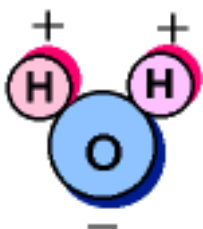
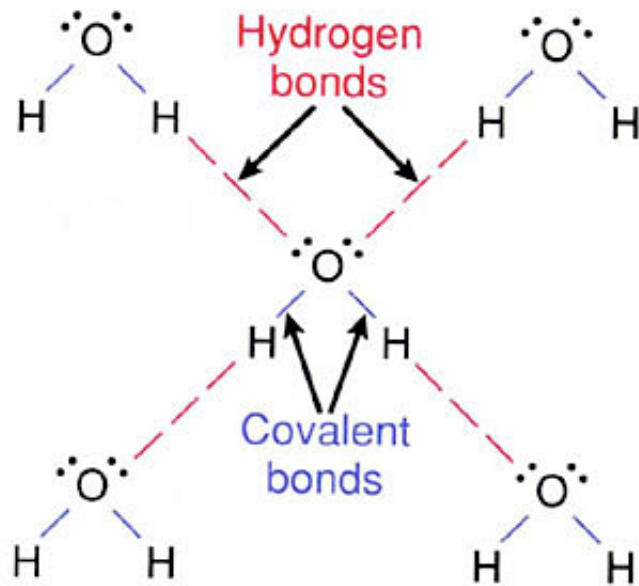


Water-H₂O-Chemistry

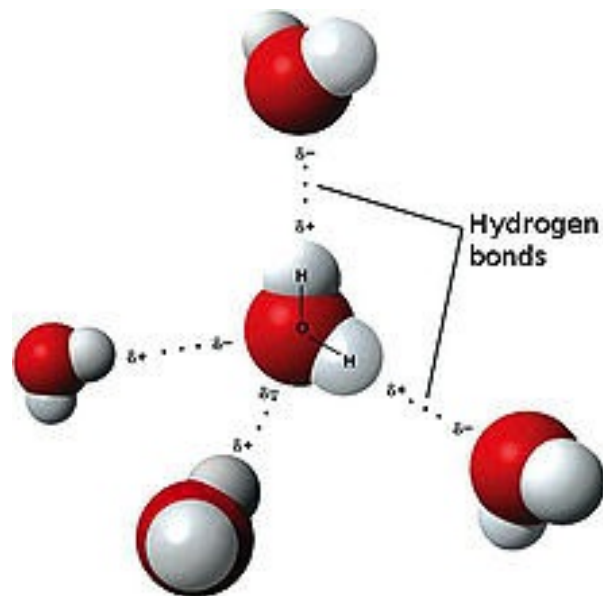
Water may be one of the most familiar substances on the planet, but it certainly isn't ordinary. Water's unique chemical properties make it so complicated that after decades of research scientists still have much to learn about this remarkable and versatile substance.



Since hydrogen is more generous with its electrons and more likely to donate them to another element while oxygen is more selfish with electrons and more likely to hold onto them, when a molecule of water forms the electrons spend more time around the oxygen and less time around the hydrogen atoms. This creates what we call a POLAR molecule. Polar molecules have more of a negative charge at one end or “pole” of the molecule and more of a positive charge at the other end. Since water is a polar substance made up of polar molecules, it is a very good solvent for polar substances. Solvents are typically liquids in which other substances are easily dissolved. Table sugar is a polar molecule and dissolves easily in water. Polar molecules dissolve in polar solvents. We could give this the saying, “like dissolves like”.



Hydrogen bonding in water.



Water is a polar molecule because the electrons in the atoms of the molecule spend more time around the oxygen than the hydrogens. Since opposite charges attract, the oxygen of one molecule of water is attracted to the hydrogen of the next water molecule. This “hydrogen bonding” makes water have unique properties.

Three unique properties of water are:

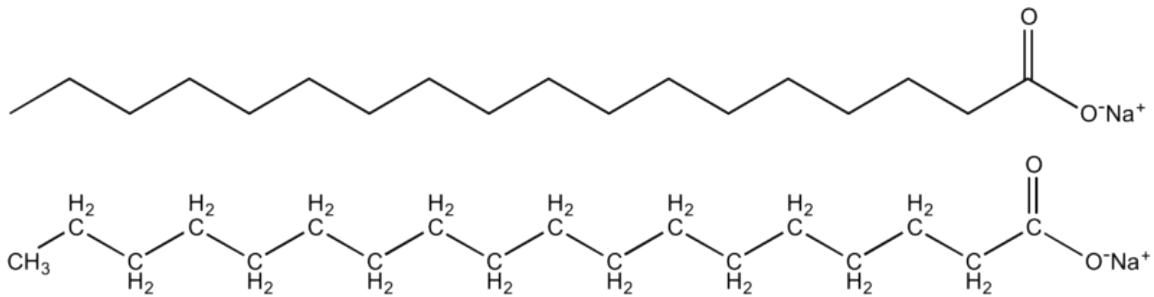
- 1) Water has a high boiling point for such a small molecule (one would expect a small molecule to evaporate rapidly at room temperature and boil at a low temperature).
- 2) Water beads up on surfaces...high surface tension, and makes it so bugs can walk on water



- 3) Water dissolves many polar substances (like dissolves like)

Soap*

Soaps are used to help dissolve non-polar substances in water...grease is non-polar and “dirt” is typically non-polar.



non-polar, hydrophobic, lipophilic tail

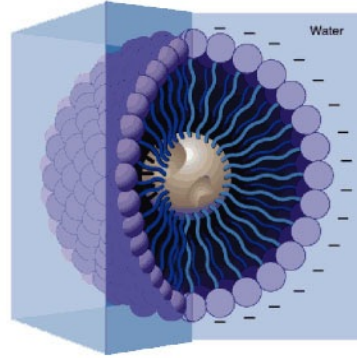
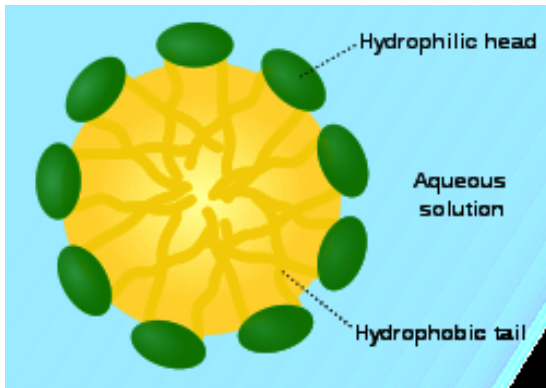
polar end

What do polar, non-polar, hydrophobic and hydrophilic mean?

“hydro” means _____

“phobic” means _____

**Detergents are similar to soaps but typically a little more complex in structure and often more effective “hard” water.*



The figure on the left: Soap molecules dropped in water forming a sphere to keep the hydrophobic tails away from the water—this sphere is called a micelle.

The figure on the right: Soap mixed in water with grease particles will form spheres to keep their hydrophobic tails away from the water and trap hydrophilic grease in the center of the micelle. This is how soaps and detergents clean clothes in a washer machine.



Concept Check

A water bug is denser than water but it can dance on the surface of pure water. Could it dance on soapy water? Explain your answer.

Some thoughts: If your body is mostly water, what parts are water-soluble and what are not? Are the proteins and sugars dissolved in blood water-soluble? Is bone water-soluble? Is the outer layer of your skin water-soluble...if not—why not? Do scientists think all life in the universe is most likely dependent on the presence of water...Why?