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Ocean Acidification



Human emissions of carbon dioxide have a large impact on Earth's atmosphere and oceans.

Human **emission**¹, or release, of carbon dioxide (CO₂) into the atmosphere has a huge impact on Earth's oceans. One effect is the **acidification**² of seawater (lowering of pH). So, what does this mean? And how can you explain the changes using basic chemistry? Let's answer those questions.

Did You Know?

Ocean acidification will probably grow by 170% this century.

Explaining pH value

First, it is important to understand the meaning of pH values. **pH**³ is a number scale used in chemistry to describe the acidity or basicity of something. "Basic" in this context does not mean simple; instead it refers to a chemical property. There are many types of **ions**⁴ within a **solution**⁵, but pH value is based on the **concentration**⁶ of hydrogen ions (H⁺) and hydroxide ions (OH⁻). The **pH scale**⁷ is a set of standard solutions with established pH values. A substance is acidic if the pH is less than 7, and it is basic if the pH is greater than 7. Acidic liquids contain more H⁺ while basic liquids contain more OH⁻. The scale usually ranges from 0-14 (although there are no official boundaries), with 7 in the middle. Pure water has a pH of 7 and is neutral. Lemons contain a lot of acids and have a pH of 2.2. Chicken soup has a pH of 5.8. Household bleach has a pH of 12.8. The pH value of the surface water of the oceans has gone down since the Industrial Revolution (late 1700s to early 1800s) by 0.1 pH units. This change represents a 30 percent increase in acidity.



Lemons are very acidic, with a pH value of 2.2.

Ecobottle Sample



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¹ **Emission:** release

² **Acidification:** making something more acidic; lowering the pH

³ **pH:** a number scale that measures how acidic or basic something is

⁴ **Ions:** charged particles

⁵ **Solution:** a mixture in which something is dissolved in something else

⁶ **Concentration:** amount of something in a given volume of something else

⁷ **pH scale:** a set of standard solutions with established pH values

Global warming

Since the Industrial Revolution, beginning in the late 1700s, CO₂ emissions have grown. Climate scientists agree about the dangers of more CO₂ in the atmosphere: “global warming”, also called “global climate change”. The gases in the atmosphere (mainly CO₂, but also methane) work as a sort of blanket over the earth. This gas blanket traps some heat, keeping it from reflecting into space. More gases in the atmosphere means a heavier blanket, causing Earth’s average temperature to rise above its normal level. This leads to polar ice melting, sea levels rising, weather patterns changing, and some species migrating to cooler areas while others start to die off.

Ecobottle Sample



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Consequences

Recall that the reaction between CO₂ and water (H₂O) eventually produces bicarbonate ions (HCO₃⁻) and hydrogen ions (H⁺). Many animals depend on carbonate ions (CO₃²⁻) combined with calcium ions (Ca²⁺) to create calcium carbonate (CaCO₃). They use calcium carbonate to build shells and keep coral skeletons healthy. When H⁺ ions increase, they react with carbonate ions, meaning that CaCO₃ can’t be made. This makes it harder for animals to develop and grow.



Marine species such as corals and clams are negatively affected by ocean acidification.

Too many H⁺ ions can also dissolve shells and coral skeletons. This affects snails, oysters, clams, and several coral species, among others. Weaker shells make the organisms more vulnerable to predators. The consequences don’t stop here, however. These animals are part of a complete food web. Their changing populations affect many other species.

How to reduce CO₂

Reducing CO₂ is important for our planet’s health. The countries of the United Nations started a yearly climate change conference in 1995. They started with the **Kyoto Protocol**⁸, a set of laws for developed countries to reduce their emissions.

There is also more awareness in our daily lives. You may have heard the term ‘**ecological footprint**’⁹. This is a measure of a person’s impact on the environment. Solving the climate problem is a huge international challenge. There are things you can do to make your ecological footprint smaller. For example: eat less meat, use ‘green’ electricity (e.g. solar panels, compact fluorescent bulbs), walk and bike or take public transport, buy local products to reduce shipping emissions, give money to companies that plant trees to make up for their carbon emissions, and turn off the lights when you leave the room.

⁸ **Kyoto Protocol**: a set of laws for developed countries to reduce their emissions

⁹ **Ecological footprint**: a measure of your impact on the environment

Reading Comprehension Questions:

1. What is
2. Using the pH scale, how
3. Which chemical reaction happens when CO₂ enters the (sea)water?
4. Describe
5. How is ocean acidification related to global warming?
6. What is

Extension Questions:

7. Describe how ocean acidification leads to weaker shells and coral skeletons.
8. Explain
9. Create an

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