

Discuss how the properties of properties of water affect living organisms and why water might be considered essential to life on earth.

Water is the most important biochemical. Life would not exist without it and two thirds of the earth's surface is covered by water.

Water is unique in that it is the only natural substance that is found in all three states of matter: liquid, solid, and gas. It freezes at 0° Celsius and boils at 100° Celsius. Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.

Water has a high specific heat index, which means that it can absorb a lot of heat before it begins to get hot. The high specific heat index of water also helps regulate the rate at which air changes temperature, which is why the temperature change between seasons is gradual rather than sudden, especially near the oceans. Water has a very high surface tension. In other words, water is elastic, and tends to clump together in drops rather than spread out in a thin film. Surface tension is responsible for capillary action, which allows water (and its dissolved substances) to move through the roots of plants and through the tiny blood vessels in our bodies. Water is important because it is a major component of cells, typically forming between 70 and 95% of their mass and it provides an environment for aquatic organisms. It's molecules have an imbalance of charge (dipolar) and this generates hydrogen bonding between them.

Water is an excellent solvent for ions and polar molecules (molecules with an uneven charge) because the water molecules are attracted to them, collect around them and separate them, so that they dissolve. The chemicals are then free to move around and react with other chemicals and most processes taking place in living organisms, happen like this in solution. Non-polar molecules like lipids do not dissolve in water and tend to be pushed together by it. This is important in hydrophobic interactions in protein structure and in membrane structure. Due to its ability to dissolve so many molecules, water is an important transport medium in animals and plants.

Water molecules are attracted to one another by hydrogen bonds and this restricts the movement of the molecules. This means that a relatively large amount of energy is required to increase the temperature of water (it has a high specific heat capacity) and that large bodies of water are slow to change temperature e.g. lakes and oceans. Due to their high water content, the bodies of organisms are also slow to change temperature and this makes maintaining a stable body temperature easier.

Water also requires a relatively high amount of energy to become a gas and this can be used as an effective means of cooling the body by sweating and panting. Conversely, a relatively large amount of energy must be transferred away from water to make it freeze, which is important for organisms with a high body water content and for those living in water.

Water is unusual because its solid form is less dense than its liquid form. Below 4°C the density of water starts to decrease and so ice floats on water and insulates the water below it. This reduces the chances of large bodies of water completely freezing and increases the chances of life in water surviving. These changes in density of water with temperature are important in the oceans because they set up currents, which circulate nutrients.

Water molecules tend to stick together and this is shown in the way that water moves in long unbroken columns through the xylem tissue of plants and is an important property in cells. The cohesion of water molecules generates a surface tension at the surface of water enabling small organisms e.g. pond skaters to exploit it as a habitat.