

Describe The Roles of H₂O in Living Organisms

A molecule of water consists of one oxygen and two hydrogen atoms joined by covalent bonds. Water as a liquid is vital to existence and plays extremely important roles in many aspects of both plant and animal lives. These aspects include temperature control, support, chemical reactions, transport and protection.

Without the ability to control our temperature, we as humans would not be able to survive in our natural environment. If our internal body temperature was to rise or fall even a few degrees centigrade our body would not be able to carry out its everyday functions efficiently and this could lead to loss of ability to function at all. Therefore thermoregulation is very important and water plays a part in this. One method of reducing internal body heat is sweating; sweat is mostly made up of water. The structure of the water molecule means that it has very high melting and boiling points for a molecule of its nature because of the strong attraction between them. This means that a large amount of energy is needed before the molecules begin to move about and therefore change state. It is because of this high latent heat of vaporisation that water is an effective coolant; energy from the body is used to evaporate sweat that forms on the surface of the skin from the sweat glands and this results in a reduction in body temperature as energy is used up. Also, cells are made up of 80% water and the specific heat capacity of water means that bulky organisms have fairly stable temperatures.

Support is vital to both plants and animals and often water plays a significant part in this. In plants water is responsible for making the cells of the plant turgid by osmosis and therefore providing support, particularly in the leaves of the plant. Animals with hydrostatic skeletons, for example the earthworm, rely on water for support. The pressure of the fluid (water) beneath the ring of muscles means that the animal cannot be compressed and therefore keeps its shape. A hydrostatic skeleton also allows for very free movement. Another way in which water provides support can be seen in the human eye; the aqueous and vitreous humours, made up mostly of water, help the eye to maintain its shape.

Chemical reactions are occurring constantly, in fact without them both animal and plant life would cease to exist. Water often has an important role in many chemical reactions; plants react water with carbon dioxide and light energy to produce glucose and oxygen in the process of photosynthesis. A hydrolysis reaction in the human gut allows disaccharides to be broken down into monosaccharides, which involves the addition of a water molecule. Water can also play a part in chemical reactions by form of a solvent in which they take place. The polarity of a water molecule as a result of the arrangement of the hydrogen atoms makes water a good solvent. Water also aids gaseous exchange and for this reason the walls of the lungs are moist.

Transport systems are needed in both plants and animals to ensure that nutrients reach the areas in which they are needed; water is vital to these transport systems. Humans are reliant upon the blood to transport crucial substances around the body in order that nutrients reach the organs and waste products are carried away from the organs. Blood is composed mostly of water (it is 55% plasma and 90% of that plasma is water) and, due to the great polarity of the water molecule, it is a solvent meaning that substances may be dissolved into it. This means that as the blood flows around the body through arteries and veins, the substances dissolved into the blood can be carried with it. Similarly in plants water is used to transport substances through the xylem and phloem of the roots and stem.

Protection is very important to both plant and animal life and without it neither would survive. In human reproduction the foetus is protected in the womb by the amniotic fluid, this makes sure that it does not become damaged whilst it is being carried inside the mother. Water in skin cells can protect the skin from harmful rays produced by the sun as it filters out ultra-violet rays. Water is a very useful lubricant due to its viscosity and is used for protection in many areas of the human body, for example it is found in synovial fluid at joints between bones and in pleural fluid surrounding the lungs. Water is also used in plants to control the opening and closing of guard cells, protecting the plant from losing too much water by transpiration which would result in its death.

Many living organisms also use water as a habitat. Fish for example are able to live in water and are adapted for this purpose; they respire using the oxygen that is dissolved into the water as the result of it being a good solvent.

Conclusively water is vital to many aspects of both human and plant life. Its excellent range of chemical and physical properties allows it to be used in a wide variety of ways including temperature control due to its high latent heat of fusion, support as a result of its incompressible cohesive forces between molecules, chemical reactions due to its polarity, transport due to its ability to act as a solvent and protection as a result of its viscosity. Without water all forms of life would cease to exist.