Testing the Water

There are many different types of test kits on the market today. Many of these are effective, inexpensive, and offer a broad choice of tests. You can, however find more expensive, high precision testing if you are a stickler about water quality

Most expert aquarists will agree that testing the aquarium water and understanding how to regulate the water quality from these tests will ensure long-term success in the aquarium. This practice will prolong the life and health of it's inhabitants. There are many water parameters that you can test. This section will focus on the main test's, and briefly discuss their significance to the aquarist

Temperature-This is most commonly measured in degrees Fahrenheit (F), and in degrees Celsius (C). Temperature measures the relative heat of the aquarium water. This is measured with a thermometer. It is best to keep thermometers away from heating and cooling devices, as this will give inaccurate readings, and ultimately misinformation (especially in larger aquariums.) Coldwater fish are generally kept in the 50-70 F range. Most fresh and saltwater fish are kept from 75-80 F, and there are families of fish (i.e.. cichlids, discus, other Amazonian fish) which do best in the 80-85 F range. It is important to understand what environment your specimens live in in the wild to better understand how to regulate the aquarium, especially when it comes to temperature..

pH-Measures the acidity of the water by test kits, electronic probes, and various other testing devices. A pH reading of 7.0 is neutral. A pH reading of above 7.0 is alkaline, and a pH of less than 7.0 is acidic. Fish can survive in a pH range from 5.0-9.5. Most freshwater tanks should be kept slightly acidic (6.5-7.0) for egg-laying fish, and slightly alkaline (7.2-7.6) for live-bearing fish. However, there are exceptions (i.e. Cichlids 7.5-8.5). Saltwater aquariums are safe in the 7.4-9.0 range. Different aquarium setups and different inhabitants have different pH levels.

Salinity-Measured mainly in Specific Gravity (SG), and Conductivity (C) by use of a hydrometer or electronic probe. Saltwater is heavier than freshwater. There are many more minerals in seawater, including Sodium Chloride (NaCl) which is it's major component and constitutes about 30% of the total elements in seawater. Thus, SG measures the density of the aquarium water. Beware that many brands of hydrometers will give different readings at different temperatures. Freshwater tanks should have an SG of 1.000-1.005. Most marine tanks should have an SG of 1.020-1.025. Seawater is also more conductive than freshwater. It is able to carry current, because it is more dense. Some aquarists around the world measure the water by it's conductivity readings, which has a direct correlation to the SG of the aquarium water.

Ammonia (NH3)-Measured in milligrams per liter (mg/l), or parts per million (ppm), most commonly with a test kit. This highly toxic chemical is caused by the decomposition of fish waste, decaying food, and dead fish. Unfortunately, ammonia can be found in nearly all aquariums. Ammonia is the number one killer of tropical fish. With an ammonia level of 6 ppm in a freshwater aquarium, the death rate may be as high

as 50%. As the level of ammonia rises, the death rate climbs even higher. Ammonia affects fish by causing the blood to lose it's ability to carry oxygen. This creates stress and lowers the resistance of fish to such recurrent bacterial infections as fin and tail rot, body slime, eye cloud, mouth fungus, and body sores.

Nitrite (NO2-)-Measured in mg/l or ppm. Measured with test kits or electronic probes. Nitrite is a toxic waste material found in varying concentrations in most aquariums. It is produced by the nitrifying bacteria *Nitrobacter* in the biological filter as it breaks down ammonia. As the biological filter develops and grows, the nitrifying bacteria uses nitrite as a food source, converting it to non-toxic nitrate. This reduces the level of nitrite in the aquarium. Regular testing for nitrite is important because even low levels of nitrite affect the red blood cells of fish by reducing their ability to carry oxygen, thus causing suffocation, and death.

Nitrate (NO3-)-Measured in mg/l or ppm by using test kits or electronic probes. Nitrate is also produced in an aquarium, mainly by the bacteria *Nitrosomonas.* This occurs in the biological filter. These, along with other beneficial bacteria in the biological filter convert toxic ammonia, and nitrite, into nitrate. A high nitrate level indicates a build-up of fish waste and organic compounds resulting in poor water quality and contributes to the likelihood of fish disease. Excessive nitrate also provides a nitrogen source which can stimulate algae blooms. In the opinion of many marine aquarists, maintaining a low nitrate level significantly improves the health of fish and invertebrates.

General hardness (GH)-Measured in mg/l or ppm. Mainly a test for freshwater aquaria. Test kits are used to measure this most often. General hardness is the measure of calcium (Ca++) and magnesium (Mg++) ion concentrations dissolved in water. These minerals are present in well, and bottled spring water. The level of general hardness in tap and bottled water depends on the source of the water and the treatment processes it has undergone. Hard water (>200 ppm) is high in calcium and magnesium, while soft water (50-100 ppm) is low in these minerals. Below is a table of recommended GH and KH ranges for different species.

GH & KH RANGE	**AQUARIUM LIFE**
0-50 ppm	Discus, arowanas, elephantnose, neons, cardinals, live plants
50-100 ppm	Most tropical fish including angelfish, cichlids, tetras, botia,
100-200 ppm	Most tropical fish including swordtails, guppies, mollies, goldfish
200-400 ppm	Rift lake cichlids, goldfish, brackish water fish

Carbonate hardness (KH)-Measured in mg/l, ppm, or the German dKH. Measured with test kits. Carbonate hardness (also known as alkalinity) is the measure of carbonate (CO3-) and bicarbonate (HCO3-) ion concentrations dissolved in water. These minerals are present in municipal, well, and bottled spring water. The level of carbonate hardness in tap and bottled water depends on the source of the water and the treatment processes it has undergone. Carbonate hardness helps stabilize pH in the aquarium. An aquarium with a low KH level (50 ppm or less) will tend to be acidic. Aquariums with very low KH are also subject to rapid pH shifts, if not monitored carefully. Water with a high KH level (>200 ppm) usually has a high pH. In many saltwater aquariums, especially reef aquariums, the demands for carbonate hardness are high. Carbonate hardness in marine aquaria constantly decreases as biological processes, primarily biological filtration, produce acids that neutralize bicarbonate ions and remove them from the water. (Moe, The Marine Aquarium Reference 1989)

Oxygen (O2)- Measured as dissolved oxygen (DO) in mg/l and ppm. Oxygen is essential for nearly all types of life. It may be measured with test kits or electronic probes. Many fish and invertebrates suffer when the DO drops below 3.5 ppm and few survive DOs below 2 ppm. There isn't a lot of excess oxygen, especially in a marine aquarium. Protein skimming, proper water circulation, and sufficient air circulation at the water surface will help tremendously. For general purposes, a good air pump can also help. Most tanks should have a DO reading from 7-10 ppm.

Carbon dioxide (CO2)-Measured by monitoring pH values (see above). Tested with various kit's or devices. A test of special interest to freshwater plant aquarists, and saltwater reef keepers. CO2 is a product of the biological combustion of oxygen and carbon and is a waste product of animal metabolism and plant respiration. CO2 levels have a direct effect on the buffering capacity of the aquarium water, and alter the pH.

Redox potential-(ORP)-Measured in millivolts (mV). A measurement of the oxidation/reduction potential of the water molecule. Measured mainly via electronic probes. Redox refers to the electrical charge on a molecule that has been formed in a "reduction-oxidation chemical reaction." "Potential" refers to the electrical charge on a molecule that has been formed in an aqueous solution. To explain what this means in English now, is that it's basically a measurement of the "livability" of the aquarium water. This measurement has become of special interest to reef aquarists, as water quality demands are high, and the aquarium is sustaining a lot of marine life. Natural seawater has a range of 350-400 mV, however some aquarists have broken the 400 mV barrier with great success.