

Bicarbonate buffer

"The bicarbonate buffering system is important in many different cellular processes. Just a few are listed below.

- It is one of the major buffering systems used to maintain the pH of mammalian blood.
- It is used in the formation of acid in the lumen on the stomach.
- It is used to neutralize the pH of the chyme leaving the stomach and entering the small intestine."

Before we talk about the buffering process, let's take the mystery out of the chemistry with the following exercise. Answer the following questions:

When CO₂ combines with H₂O, carbonic acid results? Complete the chemical formula of the carbonic acid molecule in the space above the molecule in the table below, i.e. write the number of each atom present in the resulting molecule.

CO ₂	+	H ₂ O	↔	H C O	↔	H ⁺	+	H C O
				Carbonic	Bicarbonate			Bicarbonate
				acid	anhydrase			ion

Next, the enzyme bicarbonate anhydrase removes a hydrogen ion from carbonic acid to form a bicarbonate ion. Complete the chemical formula above the term "bicarbonate ion." Notice both reactions (arrows) are reversible. This tends to keep the numbers of molecules on either side of the reaction balanced. This means if you want to create more bicarbonate ions on the right side of the table, you must start by adding more carbon dioxide at the left side. Likewise, if you were to pour in more hydrogen ions (acid) the enzyme bicarbonate anhydrase would tend to convert the excess hydrogen ions into carbonic acid, reducing the acidity of the system.....or buffering the system against a change in pH.

Now, the bicarbonate was formed through the loss of a H⁺, thus it now has an electron that is not balanced by a positive H⁺; so indicate on the molecular formula in the table above that bicarbonate is a negative ion.

Reversible reactions normally reach a "*dynamic equilibrium*" where the reactions continue, but forward reactions are balanced by reverse reactions, and the number of resultant molecules remains at some *equilibrium concentration (or mass balance)*. If you were to suddenly add a bunch of H⁺ (think Jalapeno peppers) to the above system at equilibrium, that would shift the reactions to the left removing many of the H⁺ and raising the pH (i.e. lowering the acidity).

The buffering process: **"When excess hydrogen ions are added to the system the equilibrium is shifted to the left. This means that some of the added hydrogen ions will react with the bicarbonate ions to produce carbonic acid and the carbonic acid will dissociate into carbon dioxide and water as shown below.**

When hydrogen ions are removed from the reaction, the equilibrium will shift to the right. More carbon dioxide will combine with water and more carbonic acid will be produced and more hydrogen ions and bicarbonate ions will be produced."

Source

<http://academic.brooklyn.cuny.edu/biology/bio4fv/page/bicarbo.htm>