Carbonic Anhydrase: Breathe in, Breathe Out

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Abstract

All animals breathe in oxygen and breath out carbon dioxide (CO_2). Carbonic anhydrase, which is found within red blood cells, catalyzes a reaction converting CO_2 and water into carbonic acid, which dissociates into protons, and bicarbonate ions. Said to be "near perfection", carbonic anhydrase is able to catalyze at a rate of 10^6 reactions per second. We modeled the alpha form, found in humans.

The enzyme contains a pocket of amino acids His94, His96, and His119 that hold a zinc ion. When a CO_2 enters the active site of the enzyme, it gains an OH^- that was bonded to the zinc, forming carbonic acid that is then released. In order to replenish the OH^-, water dissociates. The OH^- binds to the zinc and the H^+ is released. The reaction can now repeat itself.

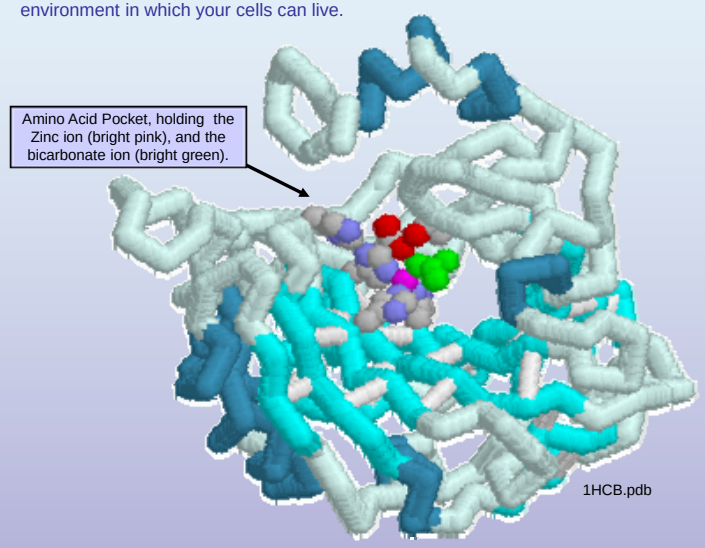
In the lungs, carbonic anhydrase reverses the reaction, turning the carbonic acid back into CO_2 to be exhaled. This process also maintains blood pH by controlling the amount of bicarbonate ions and protons dissolved in the blood.

Malfunctions in carbonic anhydrase's regulation can cause glaucoma, the second leading cause of blindness. This disorder can be treated with inhibitors of the enzyme that prevent over-secretion of fluid that presses on the optic nerve. Carbonic anhydrase inhibitors are also used to treat ulcers, neurological disorders, and osteoporosis.

Summary: Carbonic anhydrase is an enzyme that balances the pH of the blood and enables the breathing out of carbon dioxide.

In red blood cells carbonic anhydrase catalyzes the reaction to convert carbon dioxide into carbonic acid, which further breaks down into bicarbonate ions and protons (H+).

The production of bicarbonate ions and protons regulates the pH of the blood, creating an environment in which your cells can live.



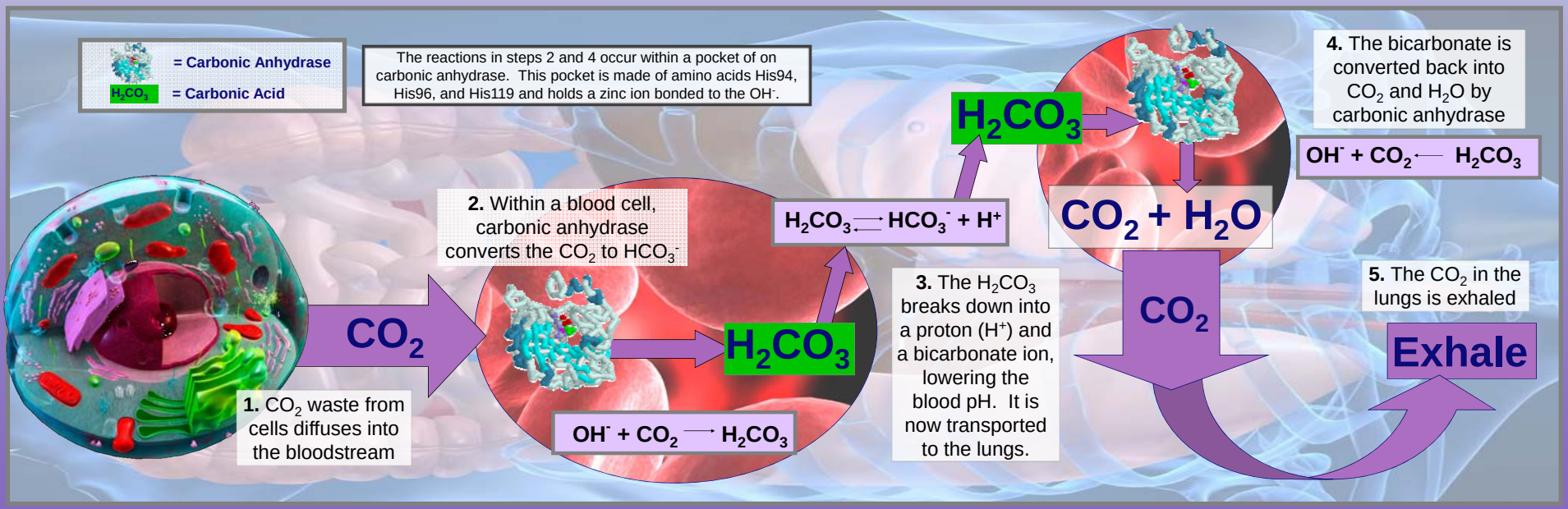
Diseases and Conditions Affected by Carbonic Anhydrase

Carbonic anhydrase is an enzyme that also regulates the pH and fluid balances in numerous systems throughout the body.

Within the kidneys and eyes, bicarbonate ions and protons are produced in order to regulate the amount of water within these organs. Carbonic anhydrase is what catalyzes the reaction that makes this possible, so when it malfunctions, medical problems such as Glaucoma or kidney failure can occur.

Carbonic anhydrase has a role in regulating gastric acid within the stomach, and maintaining a neutral pH in saliva, A malfunction in this area of the body causes ulcers.

To treat such diseases and conditions, **carbonic anhydrase inhibitors** can be used to block the active site of the enzyme and stop its use in certain areas in the body.



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