

# Coral Reefs and Carbon Dioxide

## Applications

Correlations between global temperatures and carbon dioxide concentrations on Earth.  
Evaluating claims that human activities are not causing climate change.  
Threats to coral reefs from increasing concentrations of dissolved carbon dioxide.

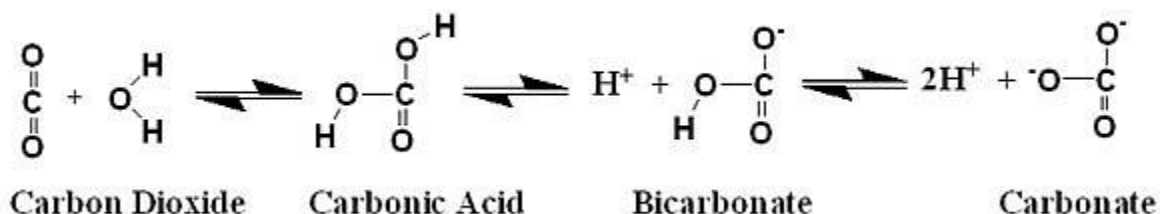
## Background:

In addition to its contribution to global warming, emissions of carbon dioxide are having effects on the oceans. Over 500 billion tons of carbon dioxide released by humans since the start of the industrial revolution have dissolved in the oceans. The pH of surface layers of the Earth's oceans is estimated to have been 8.179 in the late 18<sup>th</sup> century when there had been little industrialization. Measurements in the mid-1990s showed that it had fallen to 8.104 and current levels are approximately 8.069. This seemingly small change represents a 30% acidification. Ocean acidification will become more severe if the carbon dioxide concentration of the atmosphere continues to rise.

Marine animals such as reef-building corals that deposit calcium carbonate in their skeletons need to absorb carbonate ions from seawater. The concentration of carbonate ions in seawater is low, because they are not very soluble. Dissolved carbon dioxide makes the carbonate concentration even lower as a result of some interrelated chemical reactions. Carbon



dioxide reacts with water to form carbonic acid, which dissociates into hydrogen and hydrogen carbonate ions. Hydrogen ions react with dissolved carbonate ions, reducing their concentration.



If carbonate ion concentrations drop, it is more difficult for reef-building corals to absorb them to make their skeletons. Also, if seawater ceases to be a saturated solution of carbonate ions, existing calcium carbonate tends to dissolve, so existing skeletons of reef-building

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corals are threatened. In 2012 oceanographers from more than 20 countries met in Seattle and agreed to set up a global scheme for monitoring ocean acidification.

There is already evidence for concerns about corals and coral reefs. Volcanic vents near the island of Ischia in the Gulf of Naples have been releasing carbon dioxide into the water for thousands of years, reducing the pH of the seawater.

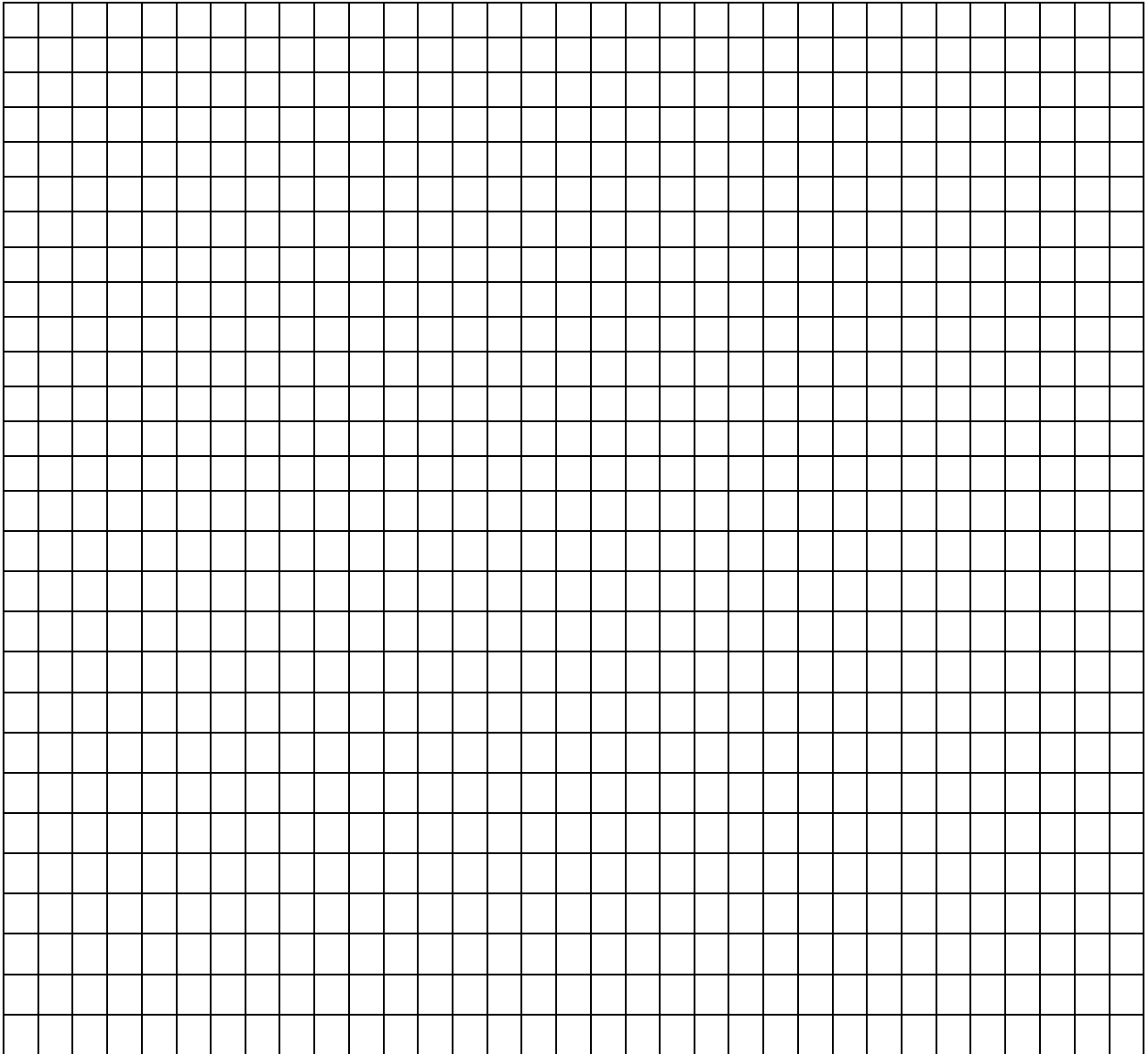


In the area of acidified water there are no corals, sea urchins or other animals that make their skeletons from calcium carbonate. In their place other organisms flourish such as sea grasses and invasive algae. This could be the future of coral reefs around the world if carbon dioxide continues to be emitted from burning fossil fuels.

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## Activity

Draw a graph of oceanic pH from the 18th century onwards, using the figures given in the text above, and extrapolate the curve to obtain an estimate of when the pH might drop below 7.



When might the oceanic pH drop below 7? \_\_\_\_\_