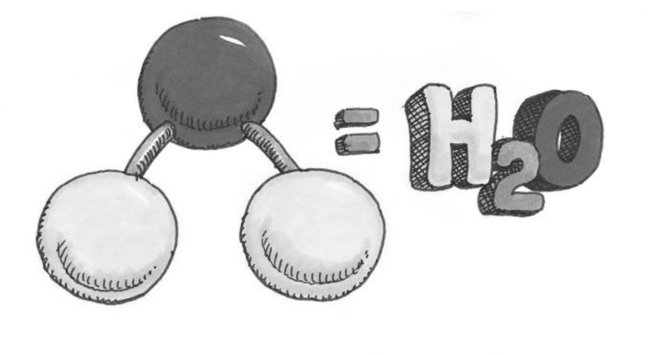
Water Chemistry & Characteristics

In a water molecule, hydrogen atoms have a slightly positive electrical charge while the oxygen has a slightly negative charge. This produces a water molecule which has an overall positive charge on the side where the hydrogen atoms are and a negative charge on the other side, where the oxygen atoms are. Although a water molecule itself has a neutral charge the differences in electrical charge at each end creates a water molecule that is polar. A polar molecule is one that has one end with a slightly negative charge and one with a slightly positive charge much like the poles of a magnet. Due to this polar nature water molecules have unique characteristics from other liquids. The side with hydrogen atoms (positive charge) attracts the oxygen side (negative charge) of a different water molecule. This is called hydrogen bonding. Water molecules act like tiny magnets, constantly attracting other water molecules, or other substances.



Water can exist in any of three states: solid (ice or crystal form), liquid, or vapor (gas) depending primarily on temperature. Water molecules are in constant motion. Solid ice becomes a liquid as more heat energy is added to the solid. Increased heat causes the molecules of ice to break away from their vibrating solid lattice into a more fluid motion. As heat energy is increased the liquid molecules move more rapidly until they have enough energy to break away from their attraction to each other (hydrogen bonding). The gas molecules move with incredible speed in every direction as water vapor in the air. Most liquids when they solidify reduce their volume. Water, unlike other liquids actually increases in volume below 4 degrees Celsius making it less dense. This is why ice cubes float in liquid water.

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.

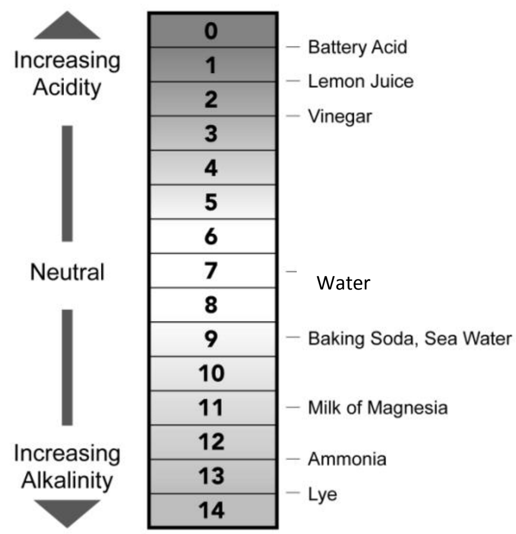
Think of the tiniest blood vessels in your body—your capillaries. Your blood is mostly water, and capillary action assists the pumping action of your heart to help keep blood moving in your blood vessels.
(Information courtesy of USGS)

Surface Tension

Surface tension is a measure of the strength of the water's surface film. Water has very high surface tension. The attraction between the water molecules creates a strong film or "skin" on the surface of the water. Surface tension allows water to hold up substances that have a greater density but not heavy enough to break the surface tension. This explains why some aquatic insects are able to "walk on water". It is surface tension that causes water molecules to clump together in drops rather than spread out in a thin film. Surface tension of water makes it difficult for the water to penetrate or "wet" fabrics or skin: consequently, many soaps or detergents contain wetting agents designed to reduce surface tension and to increase fabric penetration by water.

pH

pH is a measure of how acidic or basic water is. pH is reported in "logarithmic units," like the Richter scale. Each number represents a 10 fold change in how acidic or basic the water is. Water with a pH of five is ten times more acidic than water having a pH of six. The range goes from 0-14, with 7 being neutral. A pH of less than 7 indicates an acid. A pH of greater than 7 indicates a base.



Pure water has a pH of around 7. The exact value depends on the temperature of the water. Adding substances to water can change the pH. An approximate measure of pH can be obtained by using a pH indicator which is a substance that changes color around a particular pH value.

High pH causes water pipes and water-using appliances to become encrusted with deposits. It depresses the effectiveness of the disinfection of chlorine, causing the need for additional chlorine when pH is high. Low pH water will corrode or dissolve metals and other substances. High and low pH values dramatically affect humans and other organisms that rely on water to live.

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. 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!

(Information courtesy of USGS)