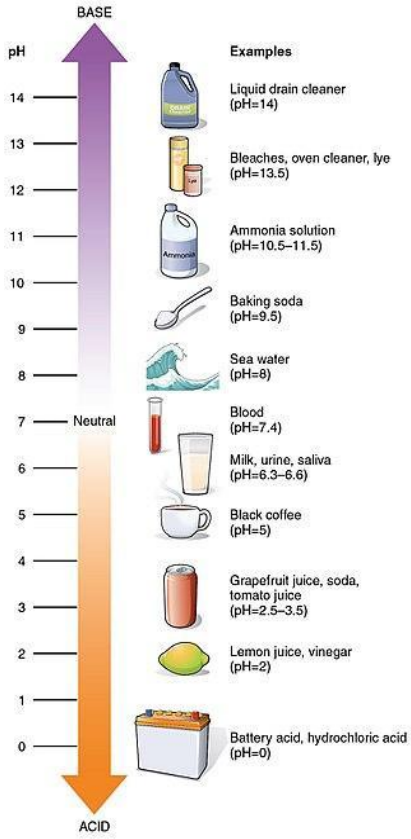
OCEAN ACIDIFICATION: THE BASICS

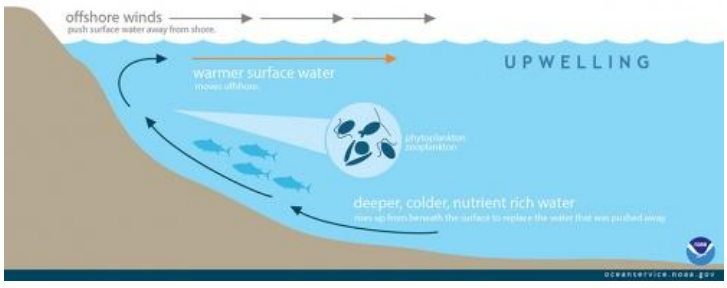
What is ocean acidification?

Ocean acidification (OA) is the gradual increase in the acidity of ocean water over an extended period of time. This phenomenon is something that scientists only recently began to focus on but the future impacts are of great concern. Ocean scientists have been tracking the pH of seawater for over 30 years but it wasn't until 2003 that the term "ocean acidification" was coined. The increasing CO_2 levels in our atmosphere being absorbed into the ocean waters cause ocean acidification. CO_2 levels in the atmosphere have been dramatically increasing since the Industrial Revolution and our consumption of fossil fuels as an energy source. OA has been well documented by scientists over the past two decades and there is a definite link between human-generated CO_2 emissions and the pH level changes in the ocean. The ocean waters tend to hover around a pH of 8, this is actually BASIC or alkaline on the pH scale, while distilled drinking water is neutral at a pH of 7. Prior to industrialization the oceans were at a pH of approximately 8.2 and today they are at 8.1, which doesn't sound like a big deal except that the pH scale is **logarithmic**. This means that each number on the pH scale represents a value of 100 times the previous number (a move from pH 7.0 to 8.0 is 100x greater). This small change of .1 actually means the oceans have become 30% more acidic from the increase in atmospheric CO_2.



What ELSE causes the pH of the ocean to fluctuate?

Carbon dioxide in the atmosphere is the primary cause for the increased average ocean acidity. However, there are some natural events that will also cause the pH to fluctuate (increase and decrease) on occasion. For example, when fresh water from inland river systems flow into the ocean the freshwater (which has an approximate pH of 7) will dilute the saltwater slightly, making it less alkaline and more acidic. Another natural process which effects the ocean pH is called **upwelling**. Upwelling occurs when the wind blows along the coast and pushes the surface water away from the coastline, this causes the cold, nutrient rich deep water to move up. The deep ocean waters contain more carbon dioxide so this will also lower the pH. One of the biggest causes of pH fluctuations in the ocean is the abundance of



plant life that exists underwater. Plants go through the process of photosynthesis (during the daytime when they will take IN CO_2) and cellular respiration (at night when they let OUT CO_2). Since the majority of the plant life on the planet lives in the water, this is on a massive scale.

How does Ocean Acidification impact sea life?

[1]"Many organisms that form the basis for the marine food chain are going to be affected by ocean acidification. It turns out that changing the pH of the ocean is not the only impact from this phenomenon. There is another, equally impactful side effect. When carbon dioxide (CO_2) mixes with water molecule (H_2O) it forms carbonic acid (H_2CO_3) that then breaks down easily into hydrogen ions (H+) and bicarbonate (HCO_3-), those available hydrogen ions bond with other carbonate ions to form more bicarbonate. The problem here is that marine organisms possessing shells (many mollusks, crustaceans, corals, coralline algae, foramaniferans) need available carbonate ions to form the calcium carbonate ($CaCO_3$) that comprises their shells. In essence, ocean acidification is robbing these organisms of their necessary building blocks."

"There have been scientific experiments focusing on how the projected acidity of the oceans will affect different organisms. Marine pteropods already have thin shells, and these shells literally dissolve over 30 days in seawater with a 7.8 pH. Studies on sea urchins and mollusks show similar results."

[1]Text from the Climate Interpreter:
https://climateinterpreter.org/content/effects-ocean-acidification-marine-food-chain

Photos: Courtesy of the NOAA website