

Module 6: Ocean Water Chemistry

Topic 6 Content: Understanding pH and Carbonic Acid in Seawater

Understanding pH and Carbonic Acid in Seawater

Today's Lesson

The pH Scale

Carbonic Acid and pH

Introduction



Click the Today's Lesson Tab to begin!

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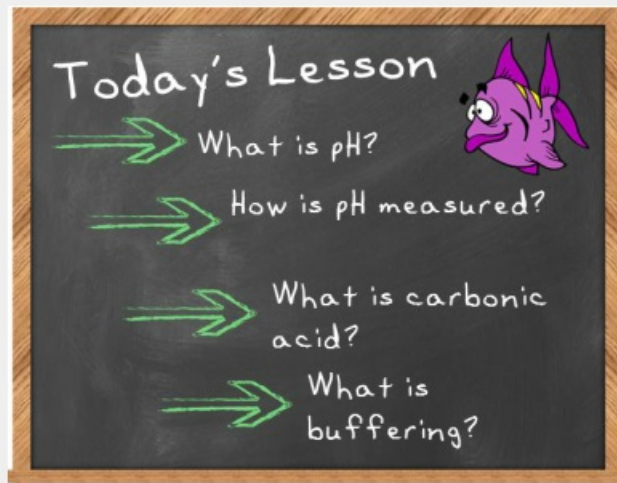
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Today's Lesson

- What is pH?
- How is pH measured?
- What is carbonic acid?
- What is buffering?

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The pH Scale

Environmental Effects	pH Value	Examples
	pH = 0	Battery acid
	pH = 1	Sulfuric acid
	pH = 2	Lemon juice, Vinegar
	pH = 3	Orange juice, Soda
	pH = 4	Acid rain (4.2-4.4)
	pH = 5	Acidic lake (4.5)
	pH = 6	Bananas (5.0-5.3)
	pH = 7	Clean rain (5.6)
	pH = 8	Healthy lake (6.5)
	pH = 9	Milk (6.5-6.8)
	pH = 10	Pure water
	pH = 11	Sea water, Eggs
	pH = 12	Baking soda
	pH = 13	Milk of Magnesia
	pH = 14	Ammonia

Image source: EPA

This diagram from the Environmental Protection Agency outlines the pH scale, which ranges from very acidic at 0 to very basic at 14. For each value of 1 indicated on the scale, the pH increases by 10 times. Listed on the right are everyday items, such as lemon juice, which has an acidic pH value of 2 and soapy water, which is basic with a pH value of 12. Pure water has a neutral pH value of 7. Whereas, seawater is slightly basic or alkaline. As indicated in the diagram seawater has a pH of about 8.1. So, now you know the pH of seawater, but what does pH value actually represent? Well, the pH scale is a measure of the amount of hydrogen ions in a solution. From where do these hydrogen ions originate and how do they get into seawater? Click on the carbonic acid and pH tab to find out.

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The diagram on the chalkboard shows the chemical equation: $H_2CO_3 \rightleftharpoons HCO_3^- + H^+$. The reaction is labeled as a reversible reaction. The top of the board is labeled 'Acidic (lower pH)' and the bottom is labeled 'Basic (higher pH)'. An upward-pointing orange arrow is labeled 'More ions' and a downward-pointing blue arrow is labeled 'Fewer ions'. There are also small drawings of fish and bubbles on the board.

The pH of seawater remains relatively constant due to the buffering action of carbonic acid, which forms when carbon dioxide mixes with water. As shown in this chemical equation, carbonic acid dissociates into negatively charged bicarbonate ions (HCO_3^-) and positively charged hydrogen ions (H^+). The pH scale indicates the measure of these free hydrogen ions. Why is this important? The quantity of hydrogen ions controls the pH of the water. Adding more hydrogen ions lowers the pH of water causing it to become more acidic. Whereas, removing hydrogen ions raises the pH causing the water to become more basic. As indicated by the double arrows in the equation, this chemical reaction is reversible. That is, if the seawater becomes too acidic, hydrogen ions can rejoin bicarbonate ions to form carbonic acid again. Reversing the chemical reaction results in fewer hydrogen ions and, thus, less acidity.