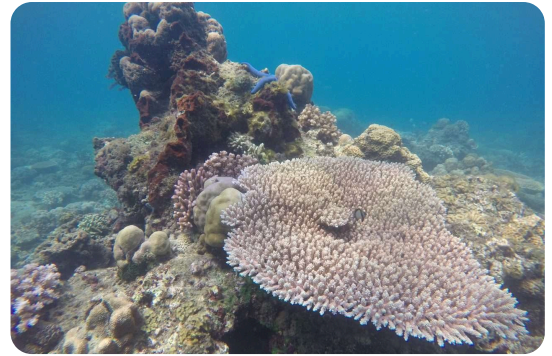




An acidifying ocean

Lesson plan: how carbon dioxide acidifies seawater, two simple experiments, and what it means for shells and corals



Ages	13 to 18 (grades 8 to 12)
Time	60 minutes, plus a 24-hour wait for experiment 2
Group	Up to 35 students, in groups of three or four
Where	Classroom or science lab
You need	Per group: red cabbage indicator or universal indicator, cups, straws, eggshell or chalk, water, soda water, vinegar, a balance

What students learn

- That the ocean absorbs a large share of human carbon dioxide emissions, and this lowers its pH.
- How the pH scale works, and why a change of 0.1 is significant.
- The basic chemistry of carbonic acid and carbonate.
- How acidification affects shell-building animals and corals, and the limits of simple models.

Before the lesson

1. Make red cabbage indicator: chop half a red cabbage, cover with hot water, leave 15 minutes and strain. Or use universal indicator.
2. Per group: 4 cups, one straw per student, 3 pieces of eggshell or chalk, water, soda water, vinegar, and a balance that reads to 0.01 g if possible.
3. Print one **record sheet** per group.

The lesson

- 1 **The ocean soaks up CO₂ 8 minutes, slides 1 to 3.** Explain the logarithmic pH scale with the ten-times rule.
- 2 **The chemistry 10 minutes, slide 4.** Keep it simple for younger classes: CO₂ makes the water more acidic and takes away shell-building material.
- 3 **Experiment 1 12 minutes, slide 5.** Everyone blows bubbles through a straw. The indicator shifts towards acid.
- 4 **Experiment 2 15 minutes, slide 6.** Set it up now, and weigh again the next day.
- 5 **Who is affected 10 minutes, slides 7 and 8.** Discuss one or two questions.

Answers and what to listen for

What to expect: breath adds carbon dioxide, which forms carbonic acid, so the indicator shifts towards acid (red cabbage goes from purple towards pink). In experiment 2, vinegar dissolves the most calcium carbonate, soda water a little, and water almost none.

Making it easier or harder

- **Younger groups:** do experiment 1 as a demonstration, and skip the equations.
- **Older groups:** discuss why the carbonate ion concentration matters more than pH itself for shell-building, and look up aragonite saturation.
- **Link:** lesson 3 brings warming and acidification together.

Safety and good practice

- Vinegar can sting eyes: wear eye protection if you have it. Never share straws, and blow out only. Don't drink any of the liquids.

Curriculum links

- **Science:** acids and bases, pH, chemical reactions, carbon cycle, climate change.
- **Maths:** percentage change.
- **Philippine senior high school:** General Science.
- **Ocean Literacy Principle 3:** the ocean is a major influence on weather and climate.

The teacher reading has the science behind every slide, with links to the sources.

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