals include crabs, snails, and clams. Many of these organisms are also lower in the food web - they are the food source for larger animals! If animals with calcium carbonate shells are harmed, it can harm the whole ecosystem. This addition of CO_2 into the ocean changes the pH (Figure 1) of the water, and it can become corrosive to these shells. It makes existing shells vulnerable, but it can also make it harder to form new shells.

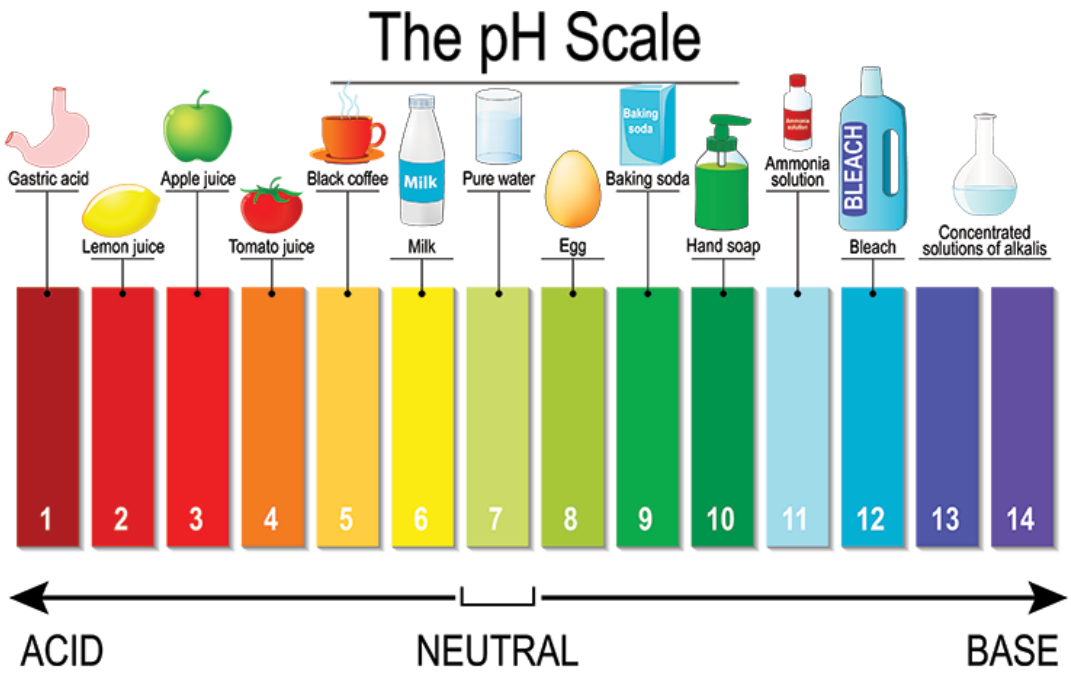

Figure 1 pH values of common every day and household items. The pH of ocean water has historically been about 8.2, but recently has begun to decline to 8.1 and lower. Stronger acidities actually have a lower pH! So, for example, as the pH of the world's oceans declines, they actually become more acidic. Source: https://www.sciencenewsforstudents.org/article/scientists-say-ph

Tasks

The goal of the following experiment (which has been modified from https://education.ocean.org/oceanlitlib/assignments/1114405) is to understand and see what happens when shells, or other items made of calcium carbonate, are placed into acidic conditions.

Materials Needed

1. Shells from the beach, at least three ***Note: make sure they are empty and there isn't a living animal in them still.**
    a. Chalk could also be used as an alternative if shells are not available, as they are also made out of calcium carbonate.
2. Water
3. Salt
4. Vinegar, white vinegar would work best
5. 5 clear containers big enough to submerge shells or chalk in
6. Observation sheet (included in these instructions)

Experimental Procedures

1. Fill each container halfway with each of the following solutions *Note, if you have limited materials you can do this with three containers and focus on containers a, b, and e.
    a. Fresh water
    b. Water with about 1 tablespoon of salt mixed in
    c. Half fresh water, half vinegar
    d. Half salt water, half vinegar
    e. Vinegar
2. Make observations about your shells (i.e. shape, color, texture, and what they feel like (hard or flexible). You can also take pictures.
3. Make hypotheses (using the chart below) about what you think will happen to the shells in each of the containers.
    a. A hypothesis is a statement about what you think will happen
        i. Example hypothesis: I think that if I put this shell in saltwater, a basic solution, then it won't change or dissolve.
4. Place one shell into each of the containers. Leave the experiment alone for one hour, then make observations about what you see.
    a. Suggested questions to think about
        i. Are there bubbles in the container?
        ii. Is the solution a different color?
        iii. Have there been any changes in the color of the shell?
        iv. Have there been any changes in the shape?

5. Leave the shells in the containers overnight and in the morning check and make more observations.
6. Leave the shells in the containers until about 24 hours after the start of the experiment. Remove the shells and make your final observations.

Discussion Questions

1. How did the shell change during the 24 hour period in the 5 treatments?
    a. What role did time play in the changes seen in the shell?
2. How did the shell in salt water (basic) compare to the shell in vinegar (acidic)?
3. Did the freshwater mixed with vinegar react the same way as the saltwater mixed with vinegar? If so, what is the difference that may have caused a different response?
4. Why are the shells of clams and crabs important?
5. Based on your observations, how might a clam or a crab respond in a more acidic ocean? If their shell was weaker how might that affect them? Do you think the conditions in your experiment reflect real world changes?
6. What error may exist in this experiment? How could you fix it or change it for next time?
    a. Use the internet or a science book to research the pH of vinegar. Do you think the ocean is becoming as acidic as vinegar?
7. If you used chalk, do you think this is a good representation of a shell? Why or Why not?
8. What species in the Chesapeake Bay could ocean acidification affect?
9. Ocean acidification occurs because of increased CO_2 in the water. Where are areas of your life that have high amounts of carbon (e.g. where in your life do you use fossil fuels?) and what changes could you make to minimize your CO_2 outputs?
10. How could you effectively communicate what you learned and help others make changes in their habits as well?

Observation Sheet

Time Elapsed	Freshwater (FW) Container	Saltwater (SW) Container	FW/Vinegar Container	SW/Vinegar Container	Vinegar Container
Hypothesis					
Initial Observations: 0 hours					
1 hour					
12 hours					
24 hours					

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https://education.ocean.org/oceanlitlib/assignments/1114405