**Biological Importance of Water**

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| Top of Form  **Rate This Paper:**  1  2  3  4  5    Bottom of Form  **Length:** 903 words (2.6 double-spaced pages) **Rating:** Red (FREE)       - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -  Biological Importance of Water    Water is an important part of life: Without it, life on earth would  not exist. Water is a major component in cells, typically forming 70  to 95% of the cell's mass. In humans water is around 80% of our mass.  Water also provides an environment for organisms to live in. One  obvious example of water's [biological importance](http://www.123helpme.com/search.asp?text=biological+importance) is that 75% of the  Earth is covered in water.   [IMAGE]Water is one of the most unusual compounds on Earth. It has a  variety of properties not found in any other liquid. These properties  are due to its molecular composition, which is simply just 2 hydrogen  atoms and one oxygen atom, making up H20.   Water is a covalent compound. This means that water has [covalent bonds](http://www.123helpme.com/search.asp?text=covalent+bonds),  which are formed by sharing electrons in the outer orbits of the  quantum shells. In the case of water however the large number of  protons in the oxygen nucleus have a stronger attraction for these  shared electrons than the comparatively tiny hydrogen nuclei. This  pulls the electrons slightly closer to the oxygen nucleus and away  from the hydrogen so that the oxygen develops a slight negative charge  and the hydrogen's a slight positive charge. This makes the water  molecule a slightly Polar Molecule.     This slight charge gives water its various properties; the first I  will discuss is its solvent properties.  ==================================================================   Water can act as a solvent. "Things" can dissolve in solvents and  therefore "things" can dissolve in water. Substances that dissolve in  water sre known as hydrophilic substances Water can dissolve polar or  ionic substances, because they contain a charge.   [IMAGE]As can be seen from the diagram (right), Ionic substances such  as [sodium chloride](http://www.123helpme.com/search.asp?text=sodium+chloride), NaCl, are made up of positive and negative ions.  Sodium chloride is held in it's structure by the strong attraction  between it's positive sodium ions and negative chloride ions. Normally  these ionic attractions require a large amount of energy to break but  when put into water the negative oxygen side of the water molecules  cluster around the positive sodium ions Na+ and the positive hydrogen  atoms cluster around the negative chloride ions Cl-. The attraction  between the Na+ and Cl- ions is weakened as the ions are separated. As  the H20 molecules have surrounded the Na+ and Cl- Ions, they prevent  the ions from joining back together and so keeping the substance in  the solution   Water's property as a solvent is biologically important to life as  most biochemical reactions such as respiration occur in solution. A  medium, that is water, is required for the transportation, as reaction  of certain substances. Blood plasma is mostly water. Blood is needed  to transport vital substances around organisms. Water cannot dissolve  hydrophobic substances such as fats and oils.   Water also has many thermal properties. It has a high boiling point,  100oC, which is unusual for a compound of such small molecular mass,  (Mr H2O = 18). Other molecules of similar size such as Carbon dioxide  (Mr CO2 = 44) are gas at room temperature where as water is a liquid.  The water molecules have a weak, partial negative charge at one region  of the molecule (the oxygen atom in water) and a partial positive  charge elsewhere (the hydrogen atoms in [IMAGE]water).   Thus when water molecules are close together, their positive and  negative regions are attracted to the oppositely charged regions of  nearby molecules. The force of attraction, shown on the diagram as a  dotted line, is a hydrogen bond. Each water molecule is hydrogen  bonded to four others. Individual bonds are weak but the sheer number  of them means that the total force keeping the molecules together is  considerable.   As water has millions of hydrogen bonds, it causes it to have a high  heat capacity. This means that water takes substantial heat to raise  the temperature of water significantly but once warm, it cools slowly.  This is essential to life where internal body temperature has to be  maintained at a constant temperature and fluctuations can result in a  breakdown of essential processes. Large bodies of water will remain at  an almost constant temperature with only very gradual changes, which  makes temperature regulations for organisms far more straightforward.  Because of the large number of bonds holding water molecules together,  it takes 2 kJ per gram of water, which is a considerable amount of  energy to separate the bonds and turn the liquid to vapour. Water is  therefore described as having a high latent heat of evaporation.  Animals use this property of water by using excess body heat to  evaporate water from their surfaces, resulting in them transferring a  lot of energy into the environment but only losing a little water.  Sweating and panting are based on this principle.   Water's freezing property is also quite unique. The density of water  when frozen (ice) at 0oC is less than liquid water. Most substances  when turning from liquids to a solid usually become denser, as the  energy in them is reduced, so they are held closer together, but this  is not the case with water. As water cools, its density does increase.  Hydrogen bonds between the water molecules take on a more latticed  formation as ice. Yet ice floats on the surface of water, which means  it's, density must be lower than that of water. Water is at it's most  dense at 4oC which is when its bonds are closest together. When water  freezes the lattice arrangement of its structure move apart slightly  and it floats on the surface. This means that the layer of ice  insulates the water below which stays at 4oC and aquatic life can  continue.   [IMAGE]The last important property of water is that it has a high  surface tension and cohesion. Surface tension can be seen in test  tubes where we see a curved meniscus. This is due to hydrogen bonds  causing a film of water to curve in the glass tube. Surface tension is  important for some insects such as water skaters and mosquito larvae  that live on surface film. They are able to survive because the film  allows them to be held above the water. Mosquito larvae hang upside  down with the air passage held above the water by surface tension. Its  ability to survive depends upon the surface tension. Without it, the  larvae would sink and die.   Cohesion is when things stick together, and are attracted to each  other. Water molecules are attracted to each other by hydrogen bonds.  If one molecule is pulled the neighbouring molecules as a result are  also dragged along. Eg, if you apply pressure in a straw, all the  water is pulled up. This is an important property as it enables water  to be transported upwards, such as in plants. The ability of a plant  to dissolve nutrients in roots and move them along the plant depends  on water's property of cohesion. | | | |