pH and Alkalinity of Water in Our Lakes, Rivers and Rain

Most of us know that the pH of a particular sample of water indicates how acidic (0-7) or basic (7-14) it is with 7 being neutral, 0 being very acidic and 14 very basic). The 0-14 scale is logarithmic so each number above 7 is 10 times more basic that the previous number and below 7 is 10 times more acidic.

pH stands for "power of Hydrogen. The numerical value of pH is based on the molar concentration of hydrogen ions (H+). The higher the (H+) concentration the lower the pH and the higher the hydroxyl ions (OH-) the higher the pH. An acid is defined as a substance that releases a hydrogen ion or proton and a base accepts a hydrogen ion or proton

Alkalinity of water is its quantitative capacity to neutralize or buffer an acid or said differently it is water's ability to resist changes in pH. Therefore if a body of water has a high alkalinity it can limit pH changes due to acid rain, pollution or other causes. The presence of carbonates and bicarbonates in soils and rock (such as limestone) help raise alkalinity.

Photosynthesis by algae during the day when plants use hydrogen causes an increase in pH and the lack of photosynthesis at night plus the normal respiration and decomposition will cause a drop in pH. A lake with high alkalinity can buffer these changes so that they may be difficult to detect. Alkalinity can be reported in mg/L (milligrams per litre) when referring to carbonate (CO_3), bicarbonate (HCO_3) or calcium carbonate ($CaCO_3$).

Why is pH Important ?

If pH is too high or low aquatic organisms living in that environment will die. Most prefer a pH range of 6.5 - 9. As the pH levels move beyond the comfort range of a particular aquatic species they will experience increase stress on their systems and reduced hatching and survival rates. Extreme pH levels generally increase the solubility of compounds making toxic chemicals more "mobile" and easier to be absorbed by aquatic life and even us humans. Slight increases in pH can increase the solubility of phosphorous making it more available for plant & algae growth.

Carbon Dioxide & pH

While carbon dioxide (CO_2) is the most common cause of acidity in water, photosynthesis, respiration and decomposition also contribute to pH fluctuations due to their impact on CO_2 levels. CO_2 can exist in water in a dissolved state like oxygen but it can react with water ($CO_2 + H_2O \Rightarrow H_2CO_3$) to form carbonic acid. This explains why "clean" rain or snow without other pollutants has a typical pH of

5.6 . The pH of rain can also be lowered further by airborne particles from wildfires, volcanic ash/dust or emissions from mining, smelting and fossil fuel combustion which when combined with rainwater can produce other types of acids. To be declared acid rain the pH must be below 5.0 Some of our rainfall in Kearney this past summer did test below 5.0

Typical Levels

Most fish prefer pH levels between 6 - 9 with a minimum alkalinity of 20 mg/L and ideal CaCo3 levels between 75 -200 mg/L. Recommended minimum pH levels for the following aquatic life is as follows - frogs (4), perch (4.5), trout (5), bass and crayfish (5.5), salmon (6) . Most grasses & legumes prefer soils with a pH of 4.5-7 .

pH of Common Substances

(Please note most of these substances will have a range of pH not a single value)

0	Battery acid	Acidic
1	Gastric (Stomach) acid	|
2	Lemon juice, vinegar	|
3	Orange & grapefruit juice	|
4	Tomato juice, beer	|
5	Black coffee	|
6	Urine, Saliva, milk	|
7	Pure water - blood	neutral
8	Sea water, eggs	|
9	Baking soda	|
10	Milk of Magnesia, mild detergent	|
11	Household cleaners & ammonia	|
12	Soapy water, hair straighteners	|
13	Bleach, oven cleaner	|
14	Liquid drain cleaner, Caustic soda	Basic or Alkaline

Some of the above information is from an excellent multi-page article "pH of Water" on the Fondriest Environmental Inc. website www.fondriest.com. Their Learning Center has a number of interesting and informative articles on environmental topics.