



Education and Research: Testing Hypotheses

Ocean Acidification

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Summary

This lesson is an exploration into the difference between acids and bases. Once students develop a basic understanding of pH, they will make the connection to ocean acidification and the impacts on coral reefs. Students will use the scientific method to conduct experiments to test the pH of various fluids using red cabbage juice as an indicator. After testing the pH of different fluids, students will test what happens to an egg over time when placed in a cup of fluids of varying acidity. The calcium carbonate eggshell represents the coral found in oceans. Students will make connections between the model and the coral reef ecosystem. Data that could be referred to is the ocean pH over time.

[TAGS: ocean acidification, coral reefs]

Key Concepts

NGSS Disciplinary Core Ideas:

ESS2.A: Earth Materials and Systems

ESS2.C: The Roles of Water in Earth's Surface Processes

Ocean Literacy Standards:

The ocean dominates the Earth's carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere.

The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water.

Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy." Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.

Objectives

Include clear, measurable statements of what students will be able to do, such as:

- **Observe** and **identify** changes that occur when red cabbage indicator is added to a fluid
- **Record** observable changes in their science journals.
- **Demonstrate** the difference between acids and bases
- **Communicate** predictions, hypotheses, and results.
- **Make connections** between our model and the ocean ecosystem

Materials

- 5 to 7 fluids, preferably clear, with a range of pH levels (see the lesson plan document below for suggested fluids)
- cups for each fluid
- liquid measuring tools (graduated cylinders or beakers)
- red cabbage juice (this can be prepared prior to the lesson, or you can have your students make it)
- raw eggs
- Red Cabbage pH scale indicator chart <http://web.stanford.edu/group/lpchscience/cgi-bin/wordpress/images/2012/11/Red-Cabbage-Color-Indicator-Chart.pdf>
- science journals
- Ask students to collect shells or pieces of coral from the beach or bring in small pieces for each student. Every student will need one piece for the assessment task.

Procedure

Day 1

1. Before teaching the lesson, review the procedures in this lesson plan document that outlines one way that this lab could be conducted:
<https://web.stanford.edu/~ajspakow/downloads/outreach/ph-student-9-30-09.pdf>
2. The following activities can be done as a whole class demonstration or in small groups.
3. For each group, set out labeled cups of 100ml of your selected fluids. Then add 50ml of the red cabbage juice to each cup.
4. Observe and discuss any changes that occur.
5. Hand out the red cabbage pH scale indicator chart and ask students to identify the pH of the fluids.
6. Discuss the pH scale and the difference between acids and bases and make connections to the experiment. Brain Pop has a good video on this topic if you have access to it:
<https://www.brainpop.com/science/matterandchemistry/acidsandbases/>

Day 2

1. As a demonstration, present cups of each of the fluids that you tested on Day 1. Place an egg in each cup and label the cups.
2. Have students make predictions of what will happen to the eggs over the course of 3 or 4 days. Have students record their predictions in their science journals.
3. Each day students make observations of the changes that occur, if any. Record observations in their science journals.
4. At the end of the experiment, students should observe that the eggshells in the highly acidic fluids will dissolve. Ask students what would happen if the ocean was made out of vinegar? Lemon juice? Milk? What would happen if the pH level in the ocean was raised? Introduce the term ocean acidification and watch a video explaining the process. Here are a couple of good videos that could be used:
<https://www.youtube.com/watch?v=Wo-bHt1bOsw> or
<https://www.youtube.com/watch?v=ogZkV-Yj7Hc>

Assessment

- **Performance**—Students will bring in a fluid from home, preferably clear, that they wish to test. Encourage students to select a fluid that you did not test in class already. Students will independently test the pH of their fluid using the red cabbage indicator provided in class and the indicator scale. Students will record the pH in their science journals and identify if it is acidic or basic. Students will then test what happens to the piece of shell or coral that they brought in. They will form a hypothesis of what will happen to the shell or coral and explain their thinking. Students will record observations of changes over 3 or 4 days in their journals. At the end of the performance task, students will explain what they did, what happened, and why.

Additional Resources