

Blood pH

by Sophia



WHAT'S COVERED

In this lesson, you will learn about the kidney's role in maintaining the blood pH. Specifically, this lesson will cover:

1. pH Balance Overview

Kidneys are organs of the body that help maintain the body's **acid-base balance**. Acid-base balance is the amount of acids and bases found in extracellular fluids of the body.

Acids are substances that increase the amount of hydrogen ions (H^+) in a liquid and lower the pH. For example, distilled vinegar is an acid of around pH 2 or 3. That means it's at least 10,000 times more acidic than water, which has a neutral (neither acidic nor basic) pH of 7. When added to warm milk, it changes the shape of milk proteins into curds that can be made into cheese. Stomach acid also has a pH of about 2 or 3; you can imagine how effective stomach acid is at curdling the proteins in potentially infectious bacteria!

Bases are substances that decrease the amount of hydrogen ions (H^+) in a liquid and raise the pH. Baking soda is a mild base (pH 9); it's about 100 times less acidic than water. This can be a problem for the Electron Transport Chain. Remember, you need to have a certain amount of hydrogen ions in the intermembrane space of your mitochondria to create an electrical chemical gradient needed to make ATP. If your blood is too basic, it means hydrogen ions are in short supply, and making enough ATP to function well will be more difficult.

Normal body pH is between 7.37 to 7.43. If you're familiar with the pH scale, you know that a pH of seven is neutral, a pH of less than seven is acidic, and a pH of more than seven is basic. If our pH is 7.37 to 7.43, that's slightly more than seven, which means the normal pH of the body is slightly basic.

For our body to function properly, for our cells and enzymes to function optimally, pH needs to stay within this range. If blood pH drops to 7.36, for example, it is still technically more basic than water, but it is too acidic for our proteins to function well (think of milk proteins curdling in vinegar). Likewise, if blood pH rises to 7.44, it's too basic for proteins to function properly.



TERMS TO KNOW

Acid-Base Balance

The amount of acids and bases in the extracellular fluids of the body; amounts of acids vs. bases affects the overall pH of extracellular fluids.



Acids

Substances that increase the amount of hydrogen ions (H^+) in a liquid and lower the pH.

pH

A measure of whether a liquid has a lot of hydrogen ions (H^+) or relatively few hydrogen ions; the lower the pH, the more hydrogen ions it has, and the more acidic it is. The higher the pH, the fewer hydrogen ions it has, the more basic it is.

Bases

Substances that decrease the amount of hydrogen ions (H^+) in a liquid and raise the pH.

2. pH Management

pH is largely managed by the amount of carbon dioxide dissolved in your blood. When carbon dioxide (CO_2) dissolves in your blood plasma, it interacts with a water molecule (H_2O) to become carbonic acid ($HOCOOH$ or H_2CO_3). However, above a pH of ~ 6 , carbonic acid would rather split into bicarbonate and a hydrogen ion ($HOCOO^-$ and H^+). This means that in your blood (pH ~ 7.4 , well above pH 6), dissolved carbon dioxide will generate hydrogen ions, making your blood more acidic and lowering the pH.

What happens when there's not enough carbon dioxide dissolved in your blood? It means that there are not enough hydrogen ions being generated, so your blood becomes more basic, and your blood pH rises. This is what happens if you hyperventilate: You're breathing so hard that more carbon dioxide is leaving your blood through your lungs than your metabolism (converting acetyl-CoA into carbon dioxide through the Krebs cycle, for example) can quickly replace. Your blood pH rises, and you may even faint.



SUMMARY

This lesson has been an overview of how the kidneys help to maintain the **body's acid-base balance**. Specifically, you learned about **pH management**.

Keep up the learning and have a great day!

Source: THIS WORK IS ADAPTED FROM SOPHIA AUTHOR AMANDA SODERLIND



TERMS TO KNOW

Acid-Base Balance

The amounts of acids and bases in the extracellular fluids of the body; amounts of acids vs. bases affects the overall pH of extracellular fluids.

Acids

Substances that increase the amount of hydrogen ions (H^+) in a liquid and lower the pH.

Bases

Substances that decrease the amount of hydrogen ions (H^+) in a liquid and raise the pH.

pH

A measure of whether a liquid has a lot of hydrogen ions (H^+) or relatively few hydrogen ions. The lower the pH, the more hydrogen ions it has, and the more acidic it is. The higher the pH, the fewer hydrogen ions it has, and the more basic it is.