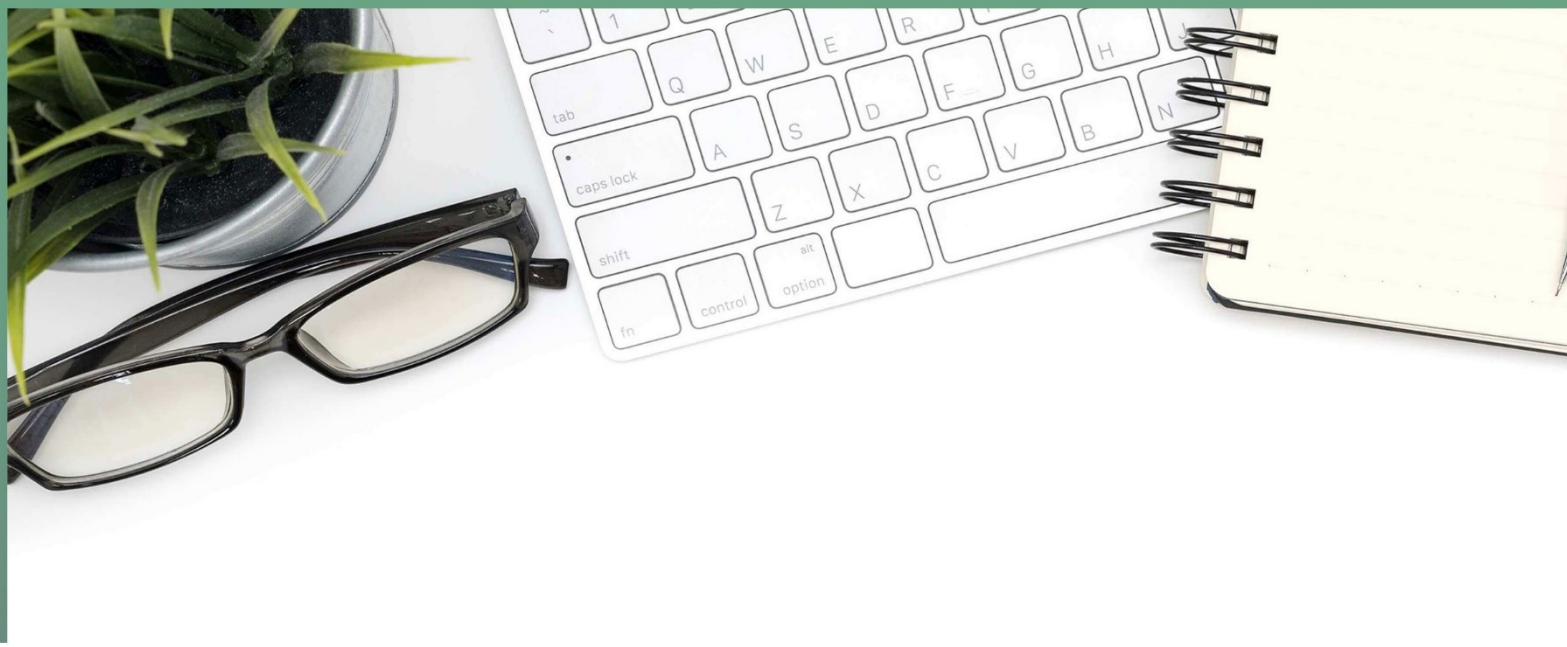

# NEET Biology

## Short Notes

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These are some important concepts and points that you need to remember before solving questions on chapter Transportation in Plants.

**1. What material is transported and what different types of transport are there?**

Plants transport water, mineral nutrients, organic nutrients and different plant growth regulators.

Over **short distances,** substances move by **diffusion** and also helped by **cytoplasmic streaming** supplemented by active transport.

On the other hand, **long-distance** transport occurs through the vascular system (xylem and phloem) and is called **translocation.**

For water, translocation is essentially **unidirectional** as water is obtained by plants from the roots only and then transported to the rest of the shoot.

Organic and mineral nutrients are transported bidirectionally as the organic matter that is synthesized in leaves will be required by roots and other parts. In times of drought or scarcity, the stored food in roots or other parts may be transported to the leaves.

**2. The concept of water potential**

Water potential is also defined as the chemical potential of water. The **greater the concentrations of water** in a system, the **greater is its kinetic energy or 'water potential'.**

Water moves from the point where water potential is greater, to the other point where water potential is less. It can also be said that the difference in water potential between two points is a measure of the amount of the work(energy) needed to move water from one point to another.

**Note:** Its unit is **Pascal** and is represented by **Psi(Ψ)**.

Conventionally, the water potential of pure water at standard temperatures, which is not under any pressure, is taken to be 0. If some solute is dissolved in pure water, the solution has fewer free water and the concentration of water decreases, reducing its water potential decreases. Hence, all solutions have a lower potential than pure water; the magnitude this lowering due to dissolution is called **solute potential (Ψs).**

Remember this simple yet very important relation as many questions can be constructed using this concept.

***Water potential= - (solute potential)***

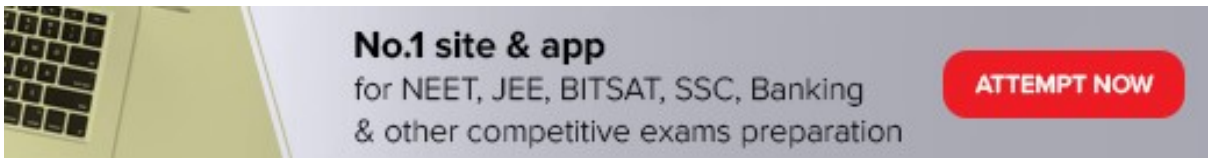
Pressure can build up in a plant system when water enters a plant cell due to diffusion causing a pressure built up against the cell wall, it makes the cell turgid, this **increases the pressure potential or hydrostatic pressure of a solution.** It is usually **positive**.

The relationship among them is

**Water potential (Ψ) = pressure potential (Ψp) + solute potential (Ψs)**

**3. Diffusion Pressure Deficit (DPD) or Suction Pressure(SP)**

Each liquid has a specific diffusion pressure. **Pure water has the maximum diffusion pressure.** The solution prepared by dissolving solute (such as sugar or salt) in pure water has lesser diffusion pressure as compared to pure solvent or water (though the solution has higher osmotic pressure). In this way, there is always a difference between the diffusion pressure of solvent and its solution. Therefore, diffusion pressure deficit may be defined as **the difference between diffusion pressure of a solution and a pure solvent, when both are subjected to same atmospheric pressure.**



To remove this deficit, the solution would absorb more solvent molecules, means water moves from low DPD to high DPD. In this way, the diffusion pressure deficit is the water absorption capacity of a solution. Therefore,

**DPD = OP (Osmotic Pressure) – TP (Turgor pressure)**

Take note of this **Inhibition pressure or Matric Potential.**
This order is very important

***Phycocolloids> Pectin > Protein > Starch > Cellulose.***

It is a **common mistake to think that cellulose has one of the highest imbibition pressures** as we are used to seeing wood, which is mostly made from cellulose, swell up during the monsoons. But among these things, **cellulose has the least affinity.**

**4. How does the water travel from the root hairs to the top of the plant?**
Water is absorbed from the ground by the root hairs either by active or passive transport. Then the movement of the water can be divided into two parts- from the root hairs to the vascular tissue (xylem and phloem) and through the vascular tissue to the top of the tree. Once the water is absorbed by the root hairs, it can follow two distinct pathways to go deeper into root layers: -

- **Apoplast Pathway –** In this pathway, water passes from the root hairs to the xylem through the intervening cell **without crossing any membrane of cytoplasm.** This pathway provides the least resistance to the movement of water. However, it is interrupted by the presence of impermeable **Casparian strips** in the walls of endodermal cells because they are made up of a mixture of wax like suberin.

The movement of water through this pathway is due to
**Transpiration Pull:** When transpiration occurs, water evaporates from intercellular spaces into the atmosphere, tension or negative pressure is generated in the xylem which is transmitted down to the root.
**Adhesion- cohesion forces:** The forces of cohesion (the attraction between 2 water molecules) and adhesion (attraction between water molecules and the walls of the xylem vessels), together with help to form a thin unbroken column of water which leads to the mass flow of water in such pathways.

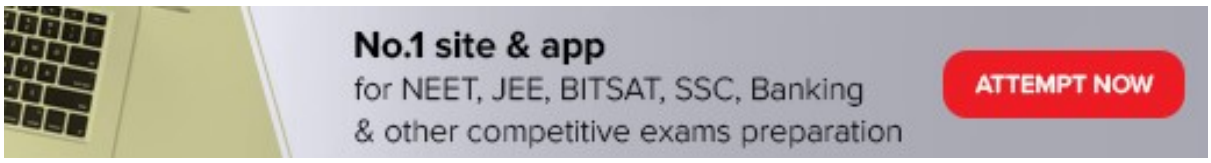
- **Symplast Pathways:** It is the pathway formed by the system of interconnected protoplasts of different cells. Neighbouring cells are connected through cytoplasmic strands that extend through plasmodesmata.

Symplastic movement can be aided by cytoplasmic streaming.

**5. Understand the differences between the different theories that govern the movement of water upward through the plant.**
You will notice that many of these concepts will just seem as an extension of another concept and both are actually based on the same gross concept. But if you do not remember the finer distinctions between them, you will get confused when two similar choices will be given in an MCQ.

- **Root Pressure-** As various mineral ions from the soil are actively transported into the vascular tissue of the roots, water follows and increases the pressure in the xylem. This positive pressure is called **root pressure.**

This pressure alone is mostly responsible for transporting water to the top of small herbaceous plants but **note** that it is **not enough** to push it up the top of larger trees.



Also, that these effects are most prominent during the early morning and at night **when the rate of water absorption is more than the rate of transpiration.**

The phenomenon of **Guttation** is a result of this.

- **Transpiration Pull –** Despite the absence of a heart or a circulatory system in plants, the flow of water upward through the xylem in plants can achieve fairly high rates up to **15 meters per hour.** The model which explains the translocation of water by the process of transpiration is known as **Cohesion-tension-transpiration pull model (Dixon and Jolly)** of water transport. Less than 1% of water reaching the leaves is used in photosynthesis and plant growth. Most of it is lost through **stomata** in the leaves. The water loss is known as **transpiration**. Thus, the water is transient in the plant.
- **Mass Flow Hypothesis/Pressure Flow Hypothesis (by E. Munch):** From this, one of the important inferences that we can have is that **water is transported via *both xylem and phloem.*** Don't make the common mistake that water flows only through the xylem. But **organic matter** flows **only through the phloem.**

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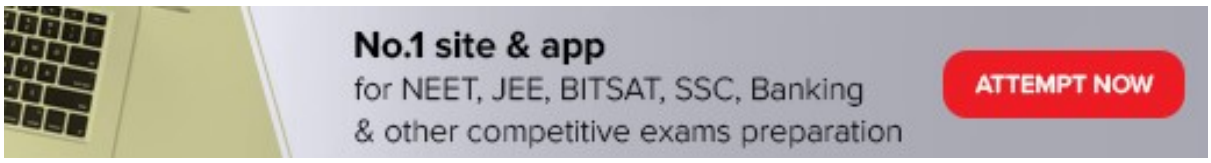

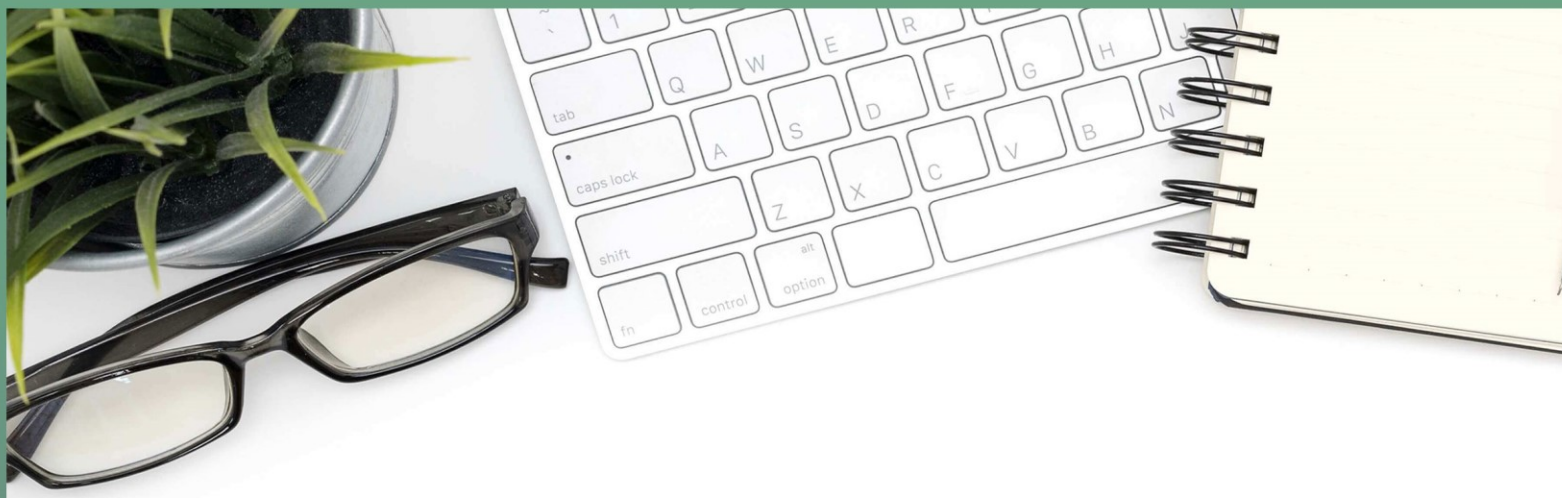

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