



Teacher Resource Kit - Experiment Lesson Plan

Ocean Acidification - Testing pH

Experiment Summary

This experiment introduces ocean acidification and how it can negatively impact marine organisms. Using CCMI's training video and resource kits, teachers will be guided through conducting a simple ocean acidification experiment with their students by a CCMI educator. Background information on ocean acidification will also be provided in the training video. Teachers undertaking this experiment are encouraged to follow up with further experiments to determine the pH of common solutions to allow students to have a greater understanding of the pH scale.

Curriculum Aim - Key Stage 2 (Year 4, 5 and 6)

Learning objectives

- Explain ocean acidification
- Define pH, acids and alkalis
- Describe how ocean acidification can have a negative impact on certain organisms
- Observe a scientific experiment and make predictions
- Recognise how to prevent further ocean acidification by reducing carbon emissions

The Cayman Islands - Science National Curriculum Alignment

- Recognise that environments can change and that this can sometimes pose dangers to living things (Year 4)
- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate (Year 5 and 6)
- Using test results to make predictions to set up further comparative and fair tests (Year 5 and 6)

Ocean Literacy Principles

- #1 - The Earth has one big ocean with many features.
- #3 - The ocean is a major influence on weather and climate.
- #5 - The ocean supports a great diversity of life and ecosystems.
- #6 - The ocean and humans are inextricably interconnected.

Necessary materials

Teacher training video

- Internet connection
- YouTube.com classroom account
- computer
- note paper
- pencil or pen



Experiment

- white vinegar
- water
- two glass jars
- pH test strips

Useful resources

- www.reefresearch.org/reefs-go-live
- www.projectaware.org
- www.doe.ky
- www.education.gov.ky/education/curriculum
- www.oceanservice.noaa.gov/kids/

Experiment Instructions

Ocean Acidification - Testing pH

1. Explain to students that different water-based liquids can be acidic or alkaline. Define the terms acid and alkali, and give an example of each. Some examples include:
 - a. acid: lemons, vinegar, coffee, urine
 - b. alkali: baking soda, ammonia, bleach, soap

Explain that scientists can decide if substances are acids or alkalis by using the pH scale and explain what the pH scale is.

2. Ask students if they think the ocean is acidic or alkaline. Explain to students that the pH of the ocean is approximately 8.1, making it slightly alkaline. Continue by explaining ocean acidification and the effect atmospheric CO₂ has on the pH of the ocean. As the amount of CO₂ in the atmosphere increases due to the burning of fossil fuels, more of it is absorbed by the ocean. When CO₂ is absorbed by the ocean, multiple chemical reactions occur. One of these reactions is the production of carbonic acid. The carbonic acid is formed when the carbon dioxide molecules interact with the water molecules. As an acid, increasing the amount of carbonic acid in the ocean reduces the pH of the water, making it more acidic.
3. Explain to the students they will be observing an experiment to demonstrate the effects of ocean acidification. Fill two cups, one with sea water (fresh water will also work), an alkali solution, and the other with vinegar, an acidic solution. Explain what pH strips are and that they can measure the pH of solutions. Dip a pH strip in the cup containing sea/fresh water and ask students to record the results.
4. Next, add a small amount of vinegar to the water cup. Ask the students to predict if the pH of this new solution will be lower, higher, or the same as it was before adding vinegar. Using the pH strips, test the new solution, and have students record the new pH value.



5. With the addition of vinegar, the pH level should go down. Ask the students to compare the two pH values. Did the results match their prediction? Why or why not? Explain to students that this experiment demonstrates ocean acidification. As an acidic substance is added to sea water, the pH decreases.
6. Discuss with students how ocean acidification can have a negative impact on certain organisms in the ocean. For example, scientists are concerned that calcium carbonate exoskeletons or shells of various marine animals may dissolve or become weakened as oceans become more acidic. Explain to students that by decreasing our carbon emissions and our carbon footprint we can reduce the amount of CO₂ in the atmosphere. Ask students to work together and list some ways they think people can reduce carbon emissions. End the discussion by informing students that if each student makes a small change to reduce their carbon emissions, the overall effects can be very positive for the environment.
7. Following the experiment and discussion, it is encouraged to conduct further experiments with students to determine the pH of common solutions. This allows students to have a better understanding of the pH scale.

Experiment Glossary

Ocean Acidification - Testing pH

Acid - solutions with a pH lower than 7 which have high concentrations of hydrogen ions; e.g. vinegar

Alkali - solutions with a pH greater than 7 which have low concentrations of hydrogen ions; e.g. soapy water

Calcium carbonate - colourless or white crystalline compound that naturally occurs in some plants, animals; e.g. mollusc shells and hermatypic coral skeletons

Carbon footprint - the amount of greenhouse gases, especially carbon dioxide, produced by an individual, event, organization, or product, that results from the burning of fossil fuels

Chemical reaction - a chemical change that occurs when two or more substances combine to form new substances

Fossil fuel - a natural fuel such as coal or gas, formed from the remains of living organisms

Hermatypic coral - stony coral, corals that help build the reef and become limestone over time

Ocean acidification - reduction in the pH of the ocean due to increased amounts of carbon dioxide in the atmosphere that are being absorbed and stored in the ocean

Organism - any living thing, such as a plant, animal, fungus, or bacteria

pH scale - a scale from 0-14 used by scientists to measure how acidic or alkaline a solution is



Student Vocabulary Assessment

Ocean Acidification - Testing pH

Below is a list of 10 vocabulary terms used during your Reefs Go Live Ocean Acidification experiment. Show the CCMI Educator that you understand ocean acidification and can match the definition on the right with the correct term on the left. Thanks for your help and good luck!

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| 1. Ocean acidification: _____ | a) Reduction in the pH of the ocean due to increased amounts of carbon dioxide in the atmosphere that are being absorbed and stored in the ocean |
| 2. pH scale: _____ | b) A chemical change that occurs when two or more substances combine to form new substances |
| 3. Acid: _____ | c) Any living thing, such as a plant, animal, fungus, or bacteria |
| 4. Alkali: _____ | d) The amount of greenhouse gases, especially carbon dioxide, produced by an individual, event, organization, or product, that results from the burning of fossil fuels |
| 5. Organism _____ | e) Solutions with a pH lower than 7 which have high concentrations of hydrogen ions e.g. vinegar |
| 6. Calcium carbonate: _____ | f) Stony coral; a coral that helps build the reef and becomes limestone over time |
| 7. Hermatypic coral: _____ | g) A natural fuel such as coal or gas, formed from the remains of living organisms |
| 8. Chemical reaction: _____ | h) Solutions with a pH greater than 7 which have low concentrations of hydrogen ions e.g. soapy water |
| 9. Carbon footprint: _____ | i) Colourless or white crystalline compound that naturally occurs in some plants, animals e.g. mollusc shells and hermatypic coral skeletons |
| 10. Fossil fuel: _____ | j) A scale from 0-14 used by scientists to measure how acidic or alkaline a solution is |