2.3.2

pH

Why do we care about the $[H^+]$ anyway? What is special about this particular ion? Well, it turns out that either too much or too little H^+ can cause serious problems to the body. If the $[H^+]$ is too low, it causes an excitation of the nervous system, resulting in constant contraction of our muscles, including the respiratory muscles, and that is a problem. On the other hand, if the $[H^+]$ is too high, it can result in depression of the nervous system, leading to coma. We use the terms acidic and basic to describe these conditions. If the $[H^+]$ of the solution is greater than 1.0×10^{-7}, we say the solution is **acidic**, and if the $[H^+]$ is less than $1.0 \text{ X } 10^{-7}$, we say the solution is **basic**.

Because the $[H^+]$ is so important and because it is rather cumbersome to say things like, "the $[H^+]$ of the fluid is $1.0 \text{ X } 10^{-7}$ Molar," chemists have developed a shorthand to express the $[H^+]$. This shorthand expresses the $[H^+]$ as the pH of the solution. The **pH** of a solution is the **negative logarithm of the $[H^+]$** (concentration expressed as moles per liter, M). So, if the $[H^+]$ is 1.0×10^{-7} M, the pH of that solution would be 7 ($-\log 10^{-7}$ is -(-7) or 7). Since this is the pH in which the $[H^+]$ and $[OH^-]$ are equal, we say that this is a **neutral solution**. When using pH, one thing that is a little confusing is that as the $[H^+]$ of a solution goes up, the pH goes down. Suppose that a solution has a $[H^+]$ of 1.0 X 10-6 M. The pH of the solution would be 6, but since the math behind pH is log base 10, the change in pH from 7 to a pH of 6 represents a 10 fold increase in hyrdrogen ions. Moving from a pH of 7 to pH of 5 represents a 100 fold increase. Thus, an **acidic solution** is any solution with a pH<7. Likewise, any solution that has a pH>7 is a **basic solution**. Below is an image that shows the pH of some common solutions.

pH	Examples of solutions
0	Battery acid, strong hydrofluoric acid
1	Hydrochloric acid secreted by stomach lining
2	Lemon juice, gastric acid, vinegar
3	Grapefruit juice, orange juice, soda
4	Tomato juice, acid rain
5	Soft drinking water, black coffee
6	Urine, saliva
7	"Pure" water
8	Sea water
9	Baking soda
10	Great Salt Lake, milk of magnesia
11	Ammonia solution
12	Soapy water
13	Bleach, oven cleaner
14	Liquid drain cleaner

pH Scale and Examples. *Downloaded from Wikimedia Commons Fall 2014; Author: OpenStax College; License: Creative Commons Attribution 3.0 Unported license.*

So, there are two important lessons from this; the lower the pH, the higher the [H^+], and a change in pH of one unit (7 to 6 for example) is a 10-fold change in [H^+]. Just for reference, the normal pH of our blood is slightly basic, 7.4 (range = 7.35 – 7.45). If the pH of the blood rises above 7.45, the person is in a state of **alkalosis** (not enough H^+), and if it drops below 7.35, the person is in a state of **acidosis** (too much H^+). In mammals, the pH range of the blood that is considered to be compatible with life is from 6.8 to 7.8. A pH above or below these values usually results in death.