

# Ocean Acidification

*Read the passage and answer the questions on the following page..*

**Global climate change** has impacts on all of Earth's ecosystems; the ocean is particularly impacted by climate change. Climate change is caused by excess **carbon dioxide** in the atmosphere that is released from many human processes, including generating electricity, manufacturing plastic, and the formation of concrete. As the amount of carbon dioxide in the atmosphere increases, the amount in the ocean also increases.

Carbon dioxide gets into the ocean via **diffusion**; carbon dioxide naturally moves to the area that has a lower concentration. The ocean acts as a **carbon sink**, holding on to 30% of the carbon dioxide released into the atmosphere. The ocean's absorption of carbon dioxide is helping to slow the rate of increasing temperatures. Unfortunately, it is not good for the animals living in the ocean in the long term.

When carbon dioxide gets into the ocean, it reacts with water to form **carbonic acid**. Carbonic acid lowers the pH of the ocean. In water, carbonic acid dissociates into bicarbonate and a hydrogen ion. The pH scale measures the hydrogen ions in the water.

Since the industrial revolution, pH has lowered 0.1 pH units. On the pH scale, lower numbers are more acidic, and higher numbers are more basic. This represents a 30% increase in acidity. Current ocean pH levels are hovering around 8.1. Oceanic pH levels are expected to continue to decrease by as much as 0.3-0.4 units by 2100. We call this process **ocean acidification**.

As pH decreases, creatures that live in the ocean are greatly impacted. Creatures like coral, clams, oysters, sea urchins, etc. that make hard shells out of **calcium carbonate** are at the highest risk. Calcium carbonate ions normally float freely in seawater; hard-shelled creatures pull these ions out of the water to build and repair their shells.

Unfortunately, the carbonate molecules will bond with any free hydrogen ions, which makes them unable to be used in the shells of these organisms. If pH continues to lower, the shells and skeletons of these organisms may not just be difficult to build and repair but instead start to dissolve.

Many of these shelled creatures help form the base of the **oceanic food web**. The oceanic food web is divided into **trophic levels**, which divide creatures based on what they consume. The first level of the trophic levels are **heterotrophs** that make their food from the sunlight, then **primary consumers** who eat heterotrophs, **secondary consumers** who eat primary consumers, and **tertiary consumers** who eat secondary consumers.

Because shelled creatures are the base of the food web, nearly all creatures at higher trophic levels, like secondary and tertiary consumers, will be impacted by their decline. It is possible that ocean acidification may cause food web collapse.

Other organisms without shells may struggle to physically adapt to higher acidity as well. Scientists are still studying the potential impacts of ocean acidification on many organisms, but some will have trouble breeding in acidic conditions, others will fail to grow to full size, and all will be affected by food web collapse.



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# Ocean Acidification

*Answer the following questions. Please use extra paper if you need it.*

1. What is a carbon sink?
2. What two things react to form carbonic acid?
3. Explain in your own words why ocean acidification is harmful to marine animals.
4. Brainstorm: How could ocean acidification impact humans and animals on land?
5. Do you think ocean acidification will impact humans? Why or why not?

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Answer the following questions. Please use extra paper if you need it.

1. What is a carbon sink?

A carbon sink is a natural feature of an ecosystem that can absorb carbon, like the oceans or forests.

2. What two things react to form carbonic acid?

Carbon dioxide and water react to form carbonic acid.

3. Explain in your own words why ocean acidification is harmful to marine animals.

Ocean acidification is harmful to marine animals because the increased pH of the ocean makes it hard for many creatures to produce shells and they may not survive. Because many of these hard-shelled creatures make up the base of the food chain, this could cause the oceanic food web to collapse.

4. Brainstorm: How could ocean acidification impact animals on land?

Ocean acidification will remove a food source for animals that eat sea creatures but do not live in the ocean like shorebirds, osprey, and even humans.

5. Do you think ocean acidification will impact humans? Why or why not?

Ocean acidification will impact humans who rely on sea food as a part of their diet. It will also impact the economies of coastal communities that rely on tourism and recreation to subsist.

