Prepared by Annie Innes-Gold, Sophie Ackerman, and Ljiljana Rajic

Objective

Students will understand the effect of ocean acidification on different kinds of shells.

Standards Met: NGSS

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

This lesson is complementary to our previous lesson: ***Your Carbon Footprint and Ocean Acidification****.*

Background

Ocean acidification, or the decrease of pH in seawater, is due to the increasing levels of CO_2 in the atmosphere in industrial society. As explained in an earlier lab, the CO_2 dissolves into seawater, creating carbonic acid which releases bicarbonate (HCO_3^-) and hydrogen ions (H^+) into the water. Some of the H^+ ions also react with carbonate ions to form more bicarbonate, thus decreasing the amount of carbonate ions. This results in reduced growth of organisms with calcium carbonate skeletons and shells, such as corals, snails, and bivalves. By 2100, ocean pH is expected to drop to 7.8, reflecting a doubling in acidity. This could have devastating consequences for marine life. 30% of the atmospheric CO_2 is absorbed by the ocean, making it a key factor in climate change moderation.

Watch this video: https://www.youtube.com/watch?v=GL7qJYKzcsk

Experimental Part

Materials

- Mussel/oyster shells (dry and free of any biological material)
- Digital scale
- pH probe/test kit (affordable digital pH meter brand: Pancellent)
- Seawater (available in pet stores)
- Vinegar
- Glass jars (with sealing lids)

Procedure

Week 1

1. Create a hypothesis. What do you think the relationship between decreasing pH (increasing acidity) and shell mass will be?
2. As a group, decide what pH values your group would like to test. Depending on how many shells you have, pick 3 or 4 pH values. One should reflect the current ocean pH, and others can reflect predicted and extreme future values. Have two replicates for each pH value (ex. 8.1, 7.8, 7.0 etc).
3. Create acidic seawater. This can be done using vinegar and using a pH meter. Create separate supplies of each pH you want to test.
4. Pour the seawater into the glass jars with sealing lids. You should have two jars full of water for each pH you want to test. Number the jars and keep track in your lab notebook of which jar corresponds to which pH. Fill the jars to the top (with a very small amount of space, so you can add the shells without the jars overflowing).
5. Take the initial weight of the dry shells. Record it in a lab notebook. Add one mussel and oyster shell to each jar, keeping track of which shell is placed in each jar. Seal the lid, and ensure there is no space between the water and lid.

Weeks 2-4

Measure pH of each jar, remove the shells from your jars and let them dry overnight. If there has been a pH change of more than 0.1, change out the water back to the original pH. Record the pH in your lab notebook. After the shells are dry, weigh them and record the mass. Place the shells back in the jars and seal them. Repeat this data collection for weeks 3 and 4.

Results

Calculate the percent weight change for each shell. This will look like:
((ending weight - beginning weight) / beginning weight) x 100

Ex. ((6 - 7) / 7) x 100 = 14 % decrease

Questions

1. Describe any trends you saw. Did these results support your hypothesis? Did the results surprise you? Did this experiment demonstrate the effect of ocean acidification on shells?
   Hint for Teacher! Answers will vary. pH either will have or have not caused a change in mass. If yes, then the shell began to degrade due to acidic conditions. This demonstrates what is occurring to calcium carbonate in nature, because of ocean acidification. If no, then maybe you would see differences if the

experiment were run for longer, or if more extreme conditions were used for a shorter amount of time.

2. Were there any experimental errors? Did your pH change from week to week, and if so, why might this have happened?
   Hint for Teacher! pH may have changed if there was a small amount of air in the jar, or if it was not completely sealed. The carbon dioxide in the air could have caused the water to become more acidic.
3. *If this lab was conducted after or in conjunction with the coral acidification lab:* How did your results compare with the effect of acidification on anemones?
   Hint for Teacher! Answers will vary. Stressors may have been detrimental to both anemones and shells. This shows how acidification and other stressors cause damage to a variety of marine life.
4. What are possible solutions to ocean acidification?
   Hint for Teacher! Reduce carbon emissions. This can be tied back to the ideas in the first lab of how to reduce emissions (i.e. choose sustainable products/energy, bike/carpool/public transportation, reduce consumption of animal products).

Take Home Messages

Ocean acidification affects a variety of marine life. A seemingly small change in pH can have far reaching consequences on ocean ecosystems.

Lesson Adopted From

http://www.cisanctuary.org/ocean-acidification/PDFs-WorkshopPage