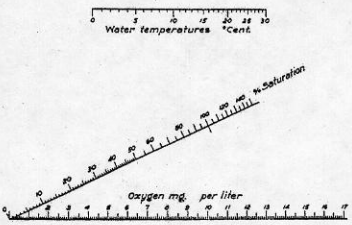
Dissolved Oxygen

What is it? Dissolved oxygen is just what it sounds like: the amount of oxygen gas dissolved in water.

The scale: Dissolved oxygen is often measured in mg/L, however it is the percent oxygen present in the water column that is most important. Using a straight edge, line up the mg/L of oxygen on the lower line with the water temperature on the upper line. Where the straight edge intersects the percent saturation line (the middle diagonal line) is your percent dissolved oxygen.



How does dissolved oxygen get into the water column: The amount of oxygen that water can dissolve is dependant on temperature. Like a glass of water can only dissolve a certain amount of lemonade powder, water can only dissolve a certain amount of oxygen. Colder water can "hold" more dissolved oxygen than can warmer water. Think of a pot of water on your stove. As you heat it up one of the first things you see is bubbles. These bubbles are oxygen that can no longer stay in the water column. This is because the molecules are moving faster with the input of energy from the stove and the oxygen is literally being "bumped" out.

Oxygen also dissolves in water through mixing forces such as wind and waves and the "breathing" of aquatic plants. Plants give off oxygen and consume carbon dioxide, the opposite of us.

What do animals need: Aquatic animals need dissolved oxygen to live. The range of dissolved oxygen for most aquatic animals is between 5 and 6 mg/L. Some aquatic organisms can live in waters with dissolved oxygen as low as 3 mg/L but anything lower is usually too stressful for survival

Temperature

Why temperature: Water temperature is a simple but important indicator of river health. It affects the rate of many biological and chemical processes that take place in the river. For example, the warmer the water, the faster the molecules are moving. Fast moving molecules act to "push" dissolved oxygen out of the water and back into the atmosphere. Every organism has a temperature range that is optimal for its health. If the water ever becomes too hot or cold, aquatic organisms become stressed and will eventually die if the temperature remains extreme. In urban areas, such as New York City, excessive warming is often a concern.

Water temperature is naturally affected by seasonal and daily fluctuations, and typically the range remains moderate supporting diverse aquatic organisms. Water temperature also influences the chemistry of the stream, for example, cooler water can hold more oxygen (very similar to how hot cocoa mix won't dissolve in cold water, but it does dissolve in warm water).

Turbidity

What is it? Turbidity is the measure of the cloudiness or clarity of water. Turbidity increases as suspended solids (tiny particles dissolved in the water) and plankton (microscopic plants and animals) accumulate in the water column. Turbidity is not the measure of water color, since dark water can still be clear. Factors affecting the levels of suspended solids are storms, water temperature, land use, soil erosion, and urban run-off.

Impacts of Turbidity: Turbidity is an important indicator of suspended sediment and its effects. Suspended particles in the water column absorb more heat than clear water, which results in higher water temperatures and decreased dissolved oxygen.

Other negative impacts of high turbidity include:

- Sunlight becomes blocked, reducing the amount of energy available for plants
- Suspended particles absorb heat, raising the amount of energy available for plants
- Eggs and macroinvertebrates living in the streambed become stressed and/or buried as suspended particles settle to the bottom of the waterbody
- Sediments tend to carry nutrients, pesticides and other pollutants into and through the waterbody

Nitrogen and Phosphorous

What are they? Nitrogen and phosphorous are nutrients that act as fertilizers for aquatic plants.

Nitrogen enters water systems from human and animal waste, decomposing organic matter, and lawn and crop fertilizer run-off.

Phosphorous occurs in water naturally, but can also enter the system through streams and fertilizers.

What range can animals and plants survive in? Nitrogen: Unpolluted waters usually have nitrate levels below 4 ppm (mg/L). Levels above 40 ppm are considered unsafe for drinking water.

Phosphorous: Levels higher than 0.03 mg/L contribute to increased plant and algal growth.

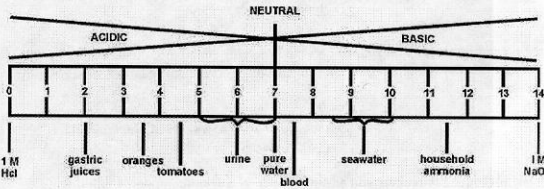
Impacts of increased Nitrogen and Phosphorous in water systems: A water body becomes unhealthy and overloaded with algae and other plants if too many nutrients, primarily nitrates and phosphates, accumulate. The first sign of excess nutrients is the presence of increased plant growth (or plant blooms).

Plant blooms often indirectly stress the aquatic community, because when the plants die the dead plant material sinks to the bottom of the waterbody. This dead material is then broken down by decomposers, such as bacteria, that live in the bottom of the waterbody. Most decomposers consume oxygen. This means that as more dead plants accumulate at the bottom of a stream or lake, more decomposers accumulate to feed off of the dead plants. The addition of decomposers leads to increased oxygen consumption, often leaving little to no dissolved oxygen left for other animals such as the fish and mayflies. As a result, large animals are forced to swim to healthier, oxygenated water, while those that can't seek new water become stressed and may eventually suffocate.

pH

What is it? pH is the measurement of the activity of hydrogen ions in a water sample or in other terms the measurement of the concentration of acid or base in a system.

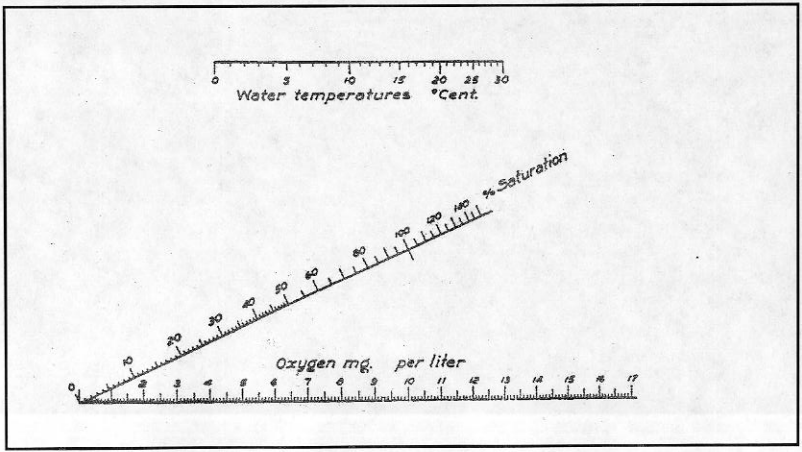
The Scale: pH is measured on a scale of 0 to 14. Pure water has a pH of 7 (neutral), acids are between 0 and 7, and bases are between 7 and 14. Examples of acids include vinegar, citrus, and most colas. Bases are often things such as drain cleaner, ammonia, baking soda and soaps.



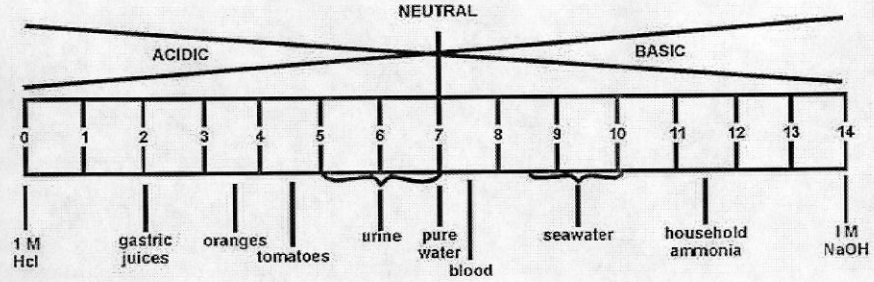
What range can animals live in? Most water bodies are naturally mildly acidic or basic, depending on the geology of the watershed. Estuaries (such as the Harlem River) are often slightly basic because it is very similar to sea water. The majority of aquatic organisms live within a narrow range of 6.5 to 8.6 on the pH scale. Slight changes in pH can change what animals can survive in that environment.

Things that can change the pH. pH can change pretty easily throughout the year. Seasons can impact change due to amounts of rain or precipitation. In addition runoff from surrounding areas can put nutrients or chemicals into the system that can have an adverse, or in some cases a positive, impact on the system. Rapidly growing algae and vegetation remove carbon dioxide (CO_2) from the water during photosynthesis. This can result in a significant increase in pH. Rapid algae growth is often a result of high inputs of nutrients into the system such as nitrogen and phosphorous.

What can affect Dissolved Oxygen: Dissolved oxygen is easily affected by many factors. Weather, temperature, nutrients inputs, plant and animal die offs all. Algae often produces oxygen during photosynthesis, however if the algae begins to take over an aquatic system, also called an algal bloom, it can change the dissolved oxygen dramatically. As algae covers the top of the water system it blocks out light for all the plants and animals below, limiting the amount of photosynthesis that can occur with other plants. Once the algae dies off it sinks to the bottom, covering everything and depleting the oxygen in the system more. As it breaks down, oxygen is consumed, and heat is given off which further depletes the oxygen because the water temperature rises.


0 5 10 15 20 25 30
Water temperatures °Cent.
% Saturation
10 20 30 40 50 60 80 100 120 140
Oxygen mg. per liter
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

pH Scale


NEUTRAL
ACIDIC
BASIC
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1 M Hcl
gastric juices
oranges
tomatoes
urine
pure water
blood
seawater
household ammonia
1 M NaOH