

Plant water relationship

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Water

- **It's an inorganic transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms**

Importance of water

- Water plays a crucial role in the life of the plant. For every gram of organic matter made by the plant, approximately 500 g of water is absorbed by the roots, transported through the plant body and lost to the atmosphere. Even slight imbalances in this flow of water can cause water deficits and severe malfunctioning of many cellular processes.
- Thus, every plant must delicately balance its uptake and loss of water. This balancing is a serious challenge for land plants. To carry on photosynthesis, they need to draw carbon dioxide from the atmosphere, but doing so exposes them to water loss and the threat of dehydration.

- Water makes up most of the mass of plant cells, as we can readily appreciate if we look at microscopic sections of mature plant cells: Each cell contains a large water-filled vacuole. In such cells the cytoplasm makes up only 5 to 10% of the cell volume; the remainder is vacuole. Water typically constitutes 80 to 95% of the mass of growing plant tissues.
- Water is the most abundant and arguably the best solvent known.
- Water has special properties that enable it to act as a solvent and to be readily transported through the body of the plant. These properties derive primarily from the polar structure of the water molecule.

- Because the oxygen atom is more **electronegative than hydrogen**, it tends to attract the electrons of the covalent bond. This attraction results in a partial negative charge at the oxygen end of the molecule and a partial positive charge at each hydrogen.
- These partial charges are equal, so the water molecule carries no *net charge*.
- This separation of partial charges, together with the shape of the water molecule, makes water a *polar molecule*,

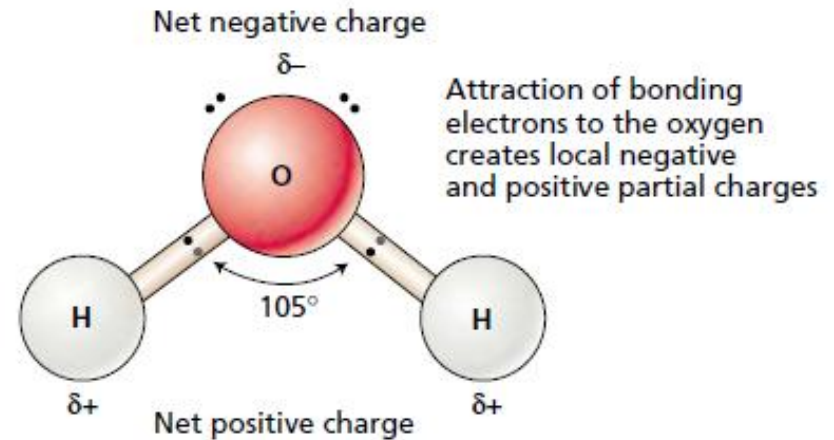


Diagram of the water molecule. The two intramolecular hydrogen–oxygen bonds form an angle of 105°. The opposite partial charges (δ⁻ and δ⁺) on the water molecule lead to the formation of intermolecular hydrogen bonds with other water molecules. Oxygen has six electrons in the outer orbitals; each hydrogen has one.

Permeability

- The entry of substances into living cells and their exit from the cells depends on the property of cell membrane known as permeability.
- A membrane may be:

Permeable

Semi-permeable

Impermeable

Diffusion

- The tendency on the part of molecules, atoms, ions, etc., of gases, liquids and solids to get evenly distributed throughout the available space on account of their random kinetic motion is called diffusion. Random kinetic motion of particles is due to kinetic energy present in them.
- Diffusion is also defined as the movement of the particles of different substances from the region of their higher concentration, free energy or diffusion pressure to region of their low concentration, free energy or diffusion pressure.

- Diffusion is dependent upon the number of particles per unit volume, density of medium, distance through which diffusion is to occur, temperature and pressure.
- Diffusion will be more rapid when the difference in concentration is larger. Gases diffuse more rapidly than liquids. Solids are the slowest to diffuse. When the particles of diffusing substance get evenly distributed, a state of equilibrium is reached. It stops further movement.
- Diffusion of particles of one substance is independent of the diffusion of particles of another substance, provided the two do not react. It is known as independent diffusion. The diffusion pressure of the individual substance is then known as partial pressure.

Have a look at this video

https://www.youtube.com/watch?v=c_IYK8sy0QA

Osmosis

- The phenomenon, whereby, when a solution is separated from a weaker one by a semipermeable membrane, the weaker solution diffuses through the membrane into the stronger solution in an effort to equalise the strength of the two solutions.

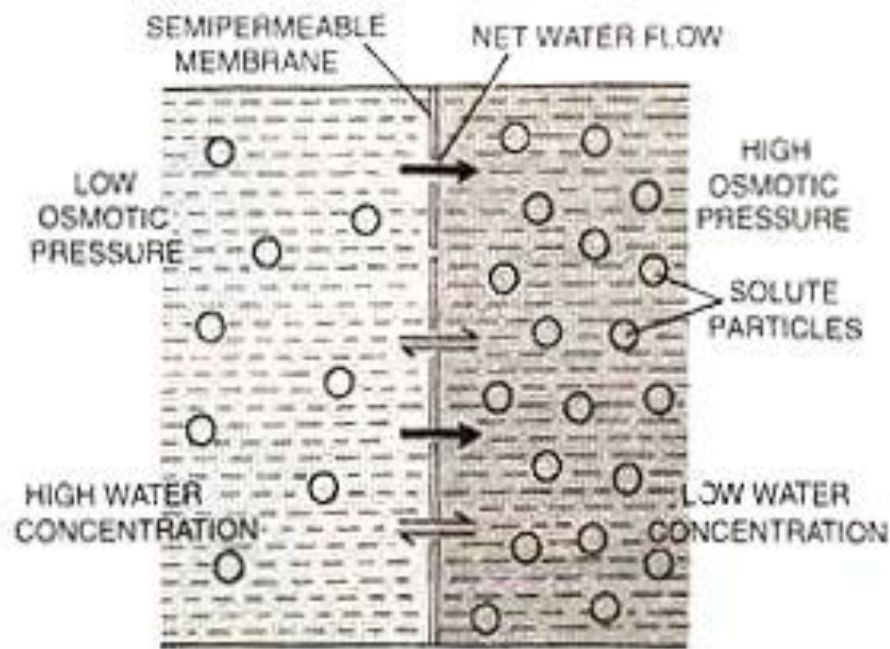


Fig. 11.6. Net movement of water from its higher chemical potential (dilute solution) to lower chemical potential (concentrated solution) when the two are separated by a semipermeable membrane.

Have a look at this

<https://youtu.be/MCvbfqz7ASs>

Types of osmosis

- Endosmosis : The osmotic entry of water into a cell, organ or system
- Exosmosis : The osmotic withdrawal of water from a cell, organ or system.

Cohesion, adhesion and tension

- **Cohesion:** the mutual attraction between molecules
- **Adhesion:** attraction between two or more than two different kinds of molecules
- The energy required to increase the surface area is known as **surface tension**.
- Cohesion, adhesion and surface tension give rise to a phenomenon known as **capillarity, the movement** of water along a capillary tube.

Water potential and its components

- The difference between the free energy of water molecules in pure water and energy of water in any other system (e.g. water in solution or in a plant cell) is termed as water potential which is represented by a greek letter psi Ψ and is measured in bars.

Solute potential (Ψ_s)

- It is defined as the amount by which the water potential is reduced as the result of the presence of the solute, Ψ_s are always in negative values and it is expressed in bars with a negative sign.

Pressure potential (Ψ_p)

- Plant cell wall is elastic and it exerts a pressure on the cellular contents. As a result the inward wall pressure, hydrostatic pressure is developed in the vacuole it is termed as turgor pressure. The pressure potential is usually positive and operates in plant cells as wall pressure and turgor pressure.

Have a look at this

https://youtu.be/zF_CAR-qRyl