Ocean Acidification (for P5+).

Time	Activity	Description	Resources/Notes	Benchmark
20 mins	Initial prep & Explanation	Set the context around climate change and pH using the presentation. Pause to go over the chemical reaction after the short pH video.	Science Presentation	
5 mins	How does CO2 impact seawater?	Write the chemical reaction on the board to explain what is happening: $CO_2 + H_20 = H_2CO_3$ (a weak acid, which breaks down into) = H^+ (acid) + HCO_3^- H_2CO_3 is called hydrogen carbonate. Learning opportunities: • Explain how chemical shorthand reads. CO2 is Carbon Dioxide. Point to each letter/number as you say it out loud e.g. C for Carbon, 2 for Di, and O for oxide, which is a way of saying oxygen in this context. • Bring up the periodic table from google and ask pupils to say what they think some common elements might be – what would Hydrogen be? Nitrogen? Can they name any other elements? Elements are the building blocks of everything that exists in the universe – imagine them as different lego – each different shape and colour is a different element.	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. For more info on acidity, see the science lesson in our peatlands resources.	
30 mins	Experiment 2 – How does acid	Continue the presentation and follow along for the experiment. This section explains the experiment in full.	• 2x transparent containers for each group • 2x seashells for each group	Plans and designs scientific investigations and enquiries.

	affect sea life?	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 for each – 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. Number ONE is water. Number TWO is vinegar. Pairs/groups take turns to fill up their first container with 50ml water. One pupil can go around to weigh shells (make sure pupils know the importance of decimal points and correct units of measurements) 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/non-brewed condiment (which is easier to buy in bigger bottles). See Notes if you do not have sensitive scales. Ask the pupils what they think will happen once we put shells into water/vinegar. Take three or so of these hypotheses and write them on the board and their worksheets. Make sure they are something you can test/observe, and one is about how the shells could dissolve/be eroded. Once each group has all their resources and have weighed their shells, they can put them into the containers. You can take a few minutes to let the pupils observe their shells, especially if it can prove/disprove any hypothesis immediately.	• Pencil and paper or whiteboard for each group • 1x50ml of water for each group • 1x50ml of vinegar/non-brewed condiment for each group *The volumes do not need to be precise, so do not worry if your jugs aren't very accurate to 50ml.* • Scales, ideally accurate to 0.1g (e.g. jewellery scales) *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.*	Carries out practical activities in a variety of learning environments.

20 mins	Reading or discussion time	Continue the presentation and discuss the actions for 15-20 minutes.		
	15 mins	Again, follow the presentation which will take you through the results, but read below for more info. Once the 20 minutes is up, organise groups to drain their water and vinegar down the sink (but not the seashells!). They should be dried well, but remind pupils not to use too many paper towels as that isn't a sustainable action! While a pupil goes around with the scales to help everyone weigh their shells again, discuss their hypotheses. Have any been proved/disproved? What might that mean for our sealife in acidifying oceans? *Remind pupils that our ocean pH is actually slightly alkaline (above 7), and this experiment used a very acidic substance to see results quickly – this is not directly what is happening to our sealife in reality, but they are having to use more energy to make and maintain their shells, which has consequences for how much food they need to eat to survive. Once everyone's shells have been weighed, see which shell's weight is higher and which is lower. What do they think happened?	$CaCO_3$ is called calcium carbonate. NOTE: You can reuse seashells multiple times for this experiment.	Investigates and records chemical changes to the properties of materials which are irreversible. Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts. Expresses informed views about scientific and environmental issues based on evidence. Analyses, interprets and evaluates scientific findings

		The seashell in the vinegar should have lost more weight because the acid has eroded it. The shells in the water may have gained weight as they could still be wet (as will the vinegar shells, but their loss of shell weight will be more than the gain in liquid weight). This is the main result of this study but pupils may have had hypothesis proven too, such as shells in the vinegar changing colour (due to the erosion/'cleaning').		
5 mins	Plenary	Go over the success criteria and also make sure the pupils understand the following logic: • That humans are putting more CO2 into the atmosphere and oceans • That CO2 causes water to become more acidic • That acidic conditions make life harder for our shelled life You could also talk about the experiment and how it went.		