Surface Water Quality

Essential Standard 2.4

Evaluate how humans use water.

Learning Objective 2.4.2

Evaluate human influences on water quality in North Carolina's river basins, wetlands, and tidal environments.

I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can list three factors that determine the quality of surface water
- I can explain why dissolved oxygen is and why it is important to water quality
- I can explain why temperature is important to water quality
- I can explain what pH is and why it is important to water quality

Water Quality

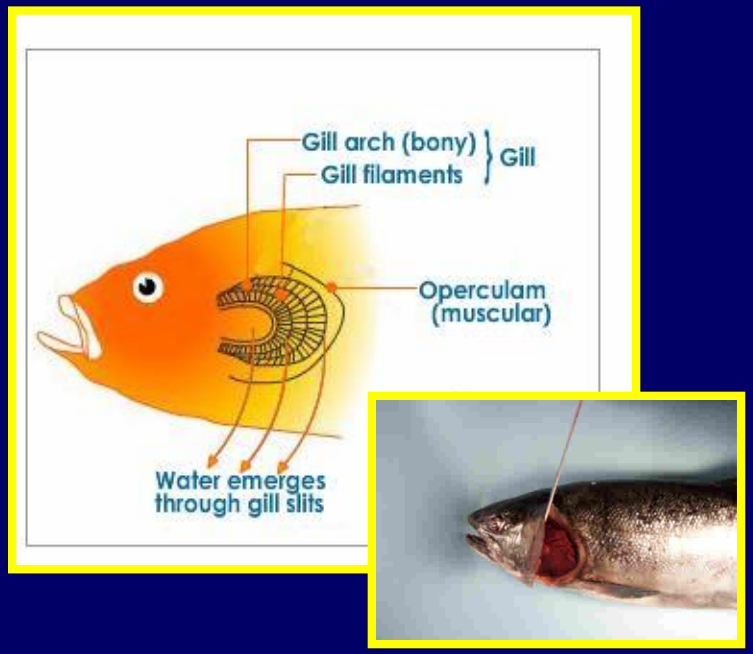
Water quality refers to a stream's ability to support aquatic life and how safe it is for human use.

One of the most important water quality indicators is the amount of dissolved oxygen in the water.

Dissolved oxygen consists of oxygen gas molecules that are dissolved in water, similar to how carbon dioxide gas is dissolved in carbonated soda.

Dissolved Oxygen

Fish breathe oxygen gas, just like we do. Although, fish use gills to take dissolved oxygen from the water, instead of out of the air.



When levels of dissolved oxygen drop too low, fish can suffocate and die, just like we would.

Dissolved Oxygen - ppm

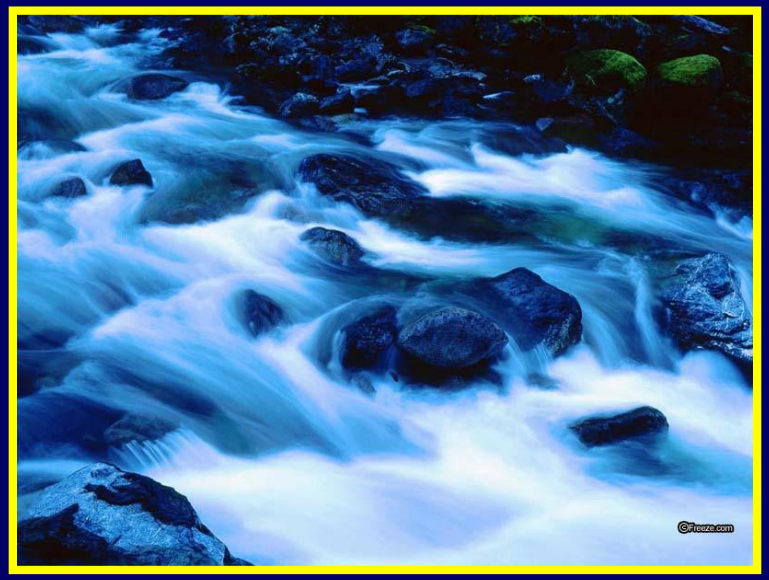
Dissolved oxygen is measured in parts per million (ppm).

8 dollars out 1 million

A reading of 8 ppm means that there are 8 oxygen molecules for every million water molecules.

Sources of Dissolved Oxygen

Oxygen can become dissolved naturally in water when plants photosynthesize, when wind blows the water around, and when water falls over rapids or riffles in a stream.



Biological Oxygen Demand

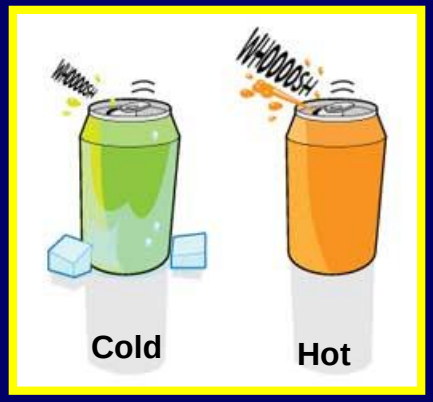
Organic wastes in surface water is mostly broken down by aerobic bacteria, meaning bacteria that require oxygen.

Surface water with a lot of organic wastes will have a high biological oxygen demand, BOD.

The breakdown of organic matter is critical not only for recycling nutrients but also for the aesthetic value of surface water.

Temperature

The temperature of the water can affect how much dissolved oxygen the water can hold.



Cooler water can hold more dissolved oxygen, whereas warm water holds less.

Temperature Tolerance

Different fish can tolerate different levels of temperature and related dissolved oxygen levels.

Trout

Requires High Levels of Dissolved Oxygen

Cold, fast moving mountain streams.

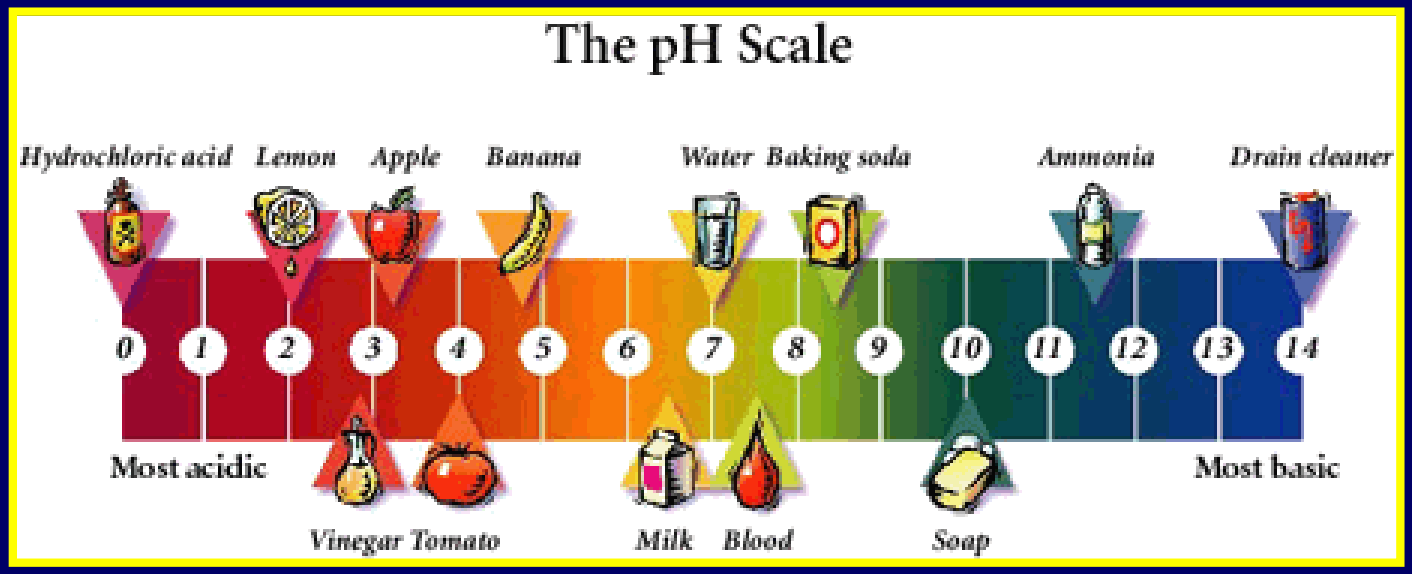
Catfish

Tolerates Low Levels of Dissolved Oxygen

Warmer, slow moving waters.

pH of Surface Water

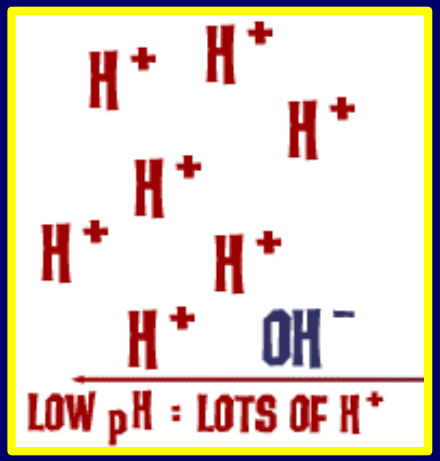
The pH of the water is another important water quality indicator and is a measurement of how acidic or basic the water is and is measured on range from 0 to 14.



Acid	Neutral	Base
Below 7	pH of 7	Above 7

Hydrogen Ions

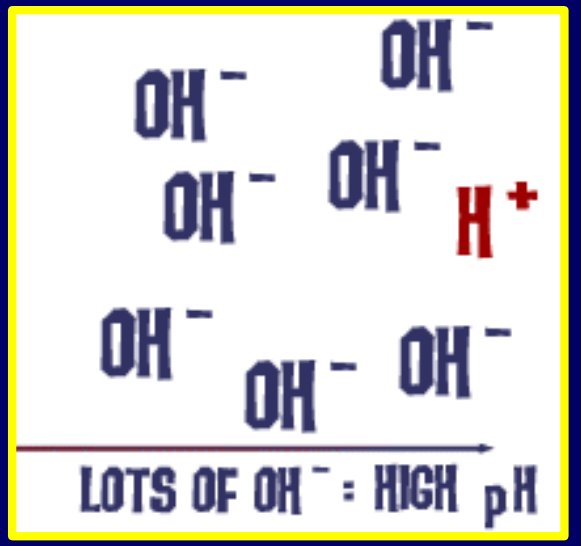
pH actually stands for percent hydrogen or hydrogen ions (H+).



When acids are dissolved in water, they release Hydrogen ions (H^+) into the water.

When bases are dissolved in water, they remove Hydrogen ions (H^+) from the water.

The OH^- react with H^+ to form H_2O



pH of Surface Water

pH values are reported in logarithmic units and each value represents a 10-fold change in the pH value of the water.

Water with a pH of 3 is 10 times more acidic than water with a pH of 4 and 1,000 times more acidic than water with a pH of 5.

pH of Surface Water

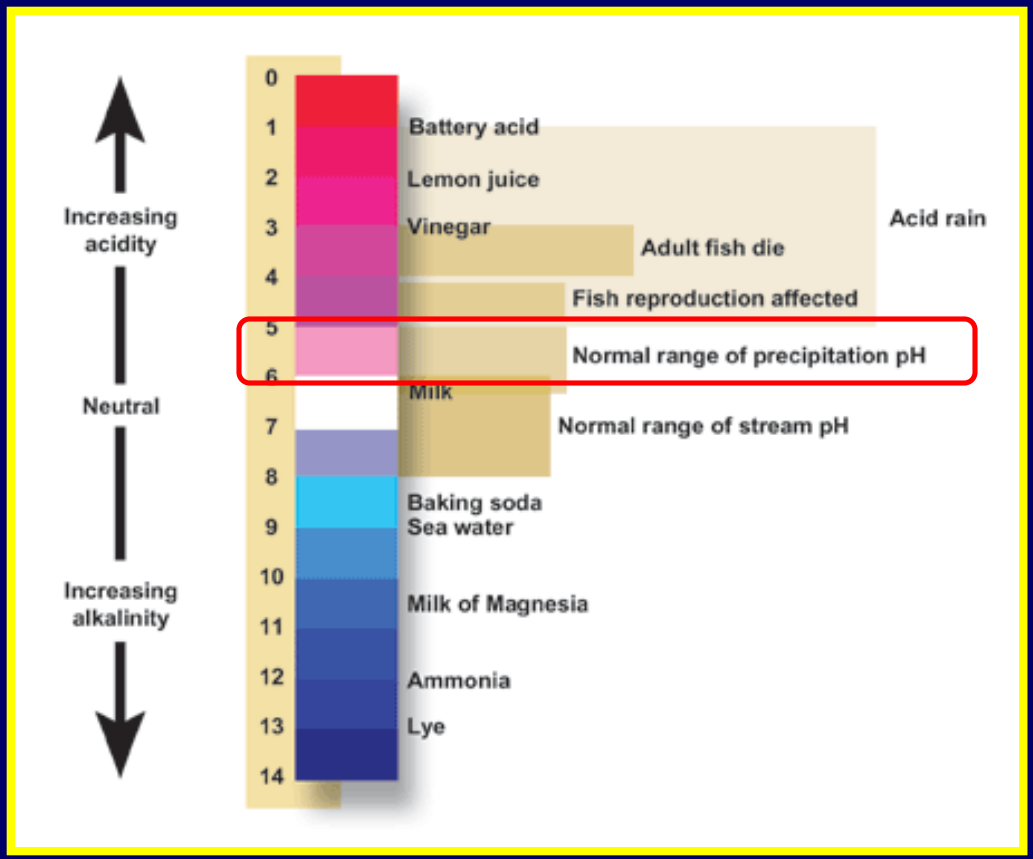
Normal rainfall has a pH of about 5.6, slightly acidic, due to rain water mixing with carbon dioxide gas in the air and the formation of carbonic acid.

$H_2O + CO_2 \rightarrow H_2CO_3$

H_2O = Water

CO_2 = Carbon Dioxide

H_2CO_3 = Carbonic Acid



pH of Surface Water

Normal stream pH tends to be closer to neutral or even slight basic, due to the rocks in the area.

If granite is the most common bedrock, streams will be more neutral.

If limestone is the most common bedrock, the streams will be more basic.

Importance of pH

The pH of water determines the solubility of heavy metals and how toxic they are to living organisms.

	Effect on Fish
Lead (Pb)	Genotoxic; cytotoxic damage in gill and fin epithelial cells in some fishes; in other fishes, it delays embryonic development, inhibits growth, suppresses reproduction, causes kidney dysfunction; inhibits hatching of eggs, hypertrophy of gills

	Effect on Fish
Mercury (Hg) and Methylmercury (MeHg)	Liver, gill arches, blood parameters, kidney, nervous system and olfactory epithelium damage, reduces sperm viability, production of eggs and their survival rate

In waters with a low pH, heavy metals such lead and mercury are more easily dissolved and so become more toxic to living organisms.

Importance of pH

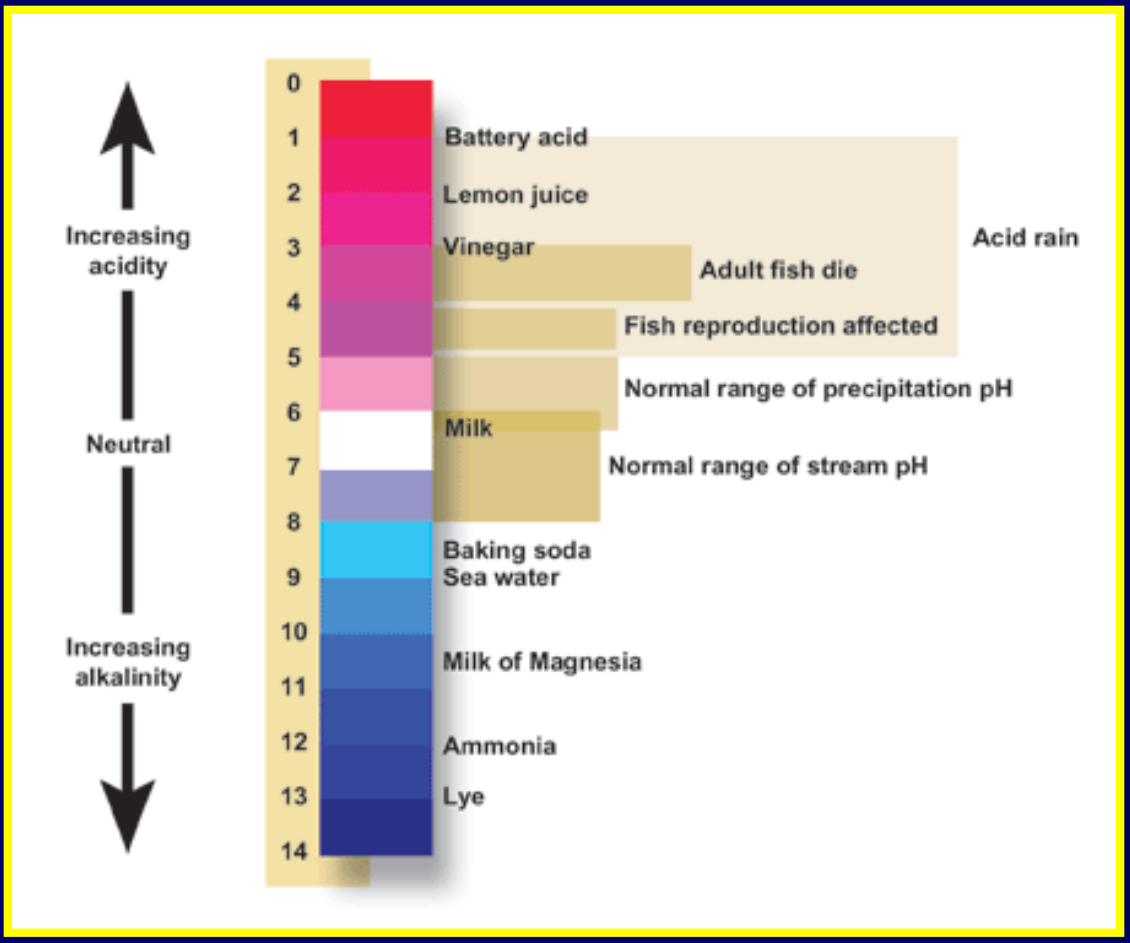
The pH of water also determines what form and how much of essential nutrients, such as phosphorus and nitrogen, will be available to organisms.

If the water is too acidic, phosphorus will react with iron and aluminum and become unavailable to aquatic plants.

However, if the water is too basic, phosphorus will react with calcium and also become unavailable to aquatic plants.

Importance of pH

When the pH of surface water drops below 5, fish eggs break down and dissolve.



When the pH of surface water drops below 4, adult fish begin to die.

pH - Indicator of Water Pollution

Not only does the pH of surface water affect living organisms but can also be an indicator of pollution.

Creek polluted by acid mine drainage from abandoned coal mines.

The End