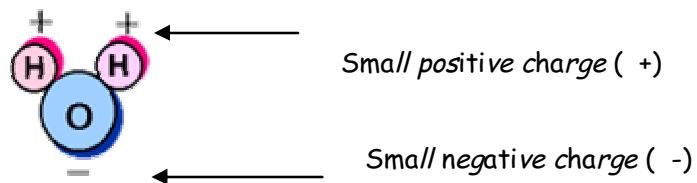


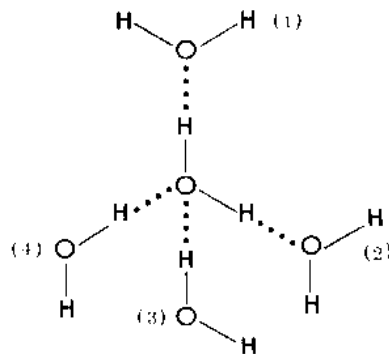
Describe the properties of water and its significance to living processes.

Water typically forms 70 to 95% of the mass of a eukaryotic cell. Although it is a simple molecule, water has the ideal properties to support life.

A water molecule consists of one oxygen and two hydrogen atoms. Each hydrogen atom shares electrons with the oxygen to form covalent bonds, but the electrons are not shared equally. Oxygen has greater electronegativity so has a greater pull on the electron causing the electrons to move away slightly from the hydrogen atoms. Therefore the water molecule has slightly positive and slightly negative regions, which makes it a dipolar molecule



The small charges on water molecules cause attraction between them. These forces of attraction are called hydrogen bonding, which gives water its unique properties. The hydrogen bonding makes water molecules difficult to separate. A greater amount of energy is needed to break the hydrogen bonds to convert water into a gas than is needed for similar compounds such as hydrogen sulphide (H₂S).



The fact that water is a dipolar molecule means that it is an excellent solvent. It is often called the universal solvent since so many things can dissolve in it. The water molecules will be attracted to the substance molecules, will collect around it and will separate it. Polar and ionic substances have an electrostatic charge so will dissolve in water (they are hydrophilic). Non-polar substances, such as fats, have no molecular charge so

will not dissolve (they are hydrophobic) which makes them ideal structural molecules in membranes and protein structure. This ability of water is vital in both plants and animals; it is the transport medium in the blood, in the lymphatic, excretory and digestive systems of animals, and the vascular tissues of plants.

Water is unusual because the solid form, ice, is less dense than its liquid form. Below 4°C the density of water starts to decrease. This is beneficial for aquatic life since ice will form at the water surface, insulating the water below and allowing life to survive. Water is a liquid at room temperature and so provides a liquid environment inside cells and aquatic environments for organisms to live in.

Water also forms a skin at its surface because it has a high surface tension called cohesion. This is beneficial for certain aquatic animals, such as pond skaters, which can move around on the surface of water. It also aids capillarity, which is the way in which water moves through xylem in plants. Water has a low viscosity so water molecules can flow and slide easily over each other and through narrow vessels in both animals and plants. Watery solutions can act as lubricants such as in the oesophagus where mucus allows the free movement of food.

The specific heat capacity of water is very high, therefore a large amount of heat is required to increase the temperature of water slightly. Owing to the high latent heat of vapourisation, large amounts of body heat are required to evaporate a small quantity of water. Organisms like humans cool down effectively but lose on a small quantity of water in doing so. This helps animals in maintaining their internal temperatures. However, the activity of water is affected with temperature changes; a low temperature makes process such as diffusion and transpiration take place more slowly, whereas a high temperature increases the rate of reaction.

Water is also colourless and transparent which means light can be transmitted even to aquatic organisms deep underwater for photosynthesis. The density of water is much more than air, which means that it can support organisms as large as whales. However, it is very difficult to compress which can be beneficial to certain organisms. Water is an important structural agent, acting as a 'skeleton' in worms and turgid plants. It provides strength and support as well as helping to form the shape.

Including photosynthesis, water also takes part in many chemical reactions. It is a raw material for photosynthesis and it also takes part in

the digestion of substances such as proteins and lipids by hydrolysis reactions.

Most organic substances in cells appear in their hydrated form. If the water was to be removed, their chemical and physical properties would be affected.

Water is essential to life for many reasons, some of which have been discussed. Sometimes, however, there is an advantage to living tissue to become dehydrated. Dehydration in reproductive structures such as pollen and seeds ensures that they can survive periods of water scarcity.

Overall water plays a very significant role in life processes in most organisms.