Ocean Acidification, an Introduction and Regional Study

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Summary

This activity was written with a middle school audience in mind, and provides an introduction to ocean acidification using a video from the California Academy of Sciences. After the introduction, students are guided through a yearlong, seasonal sampling of 1 or more bodies of water in their geographical area (the Pacific Coast of Northwest Oregon is the one used in the lesson). Next, students use data collected from a buoy off the coast of Washington state to analyze and interpret possible cause and effect of changing patterns in pH levels in the ocean. Finally, students will create a hypothesis and ask a question regarding ocean acidity levels as a jump-off point for their year long investigation.

*Ocean Acidification, Cause and Effect, pH*

Key Concepts

* pH
* Ocean Acidification
* Data Collection
* Graphing and Interpretation

Objectives

* Students will be able to **plan and carry out an investigation** regarding the chemistry of their local ocean (or other body of water).
* Students will be able to **use a model to understand** the potential causes and effects of ocean acidification.

Materials

* ENGAGE document called “Engage, Ocean Acidification Model”
* Brian Erickson’s Lesson Outline for “Candles Floating in Indicator”
	+ Small aquarium tank/bowl
	+ Distilled water
	+ Universal Indicator (Bromthymol Blue)
	+ Floating candles (5 or more depending on the size of the aquarium)
	+ Something to cover and seal the aquarium
* EXPLORE document called “Ocean Acidification, and Introductory Investigation”
	+ CAS video on ocean acidification: https://www.youtube.com/watch?v=GL7qJYKzcsk
	+ Access to probes or collection tools for collecting AT LEAST pH, if not also salinity and temperature ☺
	+ Online data entry software (Excel or Google Sheets) to enter data for each season (fall, winter, spring, summer)
	+ Buoy data from researcher Charlotte Whitefield: https://www.mbari.org/wp-content/uploads/2016/01/MBARI-Presentation-on-Data.pdf

Procedure

1. This lesson should be taught AFTER students have become familiar with pH…suggested pre-lesson: pH investigation using CU Boulder’s PHET simulation: https://phet.colorado.edu/sims/html/ph-scale-basics/latest/ph-scale-basics\_en.html
2. This lesson includes opportunities for sampling throughout the school year. If you want to just do a one-off sample, that’s great too!
3. After students have become familiar with pH, do the ENGAGE modeling activity. You can do this as a demonstration, or you could have students do it in small groups, depending on how long you want to take. It is useful to have the tank and candles set up as students are entering, to encourage them asking questions…if you do this as a demo, it should take about **15 minutes. (DAY 1)**
4. After you engage, then tell students that we will be collecting data in our own area to investigate changes in our own local ocean acidity. Pass out the EXPLORE activity, read the objective and instructions with the students, and then explain that they will be watching a video, and should fill in the blanks on their handout as they watch the video. **20 minutes. (DAY 1)**
5. Probe for questions/discussion after the video, talk about main causes of CO2 emissions (this is on the handout). **5 minutes. (DAY 1)**
6. Prepare students for water testing, collecting data on pH, salinity and temperature…this is an ideal point to end the class period (this is written with a 55 ish minute class period in mind). **12 minutes. (DAY 1)**
7. Complete water testing data collection. **(all period, DAY 2)**
8. Teach students to complete mean calculations, find the range and graph, using the data provided on their handout. You can project the document on Google Slides or a document camera and model the graphing with them. **(20 minutes) DAY 3**
9. Make observations based on the two graphs and record them in the table on the third page of the handout. **(15 minutes) DAY 3**
10. Discuss stability and change, and cause and effect with students, help them to complete the probing questions on page 4, and finally, end with a scientific question and a hypothesis regarding what they think will happen to the data they will be collecting over the course of the school year. **(15 minutes) DAY 3**
11. Collect the handout, and grade using the teacher rubric.

Assessment

* **Formative assessments**—you can grade this based student completion and understanding/ability to complete the data collection and analysis. Rubric attached.

Additional Resources

CAS Ocean Acidification video: https://www.youtube.com/watch?v=GL7qJYKzcsk

pH PHET: https://phet.colorado.edu/sims/html/ph-scale-basics/latest/ph-scale-basics\_en.html

Ocean Acidification Graphic: https://www.mbari.org/wp-content/uploads/2016/01/SOSMag-Iss05-Art07-Im003-%C2%A9Elzemiek-Zinkstok-Lushomo-SOSFCopyright-InfographicOceanAcidification-2560x3243.jpg

Ocean Acidification WHAT CAN WE DO: https://www.mbari.org/wp-content/uploads/2016/01/SOSMag-Iss05-Art07-Im004-%C2%A9Elzemiek-Zinkstok-Lushomo-SOSFCopyright-InfographicOceanAcidification-975x1235.jpg

NOAA Ocean Acidification: https://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F

Maybe related or not lesson: http://www.carboeurope.org/education/CS\_Materials/seawater\_pH.pdf

Extensions or adaptations

If you’d like to take a whole class period to focus on the CAS video, you could do the ELABORATE sheet, where students read back over their video notes, and complete the graphic organizer.

For students needing an accommodated handout, the teacher can fill in all, some, or most of the blanks in the video notes. Also, depending on student needs, the teacher can add guiding terms or fill in data as needed. This master sheet can then be copied for accommodated students.