
OCEAN ACIDIFICATION

What is ocean acidification? It is the process that happens when Carbon Dioxide (CO₂) from the atmosphere is absorbed by our oceans. CO₂ breaks up water molecules (H₂O) and releases the hydrogen, which creates acid. This lowers the pH value of the seawater.

Levels of atmospheric CO₂ change naturally around the world throughout the seasons. As vegetation dies off in Autumn and Winter, CO₂ is released into our atmosphere and when vegetation begins to grow again in Spring and Summer it absorbs CO₂. The following video from NASA shows the global change throughout the year <https://www.youtube.com/watch?v=x1SgmFaoro4>. Unfortunately humans have changed the natural cycle and have overloaded our planet with CO₂. This overload comes mostly from burning fossil fuels and from cutting down forests that are not replanted. Our oceans absorb a lot of this excess CO₂, leading to a change in the pH of the ocean. This change affects life in our ocean and today we will look at how it can change the shells of sea creatures. The following video from the Ocean Alliance gives a great introduction to ocean acidification <https://www.youtube.com/watch?v=6SMWGV-DBnk>

AIM

HOW DOES ACIDIFICATION CHANGE SHELLS?

STEP 1

Gather the following:

- Some small **EMPTY** shells from the sea shore.
- 1 glass
- Vinegar
- Rolling Pin



Remember experiments sometimes have to be repeated before they work so keep trying until it works! If it doesn't work for you the first time, choose a thinner piece of shell and repeat.

STEP 2

- Using the rolling pin carefully break the shells into smaller pieces (around 3-4cm), ask an adult for some help!
- Place the shell fragments into the glass and add the vinegar over the shells until they are fully covered. Remember vinegar has a pH of about 2.5 so it is acidic.
- Watch as the bubbles start to be released around the edges of the shells. What do you think is happening?
- Leave them over night and test to see have the shells got weaker over night?

WHAT PROCESS HAPPENED IN THE EXPERIMENT?

Shells are primarily made of calcium carbonate (CaCO_3). This calcium carbonate is stable and insoluble in marine water unless the pH changes. We used vinegar in this experiment to change the pH so you could see what happened to these shells in a more acidic environment.

- The vinegar we added contains acetic acid (CH_3COOH) and water (H_2O).
- When the shell fragments were surrounded by the vinegar, the vinegar started to **dissolve** the calcium carbonate (CaCO_3) and formed calcium acetate ($\text{C}_4\text{H}_6\text{CaO}_4$) and carbonic acid (H_2CO_3).
- The calcium acetate dissolved into the water and the carbonic acid decomposed into carbon dioxide (CO_2) which you saw as **bubbles** and water (H_2O).

The vinegar is much more acidic so that you can see the results quickly. However with the current change in pH in the ocean this same process will happen in the ocean but would happen over months rather than hours. As you saw in the Ocean Alliance video the ocean could become more acidic in a few decades that it has been in 20 million years if we don't start to address how much CO_2 we are releasing into the atmosphere.

Here in Ireland we are measuring Ocean Acidification in offshore and coastal waters. Dr. Triona McGrath explains this in her TEDx talk

https://www.ted.com/talks/triona_mcgrath_how_pollution_is_changing_the_ocean_s_chemistry/discussion

Since this talk Earth and Ocean Sciences in NUIG are leading a project (VOCAB) to study ocean acidification in our coastal waters which is funded by the Marine Research Programme 2014-2020. We take samples at specific sites, moor instruments on the seabed and we have installed equipment aboard the RV Celtic Voyager. These data sets will allow us to understand the variability in our coastal waters so that we can monitor any changes as they occur.

What can each of us do to help slow down this process?

We all need to change and reduce our dependency on processes that release CO_2 in the atmosphere. There are many ways we can all reduce our carbon footprint, as the Bell Museum details here <https://www.youtube.com/watch?v=2Jp1D1dzxj8>.

OTHER VIDEOS

- Science Bulletin gives the history of the Keeling Curve which is used to measure CO₂ around the world <https://www.youtube.com/watch?v=oZ8g-smE2sk>
- Why not try to balance a simple ecosystem with CO₂ and O₂ go to *orb.farm* using Google Chrome.

CREDITS

This experiment is brought to you by the VOCAB team in [Earth and Ocean Sciences at NUI Galway](#).

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