OCEANS ON ACID

Take a big breath and hold it. The oxygen you inhale is absorbed by the blood and carried throughout your body. Meanwhile, carbon dioxide is carried back to your lungs and is released. But wait – keep holding your breath. Your lungs will ache as you keep yourself from exhaling. Trigger impulses from your brain will signal your body to ensure normal respiration. This trigger – the urge to breathe – is not caused by the lack of oxygen in your body, but rather a build up in carbon dioxide and a change in your body's pH.

Okay, you can exhale now. Breathe.

MUCH LIKE YOUR BODY JUST EXPERIENCED – THE OCEAN'S PH IS DROPPING

Seawater is naturally alkaline, with a healthy pH around 8.2. But since the industrial revolution, this number has dropped 30% and become more acidic. In the last two centuries alone, the ocean has absorbed 525 billion tons of carbon dioxide emitted through the burning of fossil fuels. Scientists say the concentration of carbon dioxide in the atmosphere is higher now than it has been in the last 650,000 years and that this recent change in chemistry is happening faster than any known change in ocean chemistry in the last 50 million years.

TO PRESERVE OCEAN HEALTH WE MUST CURB OUR CARBON DIOXIDE EMISSIONS.

There exists a strong connection between the ocean and the atmosphere. A golden rule to remember is that what gets emitted into the air eventually makes its way into the ocean. Right now that number is about 22 million tons of carbon dioxide per day, or one third of all carbon emissions. This conceivably has "delayed" the current impacts of global warming, but it does not mean the problem has disappeared. When carbon dioxide reacts with seawater it forms carbonic acid – the same acid that creates fizz in soft drinks, and also the root of where many problems in the ocean may stem from in the coming years.

THE MARINE ENVIRONMENT IS TEEMING WITH ORGANISMS THAT DEPEND ON PROTECTIVE SHELLS TO SURVIVE.

Calcium carbonate is a key element for sea creatures to build their shells. From coral to oysters, lobsters to certain varieties of plankton – shells are the only line of defense for many creatures in the ocean. When excess carbonic acid is present, the formation of calcium carbonate becomes difficult and can dissolve shells that have already been formed.

Because so many of these organisms serve as the basis of the marine food web, this breakdown may have sweeping effects in years to come. Some one billion people rely on marine animals currently as their primary protein source. When we mess with ocean chemistry and threaten the smallest organisms in the sea, we ultimately have an impact on all of humanity.

CORAL REEFS

Corals need calcium carbonate to survive. Often described as the "rainforests of the ocean", they contain over 25 per cent of the world's fish biodiversity. However scientists have found that increasing acidity significantly reduces the ability of reef-building corals to produce skeletons. On top of the many species they house, coral reefs provide many coastal communities with a natural protection from storm surges and hurricanes. Additionally, coral reefs make up a large portion of the tourism industry in tropical destinations. In the United States alone this includes revenue of $1.2 billion per year in the Florida Keys, and $360 million per year in Hawaii.

Imagine if the pH in your blood changed, causing your bones to dissolve.

SEA BUTTERFLIES

Pteropods are free-swimming transparent sea snails with a small shell. Often called the "potato chips of the sea" due to the critical part they play in the arctic marine food chain, these beautiful, tiny creatures are essential to the diet of everything from krill, to salmon, and even whales. A recent study of pteropods in the Pacific Ocean between Central California and the Canadian border found that more than half of the creatures had damaged shells due to acidity. This creates disturbances in the food chain, of which the implications are immense, but still not fully understood.

While the impacts of ocean acidification are still being explored, scientists are finding that even creatures at the bottom of the ocean are beginning to experience issues due to changes in acidity.

The Pacific Northwest has been hit hardest by ocean acidification. Their oyster farms, valued as a $110 million operation, have become the poster child to explain the dangers ocean acidification pose to the fishing industry. In addition to potentially wiping out the farms if waters become too acidic, researchers have found that the pH of the ocean may impact the size of the oyster.

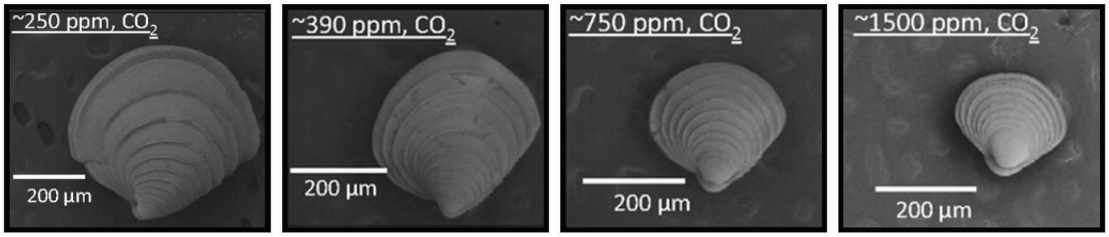
THE OCEANS FUNCTION AS OUR PLANET'S LIFE SUPPORT SYSTEM

Two of the most important factors for an organism to survive in the ocean are temperature and acidity and as we continue to emit carbon dioxide we alter both of these conditions. The sooner we reduce global carbon emissions, the sooner we are able to prevent these harmful trends.

The ocean moderates our climate and filters pollution. It supplies us with a rich diversity of food, minerals, and medicines. We also use it as a source of comfort, relaxation, recreation, and inspiration. However, due to a steady unchecked decline our oceans are in trouble, which in turn poses a threat to marine life, coastal and pelagic ecosystems, our economy, coastal cultures and societies.

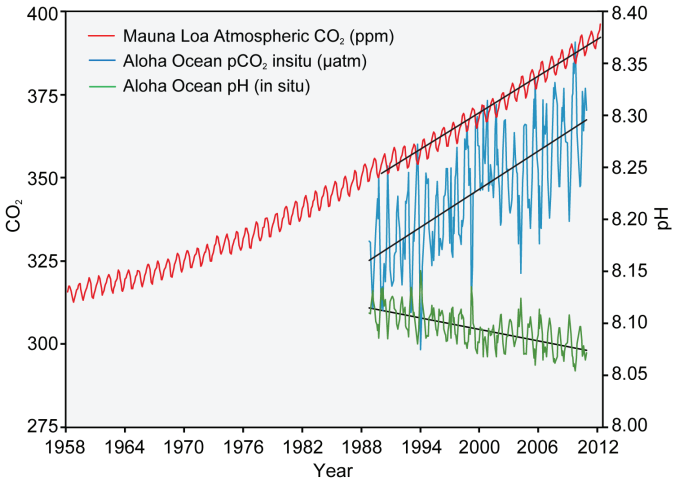
Pteropods, often nicknamed sea butterflies, are free-swimming sea snails about the size of a small pea. Their name is Greek meaning "winged-foot" they are always transparent and there thin, hard shells are made from calcium carbonate. Pteropods are an important source of food, eaten by marine from the tiny krill to salmon and even whales.

Ocean Acidification Reduces Size of Clams



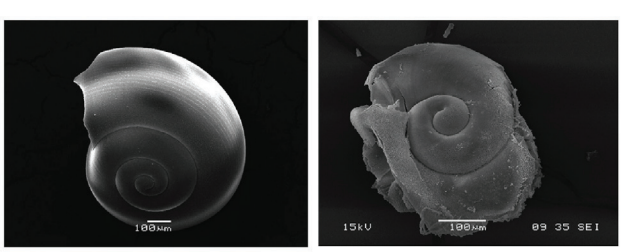
The 36-day-old clams in the photos are a single species grown in the laboratory under varying levels of CO2 in the air. The CO2 is absorbed from the air by ocean water, acidifying the water and thus reducing the ability of juvenile clams to grow their shells. As seen in the photos, where CO2 levels rise progressively from left to right, 36-day-old clams (measured in microns) grown under elevated CO2 levels are smaller than those grown under lower CO2 levels. The highest CO2 level, about 1500 parts per million (ppm; far right), is higher than most projections for the end of this century but could occur locally in some estuaries. *(Figure source: Talmage and Gobler).*

As Oceans Absorb CO_2, They Become More Acidic



The correlation between rising levels of CO2 in the atmosphere (red) at Mauna Loa and rising CO2 levels (blue) and falling pH (green) in the nearby ocean at Station Aloha. As CO2 accumulates in the ocean, the water becomes more acidic (the pH declines). *(Figure source: modified from Feely et al. 2009).*

Shells Dissolve in Acidified Ocean Water



These photos show what happens to a pteropod's shell in seawater that is too acidic. The left image shows a shell collected from a live pteropod from a region in the Southern Ocean where acidity is not too high. The shell on the right is from a pteropod collected in a region where the water is more acidic *Photos: (left) Bednaršek et al. 2012; (right) Nina Bednaršek).*

TAKE ACTION

- Take the NT3 pledge to reduce your carbon footprint.
- Learn more about Ocean Acidification by watching the documentary A Sea Change.
- Ride your bike! For trips less than a mile in length, people are 60% more willing to drive their car than walk or bike.
- Choose renewable energy for your power company.
- Install solar panels or wind generators at home or on your boat!
- Sail.