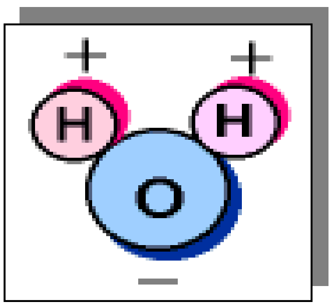
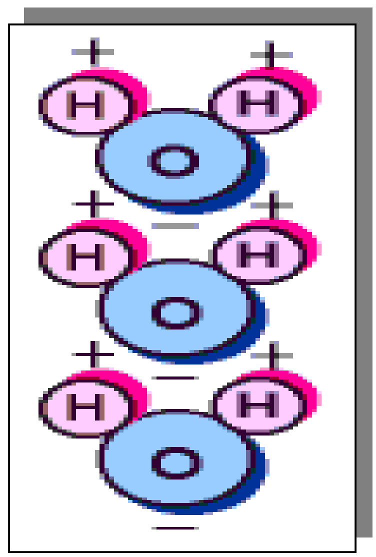
SAN ANTONIO WATER
CHEMICAL PROPERTIES

WATER'S CHEMICAL PROPERTIES

You probably know water's chemical description is H_2O. As the diagram shows, one atom of oxygen is bound to two atoms of hydrogen. The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water molecule having a positive charge on the side where the hydrogen atoms are, and a negative charge on the other side, where the oxygen atom is. Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky." As the right-side diagram shows, the side with the hydrogen atoms (positive charge) attracts the oxygen side (negative charge) of a different water molecule.





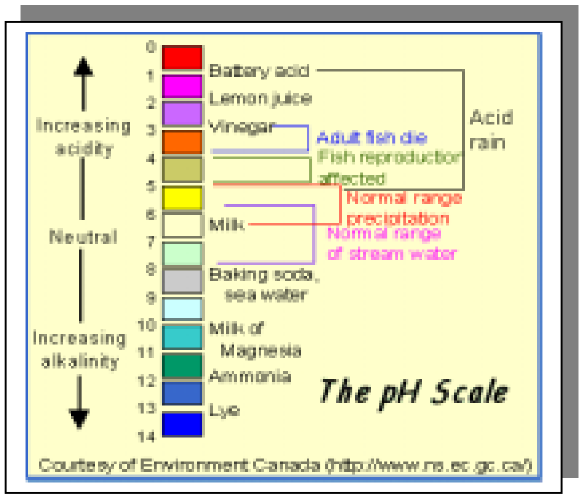
WATER MEASUREMENTS

Taking a single measurement of a water's properties is actually less important than looking at how the properties vary over time. For example, if you take the pH of the creek behind your school and find that it is 5.5, you might say "Wow, this water is acidic!" But, a pH of 5.5 might be "normal" for that creek. It is similar to how your normal body temperature (when you're not sick) is about 97.5 degrees, but a third-grader's normal temperature is "really normal" -- right on the 98.6 mark. As with our temperatures, if the pH of your creek begins to change, then you might suspect that something is going on somewhere that is affecting the water, and possibly, the water quality. So, often, the ***changes*** in water measurements are more important than the actual measured values.

Some types of measurements include:

pH

pH is a measure of how acidic/basic water is. The range goes from 0 - 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water. Water that has more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is basic. Since pH can be affected by chemicals in the water, pH is an important indicator of water that is changing chemically. pH is reported in "logarithmic units," like the Richter scale, which measures earthquakes. Each number represents a 10-fold change in the acidity/basicness of the water. Water with a pH of 5 is ten times more acidic than water having a pH of six.



Water temperature

Water temperature is not only important to swimmers and fisherman, but also to industries and even fish and algae. A lot of water is used for cooling purposes in power plants that generate electricity. They need cool water to start with, and they generally release warmer water back to the environment. The temperature of the released water can affect downstream habitats. Temperature also can affect the ability of water to hold oxygen as well as the ability of organisms to resist certain pollutants.

Conductivity

Conductivity is a measure of the ability of water to conduct an electrical current. It is highly dependent on the amount of dissolved solids (such as salt) in the water. Pure water, such as distilled water, will have a very low conductivity, and sea water will have a high conductivity. Rainwater often dissolves airborne gasses and airborne dust while it is in the air, and thus often has a higher conductivity than distilled water. Conductivity is an important water-quality measurement because it gives a good idea of the amount of dissolved material in the water.

Turbidity

Turbidity is a measure of the cloudiness of water. It is measured by passing a beam of light through the water and seeing how much is reflected off particles in the water. Water cloudiness is caused by material, such as dirt and residue from leaves, that is suspended (floating) in the water. Crystal-clear water, such as Lake Tahoe (where they work hard to keep sediment from washing into the lake) has a very low turbidity. But look at a river after a storm -- it is probably brown. You're seeing all of the suspended soil in the water. Lucky for us, the materials that cause turbidity in our drinking water either settle out or are filtered before the water arrives in our drinking glass at home. Turbidity is measured in nephelometric turbidity units (NTU).

Dissolved oxygen

Although water molecules contain an oxygen atom, this oxygen is not what is needed by aquatic organisms living in our natural waters. A small amount of oxygen, up to about ten molecules of oxygen per million of water, is actually dissolved in water. This dissolved oxygen is breathed by fish and zooplankton and is needed by them to survive.

Rapidly moving water, such as in a mountain stream or large river, tends to contain a lot of dissolved oxygen, while stagnant water contains little. The process where bacteria in water helps organic matter, such as that which comes from a sewage-treatment plant, decay consumes oxygen. Thus, excess organic material in our lakes and rivers can cause an oxygen-deficient situation to occur. Aquatic life can have a hard time in stagnant water that has a lot of rotting, organic material in it, especially in summer, when dissolved-oxygen levels are at a seasonal low.

Hardness

The amount of dissolved calcium and magnesium in water determines its "hardness." Water hardness varies throughout the United States. If you live in an area where the water is "soft," then you may never have even heard of water hardness. But, if you live in the San Antonio area and get your water from an aquifer, you may notice that it is difficult to get a lather up when washing your hands or clothes. And, industries in the area might have to spend money to soften their water, as hard water can damage equipment. Hard water can even shorten the life of fabrics and clothes!

CAPILLARY ACTION

Even if you've never heard of capillary action, it is still important in your life. Capillary action is important for moving water (and all of the things that are dissolved in it) around. It is defined as the movement of water within the spaces of a porous material due to the forces of adhesion, cohesion, and surface tension.

Capillary action occurs because water is sticky -- water molecules stick to each other and to other substances, such as glass, cloth, organic tissues, and soil. Dip a paper towel into a glass of water and the water will "climb" onto the paper towel. In fact, it will keep going up the towel until the pull of gravity is too much for it to overcome.

Consider this:
*When you spill a glass of soda (which is, of course, mostly water) on the kitchen table you rush to get a paper towel to wipe it up. First, you can thank surface tension, which keeps the liquid in a nice puddle on the table, instead of a thin film of sugary goo that spreads out onto the floor. When you put the paper towel onto your mess the liquid attaches itself to the paper fibers.

*Plants and trees couldn't thrive without capillary action. Plants put down roots into the soil which are capable of carrying water from the soil up into the plant. Water, which contains dissolved nutrients, gets inside the roots and starts climbing up the plant tissue. As water molecule #1 starts climbing, it pulls along water molecule #2, which, of course, is dragging water molecule #3, and so on.

*Think of the tiniest blood vessels in your body -- your capillaries. Your blood is mostly water, and capillary action assists the pumping action of your heart to help keep blood moving in your blood vessels.
(information courtesy of USGS)

ETC.
Here's a quick rundown of some of water's properties:

- Weight: 62.416 pounds per cubic foot at 32°F
- Weight: 61.998 pounds per cubic foot at 100°F
- Weight: 8.33 pounds/gallon, 0.036 pounds/cubic inch
- Density: 1 gram per cubic centimeter (cc) at 39.2°F, 0.95865 gram per cc at 212°F

By the way:
1 gallon = 4 quarts = 8 pints = 128 ounces = 231 cubic inches
1 liter = 0.2642 gallons = 1.0568 quart = 61.02 cubic inches
1 million gallons = 3.069 acre-feet = 133,685.64 cubic feet
(Courtesy of USGS)