

Water

Water is one of the most valuable resources essential for a human's core long-term survival. Water has numerous qualities that make it an essential resource for life on Earth as well as many chemical and physical processes. We can't imagine our life or our daily work without it.

Water as a Solvent

Water is a colourless, odourless and tasteless liquid that is essential for the life of all living things on the planet. Because water makes up 71% of the Earth's surface, the Earth is also known as the "blue planet." H_2O is the chemical formula for water, and covalent bonds exist between the hydrogen and oxygen atoms in the water molecule. A single atom of oxygen forms a connection with two hydrogen atoms.

Unique Properties of Water

i. It is Polar– Water molecules have partial positive charges on hydrogen and a partial negative charge on oxygen, which make bond polar and due to a bent structure overall water molecule is polar.

ii. Water has high heat capacity- Water serves to regulate the temperature in the environment since it takes a lot of energy to raise the temperature of a specific amount of water by one degree.

iii. It has high heat of vapourization.

iv. It has cohesive and adhesive properties- Because of its ability to establish hydrogen bonds with one another, water molecules exhibit high cohesive forces. Surface tension, or the tendency of a liquid's surface to resist rupture while under tension or stress, is caused by cohesive forces. Water also possesses adhesive characteristics, allowing it to adhere to objects other than itself.

v. It is less dense as a solid than as a liquid- When water freezes, the molecules form a crystalline structure that separates them more than liquid water does. Ice has a lower density than liquid water, which explains why it floats.

vi. It is an excellent solvent Because of its polarity and ability to form hydrogen bonds, water makes an excellent solvent, meaning that it can dissolve many different kinds of molecules. Most of the chemical reactions important to life take place in a watery environment inside of cells. Water's capacity to dissolve a wide variety of molecules is key in allowing these chemical reactions to occur.

Solvent

A solvent is a substance in which a solute dissolves and creates a solution. Solvents are usually liquids, although they can also be solids, gases, or supercritical fluids.

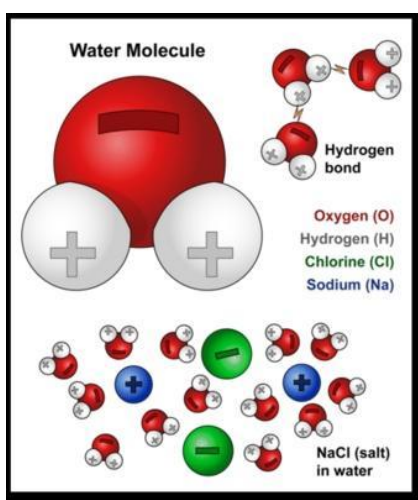
Solvent Properties of Water

Water dissolves almost everything; therefore, it is called the “**biological solvent**”.

However, the term “biological solvent” is inaccurate. Only polar molecules and ions, such as sugars and salts, can be dissolved by water. Nonpolar molecules, such as oils, do not have partial positive or negative charges. Hence they do not attract water molecules. This is why, when nonpolar compounds like oil are added to water, they separate.

Water can form electrostatic interactions (charge-based attractions) with other polar molecules and ions due to its polarity. Positive charges attract negative charges (just like the + and – ends of magnets), and polar molecules and ions interact with the partially positive and partially negative ends of water.

When there are many water molecules relative to solute molecules, as in an aqueous solution, these interactions lead to the formation of a three-dimensional sphere of water molecules, or hydration shell, around the solute. Hydration shells allow particles to be dispersed (spread out) evenly in water.



This diagram shows the positive and negative parts of a water molecule. It also depicts how a charge, such as on an ion (Na or Cl, for example) can interact with a water molecule.

Advantages of Water as a Solvent

- i. Many aquatic species rely on oxygen in the water to survive. The oxygen content of natural water in rivers and lakes is high. More gases dissolve into the water when the water is cooler or when it rushes through waterfalls. This explains why river fish cannot survive in a home aquarium because there is insufficient oxygen.
- ii. Carbon dioxide is water-soluble. The gas utilized in fizzy drinks is an example of this.

- iii. To be taken as medicine, medicinal ingredients (solids or liquids) are dissolved in water.
- iv. When we wash our clothes, the dirt on them dissolves in the water.
- v. Every day, we wash with water.
- vi. Water dissolves sugar, salt, and other flavourings. This can be used to flavour dishes.
- vii. Dyes are water-soluble.

Disadvantages of Water as a Solvent

- i. Poisons are soluble in water.
- ii. If there is too much water on the Earth, the salts will dissolve and sink deeper. The soil then contains an insufficient amount of minerals.
- iii. Some colours are water-soluble. The colours fade or the dissolved dyes stain other clothes when they are laundered.

Biological Role of Water

Water's action as a solvent lets cells move and use chemicals like oxygen and nutrients on a biological level. Water-based solutions, such as blood aid in the transportation of molecules to their proper sites. As a result, water's action as a solvent aids in the transfer of molecules such as oxygen for respiration and significantly impacts medications' ability to reach their targets in the body.

Water fills cells visually to aid in the retention of shape and structure. Similar to putting air in a balloon, the water within many cells (including those that make up the human body) exerts pressure that opposes external pressures.

Even plants that can keep their cell structure without water, however, need water to survive. At the molecular level, water permits everything inside cells to have the proper structure. One of water's most significant functions is to maintain the structures of cells, which is essential for metabolic activities.