

The changing ocean: lesson 2 of 3

An acidifying ocean

How carbon dioxide changes
seawater, and why shells and
corals care

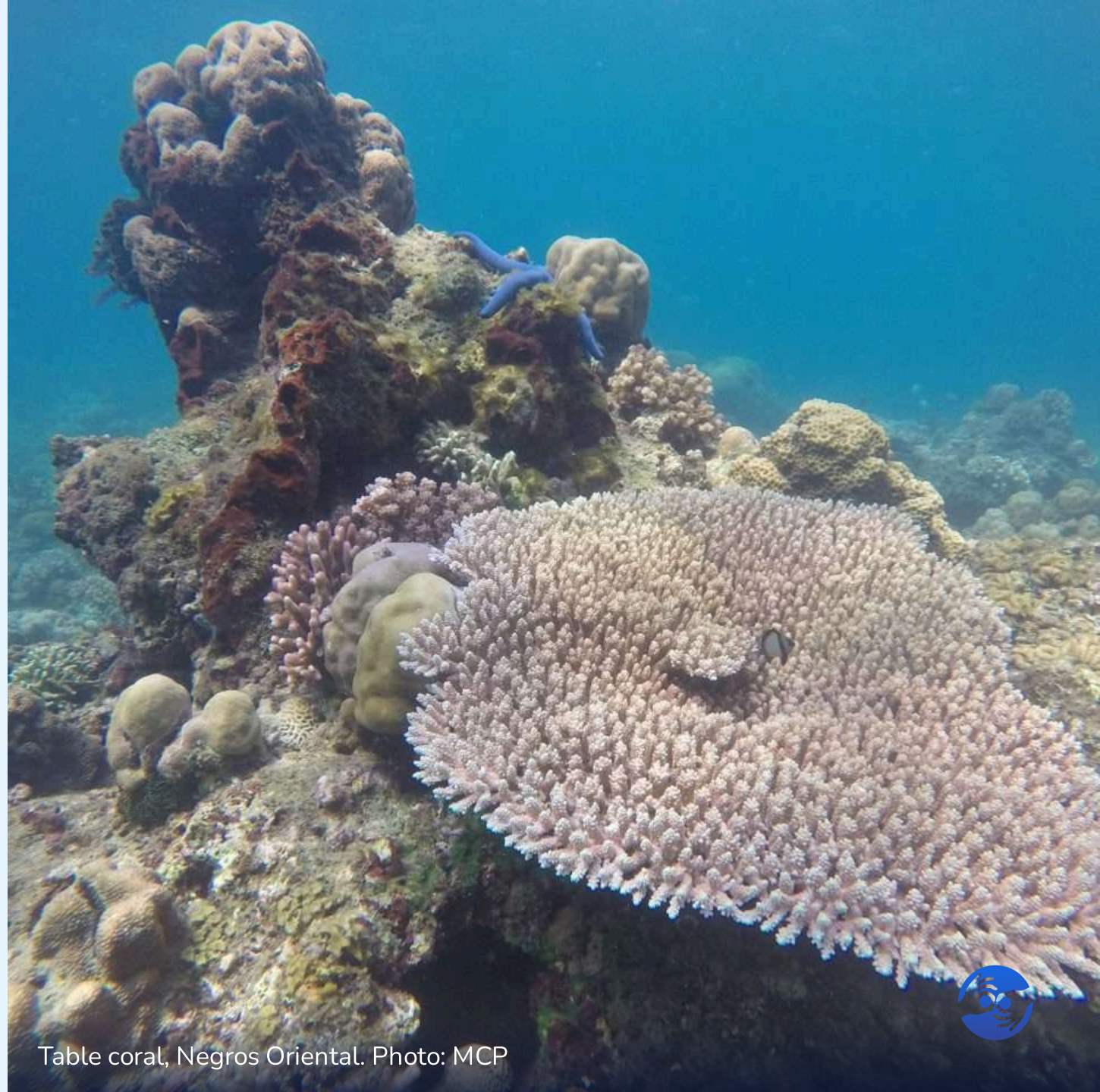


Table coral, Negros Oriental. Photo: MCP



The ocean soaks up carbon dioxide

about 1/4 to 1/3

of the carbon dioxide people release each year is absorbed by the ocean

8.2 to 8.1

the drop in average surface ocean pH since the 1700s and 1800s

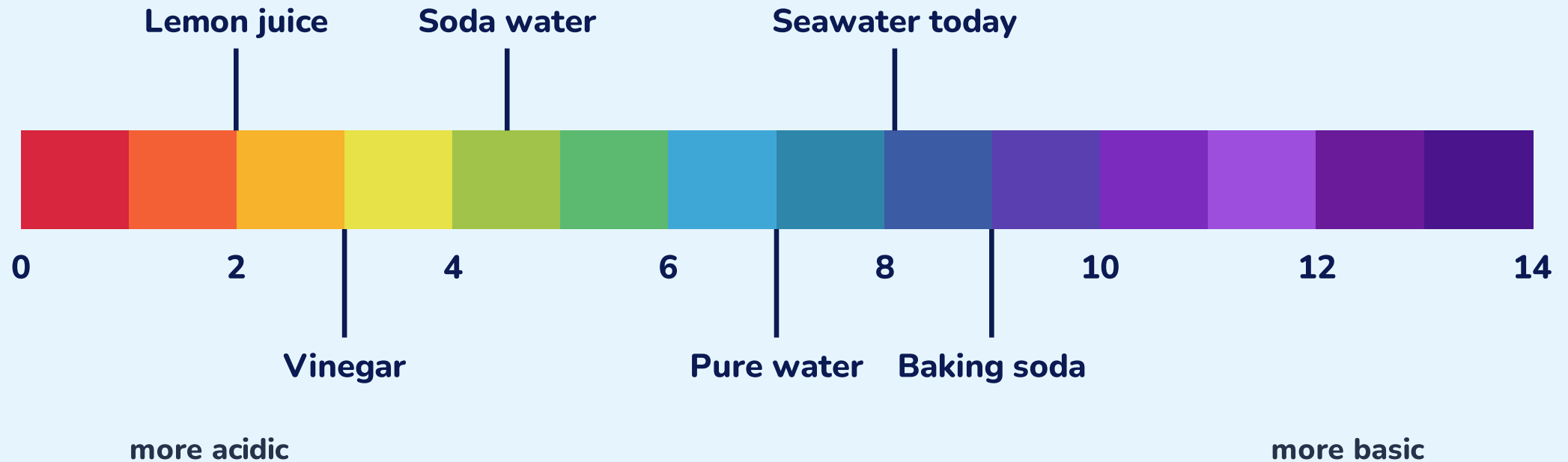
That small-looking drop means the ocean is about 30% more acidic. It is still slightly basic, but moving towards acid.

How we know: NOAA PMEL. World Ocean Review, 2021.



Understanding pH

pH runs from 0 to 14. Each step is ten times more acidic than the one above it, so small changes matter.



What happens in the water

When carbon dioxide dissolves in seawater, it forms carbonic acid, which releases hydrogen ions. More hydrogen ions means a lower pH.

Those extra hydrogen ions also grab the carbonate that corals, clams, snails and some plankton need to build their shells and skeletons.

- $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$ (carbonic acid)
- $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$
- Less carbonate: harder to build shells and skeletons



Experiment 1: your breath in water

1. Add a few drops of indicator to a cup of water. Red cabbage juice works well: it turns red or pink in acid and blue or green in bases.
2. Record the colour.
3. Using a straw, gently blow bubbles into the water for one minute. Only blow out, never suck in.
4. Record the colour again. What has your breath added to the water?

Safety

One straw per person, thrown away after.

Blow out only, and stop if you feel dizzy.



Experiment 2: shells in acid

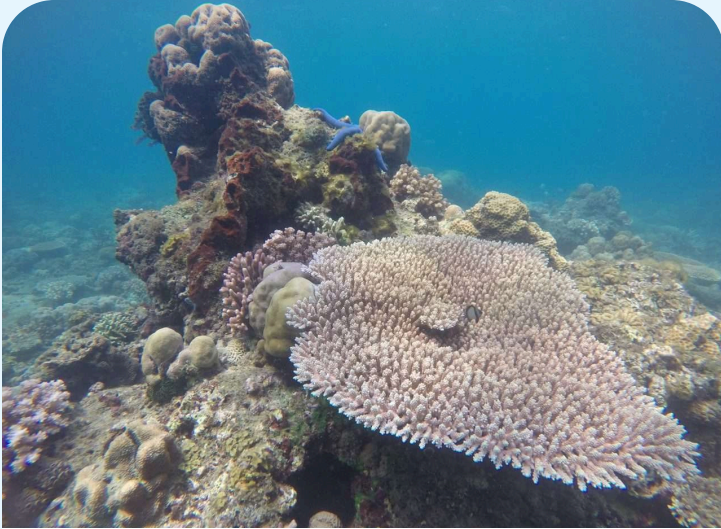
1. Weigh three pieces of eggshell or chalk. Record each mass.
2. Put one in water, one in soda water and one in vinegar.
3. Watch for bubbles. Leave them for 24 hours.
4. Dry and weigh them again. Work out the percentage change in mass.

Remember

Vinegar is far more acidic than seawater will ever become. This shows the direction of the change, not its size.



Who is affected?



Corals

Build skeletons more slowly in more acidic water.



Shellfish

Oysters, clams and snails find it harder to build shells.



Plankton

Tiny shelled plankton sit at the base of ocean food webs.



Talk about it

Why is the ocean still called basic, even though it is acidifying?

How good a model was vinegar for the real ocean?

Warming and acidification come from the same cause. What is it?

Next time: bleaching, change and hope



Photos and sources

Photos: table coral by MCP, Negros Oriental. All illustrations drawn for this lesson by Marine Conservation Philippines.

Sources:

- NOAA PMEL and Climate.gov. The origin and impacts of ocean acidification.
- World Ocean Review 7 (2021). The ocean is acidifying.

Full links are in the teacher reading. Free to use and share for education. Made by Marine Conservation Philippines. More free lessons: marineconservationphilippines.org/resources/teachers-resources/

