

Balancing people and environment.

Biosphere Explorers 2: Ocean Acidification (for P5+).

SCN 2-19a: I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made.

TCH 2-06a: I can analyse how lifestyles can impact on the environment and Earth's resources and can make suggestions about how to live in a more sustainable way.

90 minutes

Time	Activity	Description	Resources/Notes	Benchmark
20 mins	Initial prep & Explanation	<p>Talk about how human impact is causing climate change. You can use the first part of Biosphere Explorers 1 Climate Change presentation (number 4) for this.</p> <p>Ask pupils to guess the % of CO₂ that our oceans are absorbing. The answer is 30% - use this to segue onto how increased CO₂ affects our oceans (below).</p>	<p>Presentation files: Workshop 4 on climate change: https://www.carboncentre.org/a-sense-of-place</p>	<p>Plans and designs scientific investigations and enquiries.</p> <p>Carries out practical activities in a variety of learning environments.</p>
5 mins	Experiment 1 – How does CO ₂ impact seawater?	<p>Have 200ml of water in a transparent container at front of class. Add a few drops/teaspoon of pH indicator liquid. The colour should turn a green (or a yellow, which means you should add a bit more indicator liquid). This shows tap water is of neutral pH.</p>	<ul style="list-style-type: none"> • Transparent container or water jug • 200ml water • Teaspoon of pH indicator liquid • Safety goggles • Paper straw 	

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		<p>Ask the class how you will increase the CO₂ in the water (to represent how the oceans are increasing in CO₂). A pupil will use a straw to blow out slowly and steadily into the water, near the base of the container. Have a quick safety briefing and have the pupil wear safety goggles.</p> <p>The colour will change to yellow and then to red, showing that CO₂ increases the acidity of the water.</p> <p>Write the chemical reaction on the board to explain what is happening: $\text{CO}_2 + \text{H}_2\text{O} = \text{H}_2\text{CO}_3$ (a weak acid, which breaks down into) $= \text{H}^+$ (acid) + HCO_3^-</p> <p>H₂CO₃ is called hydrogen carbonate.</p>	<ul style="list-style-type: none"> pH scale <p>Note: Hydrogen ions (H⁺) are inversely related to pH and can be measured on the pH scale. Therefore, the more hydrogen ions present, the lower the pH; conversely, the fewer hydrogen ions, the higher the pH.</p>	
30 mins	Experiment 2 – How does acid affect sea life?	<p>The class can work in pairs or groups on their tables. They will get two containers which will hold at least 50ml and a small seashell – so each group gets two shells. Ensure the class decides which shell and container is number one, and number two. Emphasise that they cannot mix this up.</p> <p>Pairs/groups take turns to fill up their first container with 50ml water. One pupil can go around to weigh shells and another pupil can give pH indicator paper out for each seashell in each group. The teacher can fill their second containers with 50ml vinegar.</p>	<ul style="list-style-type: none"> 2x transparent containers for each group 2x seashells for each group 2x pH indicator paper for each group Pencil and paper for each group 1x50ml of water for each group 1x50ml of vinegar for each group 	<p>Investigates and records chemical changes to the properties of materials which are irreversible.</p> <p>Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar</p>

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		<p>Once each group has all their resources and have weighed their shells, they can put them into the containers. Then, using the pH indicator paper, they can check to make sure the vinegar and water are the expected pH. If you don't have indicator paper, use the indicator liquid on a demonstration pair of containers. Refer to a picture of a pH scale on the board.</p> <p>The shells are left for 20 minutes before they are removed, dried, and weighed again. Again, make sure pupils don't mix up their numbered shells.</p> <p>Put the next chemical reaction on the board to show how acidity will erode the seashells: Acid (H^+) + shell ($CaCO_3$) = Ca_2^+ + H_2O + CO_2. You can ask pupils to guess what Ca (calcium) could be. If they need a clue, talk about how it is important for our bones and teeth.</p> <p>After twenty minutes, take the shells out of their containers and dry them off. You can then reweigh them and compare their weights to before the experiment.</p>	<ul style="list-style-type: none"> • 2x measuring jugs accurate for 50ml <p><i>The volumes do not need to be precise, so do not worry if your jugs aren't very accurate to 50ml.</i></p> <ul style="list-style-type: none"> • Scales, ideally accurate to 0.1g (e.g. jewellery scales) <p><i>If you do not have access to scales accurate to 0.1g, weigh all number 1 shells together and divide for the average, repeat for number 2.</i></p> <p>CaCO₃ is called calcium carbonate.</p> <p>NOTE: You can reuse seashells multiple times for this experiment.</p>	<p>but more complex) contexts.</p> <p>Expresses informed views about scientific and environmental issues based on evidence.</p> <p>Analyses, interprets and evaluates scientific findings.</p>
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		<p>The seashell in the vinegar should have lost more weight. The shells in the water may have gained weight as they could still be wet.</p> <p>A discussion on the reaction & what climate change means for our sea life follows, bringing it back to the positive actions we can do to ensure we reverse climate change as quickly as possible by becoming a carbon negative society.</p>		
20 mins	Greenhouse Gas Board Game – group round	<p>Play as a class while waiting for the seashells to react. This will demonstrate how we are increasing CO₂, and how we can reverse this.</p> <p>If you do not have the Biosphere Explorer 1 Pack you can spend this time during the experiment discussing climate change actions</p>	The Biosphere Explorer 1 Pack has the greenhouse gas board game and pieces (given to primary schools in the Galloway Glens area). You can also reach out to info@carboncentre.org to borrow a pack.	



This lesson plan is from Crichton Carbon Centre's Biosphere Explorers 2 project, funded by Galloway Glens.

