



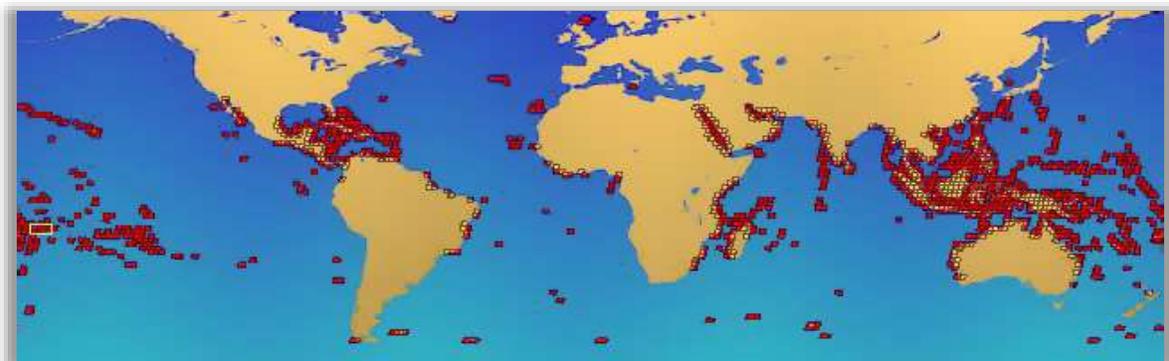
TEACHER BACKGROUND: CLIMATE CHANGE AND CORAL REEFS

A coral reef is a community of living organisms. It is made up of plants, fish, and many other creatures. Coral reefs are some of the most diverse ecosystems in the world. They are home to about 25% of all marine life. There are sponges, sea slugs, oysters, clams, crabs, shrimp, sea worms, starfish and sea urchins, jellyfish and sea anemones; various types of fungi, sea turtles, and many species of fish. Some people refer to them as the "rainforests of the oceans."



Coral reefs have been around for millions of years. Less than 0.1% of the world's ocean floor is covered by coral reefs. The reefs grow best in warm, shallow, clear, sunny and moving water. However, they grow very slowly—anywhere from 0.3 cm to 10 cm per year. The reefs we see today have been growing over the past 5,000 to 10,000 years

Locations of the Earth's coral reefs





Coral reefs are made of tiny animals called "**polyps**" that stay fixed in one place and are the main structure of a reef. Polyps have a hard outer skeleton made of calcium (similar to a snail's shell). Each polyp is connected by living tissue to form a community. Only the top layer of a coral reef contains living polyps. As new layers of the coral reef are built, the polyps leave the lower layers.

Each polyp has a ring of tentacles shaped like a cup around a central opening. The tentacles are like long arms with tips that can sting. They are used either for defense or to capture zooplankton (small animals) for food.



Coral reefs are important; they do many important things that help to maintain the health of the marine ecosystem. Reefs :

- ✚ Protect shorelines from big waves by absorbing wave energy;
- ✚ Provide a safe place for fish to spawn (release eggs into the water)
- ✚ Provide habitats for a large variety of organisms
- ✚ Provide food (fish and shellfish) for many people living along coastlines
- ✚ Are a source of medication—some anti-cancer drugs and painkillers come from reefs and
- ✚ Help as short term sinks for carbon.

Coral reefs are fragile ecosystems; they are very sensitive to any changes. Worldwide, coral reefs are disappearing for a number of reasons.

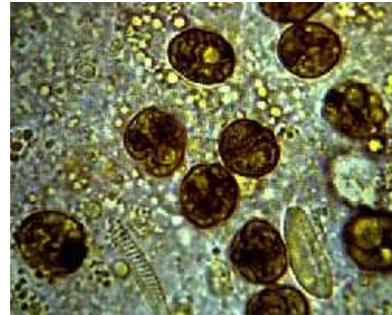
- ✚ Fertilizer used on farms or home gardens washes into the oceans. The fertilizer creates conditions that make algae increase. The extra algae cover the coral and it dies.

- ✦ As CO_2 emissions increase, more CO_2 is absorbed into the oceans. This makes the water more acidic which makes it harder for coral to make their shells.
- ✦ Increased greenhouse gas emissions are making the water warmer. Coral can't live in water that is too much warmer or colder than 26-27 degrees Celsius.
- ✦ Chemicals from sunscreen, pollution from sewage, and herbicides and pesticides used in farms or home gardens can all wash into oceans and poison coral.
- ✦ Dangerous fishing methods, like cyanide or blast fishing, harm and kill coral.

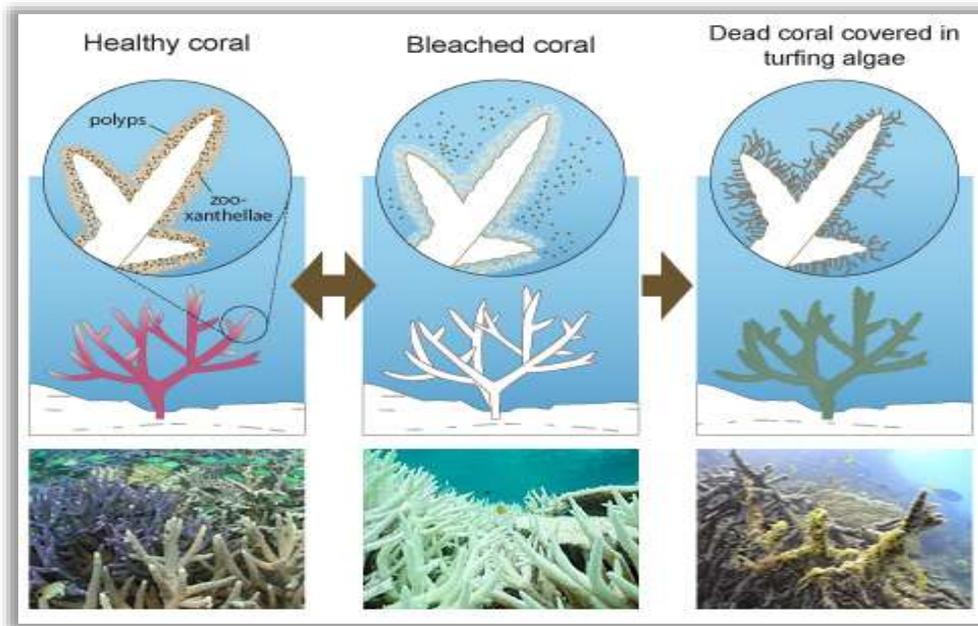
Climate change leads to coral bleaching

The warmer air and ocean surface temperatures caused by [climate change](#) affect corals and change coral reef communities by inducing coral bleaching events. These impacts affect corals and the many organisms that use coral reefs as habitat.

Many types of coral have a special symbiotic relationship with a tiny marine algae, **zooxanthellae**, that live inside corals' tissue and are very efficient food producers that provide up to 90 per cent of the energy corals require to grow and reproduce.



Coral bleaching occurs when the relationship between the coral host and zooxanthellae, which give coral much of their color, breaks down. Without the zooxanthellae, the tissue of the coral animal appears transparent and the coral's bright white skeleton is revealed. Corals begin to starve once they bleach. While some corals are able to feed themselves, most corals struggle to survive without their zooxanthellae.

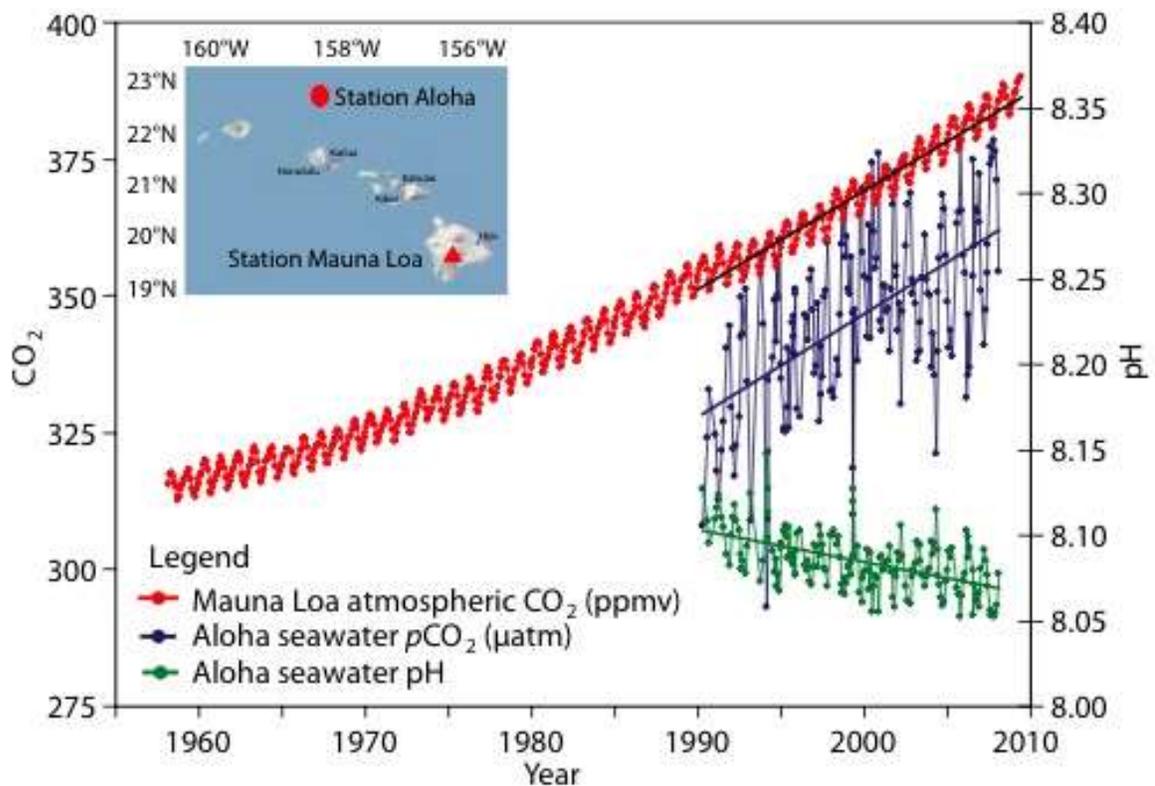


If conditions return to normal, corals can regain their zooxanthallae, return to their normal color and survive. However, this stress is likely to cause decreased coral growth and reproduction, and increased susceptibility to disease. Bleached corals often die if the stress persists. Coral reefs that have high rates of coral death following bleaching can take many years or decades to recover.

Climate change alters ocean chemistry and causes acidification

Much of the carbon dioxide that enters the atmosphere dissolves into the ocean. In fact, the oceans have absorbed about 1/3 of the carbon dioxide produced from human activities since 1800 and about 1/2 of the carbon dioxide produced by burning fossil fuels. As carbon dioxide in the ocean increases, ocean pH decreases or becomes more **acidic**. This is called **ocean acidification**.

With ocean acidification, corals cannot absorb the calcium carbonate they need to maintain their skeletons and the stony skeletons that support corals and reefs will dissolve. Already, ocean acidification has lowered the pH of the ocean by moving the ocean's pH from 8.179 to a current pH of 8.069, which means the ocean is about 30% more acidic now than it was in 1751. If nothing is done to reduce carbon dioxide emissions into the atmosphere, ocean acidification will increase and more and more corals will be damaged or destroyed.



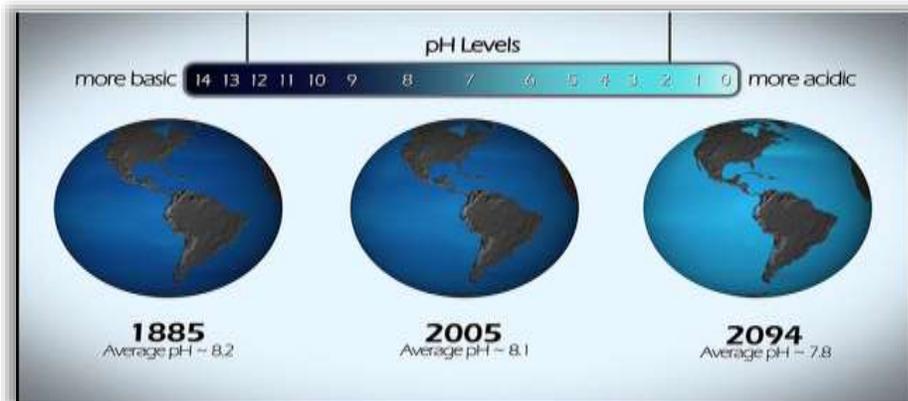
Pacific Ocean CO₂ and pH. Source: Mauna Loa data: Dr. Pieter Tans, NOAA/ESRL; HOTS/Aloha data: Dr. David Karl, University of Hawaii.

Ocean acidification affects more than just corals. A wide variety of organisms within the marine food pyramid are effected. Snails, clams, and urchins also make calcium carbonate shells and ocean acidification negatively impacts these organisms as well. Just like corals, ocean acidification makes it harder for these organisms to absorb the calcium carbonate they need to build their shells.

Arctic zooplankton such as *pteropods*, which make shells from calcite minerals, will be most affected by acidification. These tiny organisms are a major food source in the Arctic for organisms ranging in size from tiny krill, to juvenile salmon and whales. The photos above show what happens to a pteropod's shell when placed in sea water with pH and carbonate levels projected for the year 2100. The shell slowly dissolves after 45 days. (See image on page 6.)



If we continue to produce carbon dioxide at the current rate, future atmospheric carbon dioxide will be high enough to lower ocean surface pH to 7.8 by the year 2100. Laboratory studies suggest a pH about this low could dissolve coral skeletons and may cause reefs to fall apart. If coral reefs are lost, vital habitat will be lost too. The future health of coral reefs and many marine organisms depends on our ability to reduce our carbon dioxide emissions on a global scale.



Future emissions depend on how many people there are on the planet, what energy sources we use, how much energy we use, what new technologies we create—just to name a few factors.