

STEAM Subject: Marine Science

Lab: Ocean Acidification

Grades: 4–8

Learning objective:

Students will be able to:

- test and observe the effects of acidification in calcium shelled organisms
- explain what ocean acidification is
- identify solutions to reduce our emissions of greenhouse gases into the atmosphere

ENGAGE:

Ask students the following questions:

- What is ocean acidification?
 - *The decrease of the pH of the Earth's oceans, caused by increasing levels of carbon dioxide (CO₂) in the atmosphere. This makes the ocean more acidic.*
- What are some examples of ocean animals that have shells?
 - *Corals, mollusks (clams, oysters, etc.), crustaceans (lobsters, crabs, etc.)*
- What do they use their shells for? What would happen if their shells disappeared?
 - *Protection from predators and the external environmental factors. If they lose their shells, they would be very vulnerable and can easily die.*

EXPLORE:

Ocean Acidification Activity:

Students will observe the effect of acid on calcium-based shells.

Materials needed per student:

- Egg
- White vinegar (about 1 to 2 cups)
- Cup (large enough for an egg)

Directions:

1. Have each student take their egg and hold it over the sink. Instruct them to squeeze the egg in their hand as hard as they can. They should not be able to break the egg. Can they see the yolk inside? Optional: hold a flashlight to the shell of the egg to see the yolk.
2. Ask students to elaborate on why eggs have hard, unbreakable shells.
 - a. *For protection, since the developing bird (yolk) inside is very soft*
3. Explain that eggshells are made of the same material as seashells — calcium carbonate. This compound dissolves in acid. Ask students what they expect



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might happen to their eggs if submerged in acid and what might happen to mollusks if ocean waters become more acidic.

4. Have students put their eggs in their cups and cover the eggs with white vinegar.
5. Let sit for about 1–3 days. Have students observe the eggs periodically.
6. After, have students dump out the vinegar and rinse the eggs with water. Ask students to make observations of what the eggs are like now. Students can bounce their eggs gently.
7. Ask students if they expect their eggs to be more fragile now. (Optional: have them hold their eggs over the sink and squeeze again. The eggs should break easily.)

Discussion:

Ask students to explain how acidification affects shelled organisms. What happens to ecosystems if they lose these organisms due to acidification? How can ocean acidification be slowed?

EXPLAIN:

Ocean Acidification:

Earth's oceans act as carbon dioxide sinks, meaning that they absorb about 30% of the atmosphere's carbon dioxide because of how carbon dioxide can dissolve in water. This process is naturally occurring and vital for our atmosphere. However, current rates of carbon dioxide input into the atmosphere increase carbon dioxide uptake by the oceans considerably more than what the rates would be without human interference. When carbon dioxide dissolves in water, the water becomes more acidic through chemical processes. So, when a lot of carbon dioxide dissolves into the oceans' waters, the oceans become more acidic.

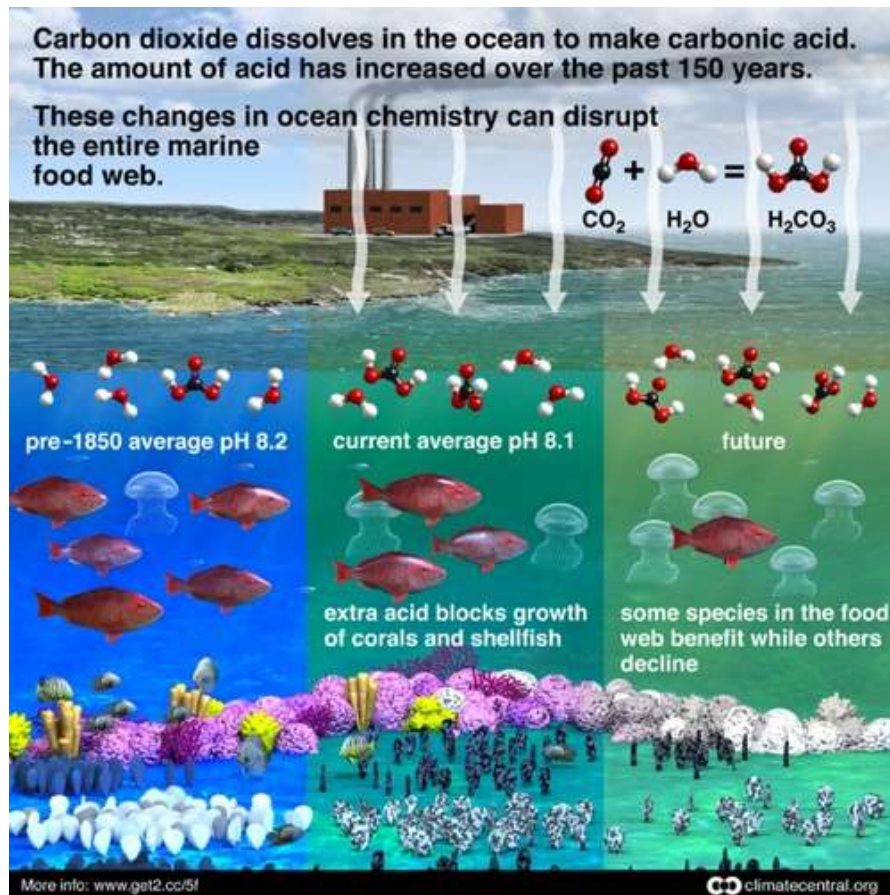


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This process is the basis behind ocean acidification. It presents a problem for calcifying organisms (those with shells) such as corals, shellfish, and crustaceans because acid dissolves calcium carbonate, the main component in their shells that make the shells hard. As a result of ocean acidification, these organisms lose their natural protection and die, causing ecosystem-wide changes.

- Read more about ocean acidification here: <https://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F>
- Watch videos about ocean acidification and increasing carbon dioxide levels:
 - California Academy of Sciences: <https://www.youtube.com/watch?v=dbMomQgl3Fk>
 - Cartoon Crash Course: <https://www.youtube.com/watch?v=ogZkV-Yj7Hc>

- Alliance for Climate Education:
<https://www.youtube.com/watch?v=6SMWGV-DBnk>
- Find ways to reduce your greenhouse gas emissions:
 - Climate Kids Resources 10 Things I Can Do to Help!
<https://www.climatekids.org/resources>
 - Climate Kids NASA. How can I reduce my "carbon footprint"?
<https://climatekids.nasa.gov/how-to-help/>
- Review Science Vocabulary:
 - **Ocean acidification:** the pH is decreasing (neutral-acidic). The ocean average pH is 8 (basic).
Because of human-driven increased levels of carbon dioxide in the atmosphere, there is more CO₂ dissolving into the ocean. The ocean's average pH is now around 8.1, which is basic (or alkaline), but as the ocean continues to absorb more CO₂, the pH decreases and the ocean becomes more acidic. (<https://www.noaa.gov/education/resource-collections/ocean-coasts-education-resources/ocean-acidification>)
 - **pH:** quantitative measure of the acidity or basicity of aqueous or other liquid solutions. A solution with a pH less than 7 is considered acidic; a solution with a pH greater than 7 is considered basic, or alkaline.
 - **Calcium carbonate:** the compound that shells are made of



EVALUATE:

Have students think of shelled organisms around them — in oceans, their backyards, even their dinner plates. How would these organisms be affected by acidification? How would their ecosystems be affected as a result?

What can you do to slow ocean acidification and preserve these ecosystems? Can you decrease the amount of carbon dioxide that is released into the atmosphere?

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