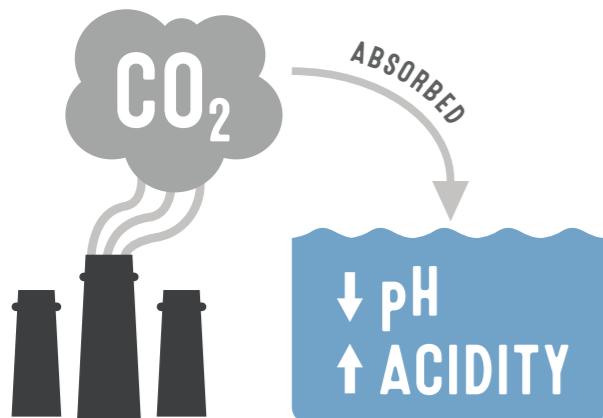


# CARBON DIOXIDE AND OCEAN ACIDIFICATION

Climate change is a much-discussed effect of rising carbon dioxide levels, but they can also affect our oceans. This graphic takes a look at how.

## THE BASICS



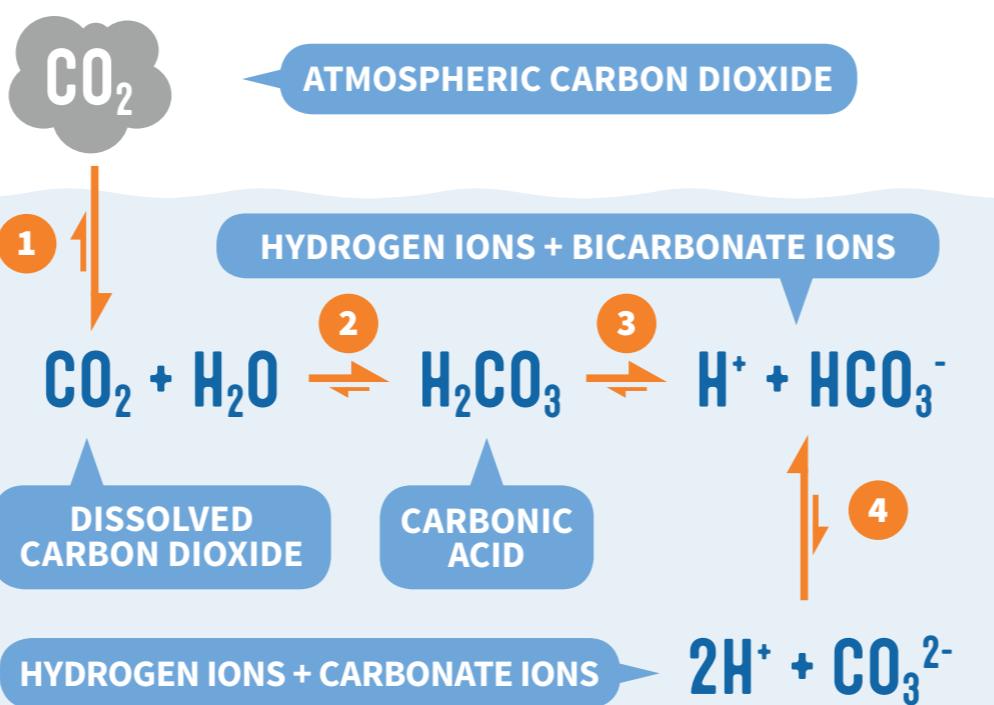
Atmospheric carbon dioxide has increased by 40% from pre-industrial levels due to burning of fossil fuels and deforestation. Ocean acidification occurs when atmospheric carbon dioxide dissolves in seawater.

PRE-INDUSTRIAL	2013	2100
pH 8.2	pH 8.1 25% MORE ACIDIC	pH 7.7 (PROJECTED)

Acidity and alkalinity are measured on the logarithmic pH scale. A pH over 7 is alkaline; below 7 is acidic. A change of one unit represents a tenfold change in acidity or alkalinity. Seawater is alkaline, but average ocean surface pH has dropped by 0.1 since pre-industrial times, a 25% increase in acidity.

## THE CHEMISTRY OF OCEAN ACIDIFICATION

Atmospheric carbon dioxide dissolves in seawater (1) and reacts with the water to form carbonic acid (2). Carbonic acid dissociates (splits up) into its ions (3); hydrogen ions produced by this dissociation increase acidity, lowering seawater pH. Increased atmospheric carbon dioxide ultimately produces more hydrogen ions, lowering pH further.



Hydrogencarbonate ions can dissociate further to form carbonate ions (4) but this is less favoured. Consequently hydrogencarbonate ions are the most abundant form of inorganic carbon in the oceans. Calcium carbonate can also react with dissolved carbon dioxide in seawater to form more hydrogencarbonate ions (5).



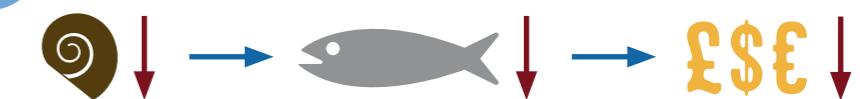
## THE EFFECTS OF OCEAN ACIDIFICATION

### 1 EFFECT ON CALCIFYING ORGANISMS AND CORAL



As ocean pH drops, hydrogen ions react with carbonate ions. Calcifying organisms such as clams, oysters and crustaceans use the carbonate ions from seawater to make shells. When calcium carbonate is undersaturated in seawater, their shells can start dissolving. Coral skeletons can also be affected.

### 2 EFFECT ON FOOD WEBS AND FISHING



Calcifying organisms are at the root of a number of marine food webs. Negative effects on their population could have a knock-on effect on species that feed on them, impacting fishing industries.

### 3 EFFECTS ON ANIMAL CHEMICAL SIGNALLING



Many marine species use chemical signals for detecting predators, settlement, and reproduction. Ocean acidification can alter signalling molecules, which could in turn have potentially detrimental effects on a number of different species.

