

# NEET Biology

## Short Notes

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In this PDF, we are providing short notes on the Topic: Transport in Plants which is an important chapter for NEET 2019. This is an important section to pay attention from the Unit Plant Physiology as every year 2-3 questions are asked from this chapter. In this article, we tried to cover important and brief points for the revision purpose.

## Transport in plants

Similar to every other living organisms, plants also have an evolved transport system, which ensures for the conduction of water and nutrients in the plants. Plants vary in height from shrubs and herbs to tall trees. The presence of the transport system further ensures the long-distance transport of the plant. This process of the transport of water and minerals in over a long distance is carried out through the vascular system and is referred to as **Translocation**.

### • Means of transport:

Following mentioned are the different processes, which help in the transportation of water and nutrients in the plants:

1. **Diffusion:** It is defined as the random movement of the substances from the region of higher concentration to the region of lower concentration of the solute molecules.
  - The process is not dependent on the expenditure of the energy, as the movement of the substances occurs down the concentration gradient.
  - It depends on the size of the molecules, a concentration gradient of the molecules, and the surface area available for transport.
2. **Facilitated diffusion:** The movement of the molecules, which are hydrophilic in nature is assisted by the protein molecules, which are present on the membrane of the cell, and the process is referred to as facilitated diffusion.
  - The process also occurs down the concentration gradient, and hence, does not require the energy expenditure.
  - The process of facilitated diffusion is limited by the presence of a specific number of membrane proteins and their saturation.
  - The process is highly specific in nature and is also sensitive to various inhibitor molecules.
  - One common example is **Porins**, which is responsible for creating a large pore in the cell's outer membrane. Aquaporin is also an example of a membrane protein responsible for the transport of water molecules.
  - **Symport** is defined as the process of movement of the substances in the same direction as that of the carrier molecule.
  - **Antiport** regulates the movement of the substances in the reverse direction.
  - However, if the movement of the molecule takes place independent of the other molecule, it is referred to as **Uniport**.
3. **Active transport:** The process of the movement of substances from a region of lower concentration to the region of higher concentration, that is, against the concentration gradient, is referred to as **Active Transport**.
  - This process, in contrast to the above two processes of passive transport, requires the expenditure of energy.
  - It is also referred to as the **Uphill Transport**. The following table gives an insight into the different transport processes:



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Property of the transport process	Diffusion	Facilitated transport	Active transport
Membrane protein	NO	YES	YES
Selective in nature	NO	YES	YES
Transport saturation	NO	YES	YES
Uphill movement	NO	NO	YES
ATP requirement	NO	NO	YES

### Plant-Water relation

Plants require water for different physiological activities, for example, providing fluidity to cells, acting as the medium for the occurrence of several biochemical reactions, and several others. The terrestrial plants require a huge amount of water, to suffice for the phenomenon of transpiration. It is defined as the process, wherein the plants lose water from the leaves by the process of evaporation, in order to keep its body parts cool (lower temperature).

1. **Water potential:** The term water potential is described for a system, say a cell, which, in turn, reflect its kinetic energy. The kinetic energy of pure water is maximum.
  - The random movement of the molecules of the water, which, in turn, results in the net movement of the water can also be defined in terms of water potential, that is, from the region of higher water potential to the region of lower water potential.
  - It is often represented by the symbol ' $\Psi$ ' and SI unit of measurement is **Pascal**.
  - Furthermore, at the standard temperature, the water potential of pure water is considered to be **Zero**.

In case a certain amount of solute is dissolved in the pure water, its potential decreases. This magnitude representing the decrease in the water potential of the pure water, as a result of solute dissolution, is referred to as **Solute potential**.

- It is given as ' $\Psi_s$ '. Furthermore, the pressure, which is build up in a cell due to the movement of the water into the cell, in turn, making it rigid, is referred to as **Pressure Potential** and is denoted by ' $\Psi_p$ '. The relationship between the three terms is given as follows:

$$\Psi_w = \Psi_s + \Psi_p$$

2. **Osmosis:** It is the process similar to that of diffusion, except that the movement of the substances in diffusion occurs across a semipermeable membrane.
  - i. The process further, is dependent on the concentration and the pressure gradient. Also, it must be noted that the value of osmotic potential is equal to the value of osmotic pressure.
  - ii. The semipermeable membrane used in the process is selectively permeable to the solute molecules.



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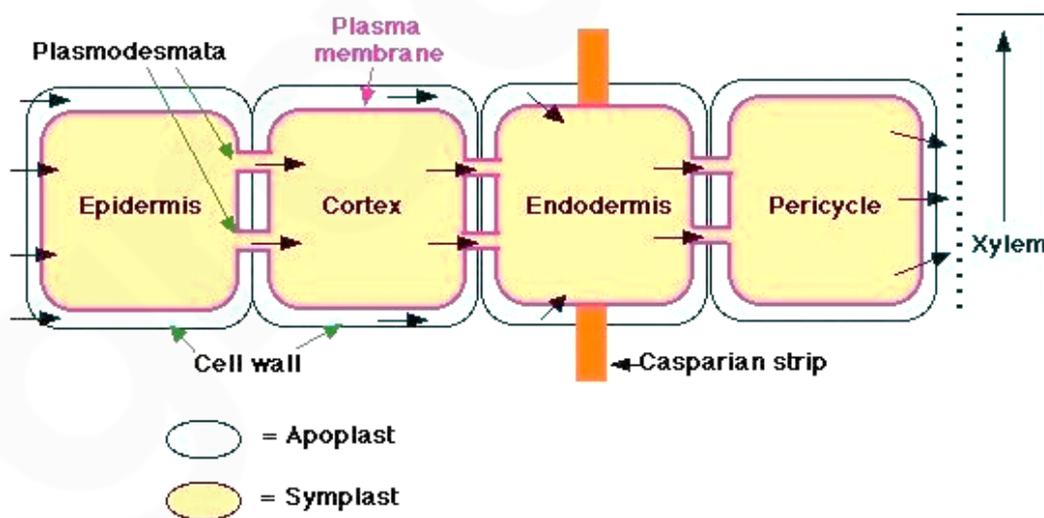
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3. **Plasmolysis:** It refers to the shrinkage of the cell structure, as a result of the movement of water out of the cell. This usually happens when a cell is placed in a **Hypertonic** medium.
  - The term turgid is opposite of plasmolysis and flaccid refers to the condition when the amount of water in the cell and the external environment is equal.
4. **Imbibition:** It describes a condition of diffusion, wherein the water molecules are absorbed by a certain solid substance, such as colloid. Further, as a result of absorption of the water molecule, the substance increases in its volume. One common example is the absorption of water by seeds.

### Long Distance Transport of Water

The movement of the food and water in the plants is generally categorized as mass flow movement, wherein the substances are transported from one region to another region in masses. The hydrostatic pressure, both positive and negative aids in the process of mass flow.

- **Absorption of water in the plants:** The water molecules in the plants is absorbed from the soil into the roots by the process of diffusion.
  - The diffused water is further, transported into the deep roots via **Symplast or Apoplast**.
  - The major difference between the symplast and apoplast is that in symplast pathway, the movement of the water molecules occurs via plasmodesmata, while in apoplast pathway, the movement of the water occurs through the cell wall.
  - However, during the transport through the apoplast, the water is not able to permeate the **Casparian strip** and thus, enters the cytoplasm and moves further, through the plasmodesmata.
  - The following diagram gives a general overview of the transport of water in the plant root system.



**Figure:** The movement of water across from the root hair cell to the xylem tissue.

- **Upwards movement of water in the plants:** The upward movement of water in the plants is regulated mainly by two processes, namely, root pressure and transpiration pull.



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- The movement of the ions from the soil into the root creates a positive pressure gradient for the movement of water into the root cell, which is referred to as **Root Pressure**.
- A common example to illustrate this phenomenon is **Guttation**. The process of the collection of the water droplets on the plant leaves, during the night, is referred to as **Guttation**.
- Further, the loss of water from the plant leaves during the day, as a result of evaporation, in turn, helps in the establishment of a gradient for the upward movement of water. This movement is aided by the cohesion-tension transpiration pull.

### **Transpiration:**

Transpiration is the loss of water from the leaves of plants as a result of evaporation. The loss is regulated by the guard cell, which, in turn, regulates the opening and closing of the stomata. Cohesion, adhesion, and the process of surface tension drive the transpiration process of the xylem sap.

- These mentioned properties of the water molecules help it to rise in the thin plant tissues and resist the pulling force (gravitation pull). The process of transpiration is important due to the following reasons:
  - It helps in the creation of transpiration pull.
  - It ensures the supply of water for photosynthesis.
  - It helps in cooling the surface of the plants.
  - It also helps in maintaining the structure and shape of the cells of the plants.

### **Uptake and Mineral Nutrient Transportation**

It is to be noted that the transport of the nutrient or the food molecules to the plants from the soil is not as simple as that of the movement of water molecules. This is because the nutrients present in the soil are to be converted into their ionic forms and also the concentration of ions in the soil is less than that of the present in the plant roots. Thus, the nutrients from the soil are absorbed by the process of active absorption.

- Once the mineral has reached xylem, either through an active or passive process, the further movement of the nutrient molecules occurs with the help of the transpiration stream.
- During the transport of the nutrient molecules, the transport protein present in the endodermal cells acts as the control point to adjust the type and quantity of the solute molecules that are to be transported.
- Further, in order to mediate the flow of ions, the growing regions of the plants act as the sink for the molecules. Also, it must be noted that during the transport of the molecules, no exchange between the phloem and xylem occurs.
- **Phloem transport:** The phloem sap mainly constitutes for sucrose and water, however, the translocation of other hormones and certain amino acids occur via the phloem. Further, in contrast to xylem, which is **unidirectional**, that is from roots to the shoot region, phloem is **bidirectional** in nature.

**Mass flow hypothesis:** Glucose molecules are synthesized at the source (leaves) and converted into sucrose prior to its translocation. It is then moved to the companion cells and further, to the sieve tube cells (living phloem cells) by the process of active transport.

- This process is referred to as loading, which creates a hypertonic environment in the phloem.



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- The build-up of the osmotic pressure in the phloem causes the movement of the phloem sap towards the sink. It must be noted that at the sink the osmotic pressure is maintained low. The movement of the phloem sap out of the phloem is mediated by an active transport process.
- The increase in the hydrostatic pressure in the phloem (sieve tube cells) results at the beginning of the pressure flow, which results in the movement of the sap through the phloem.
- The transport of the sucrose, nutrients, and water was illustrated by the girdling experiment.

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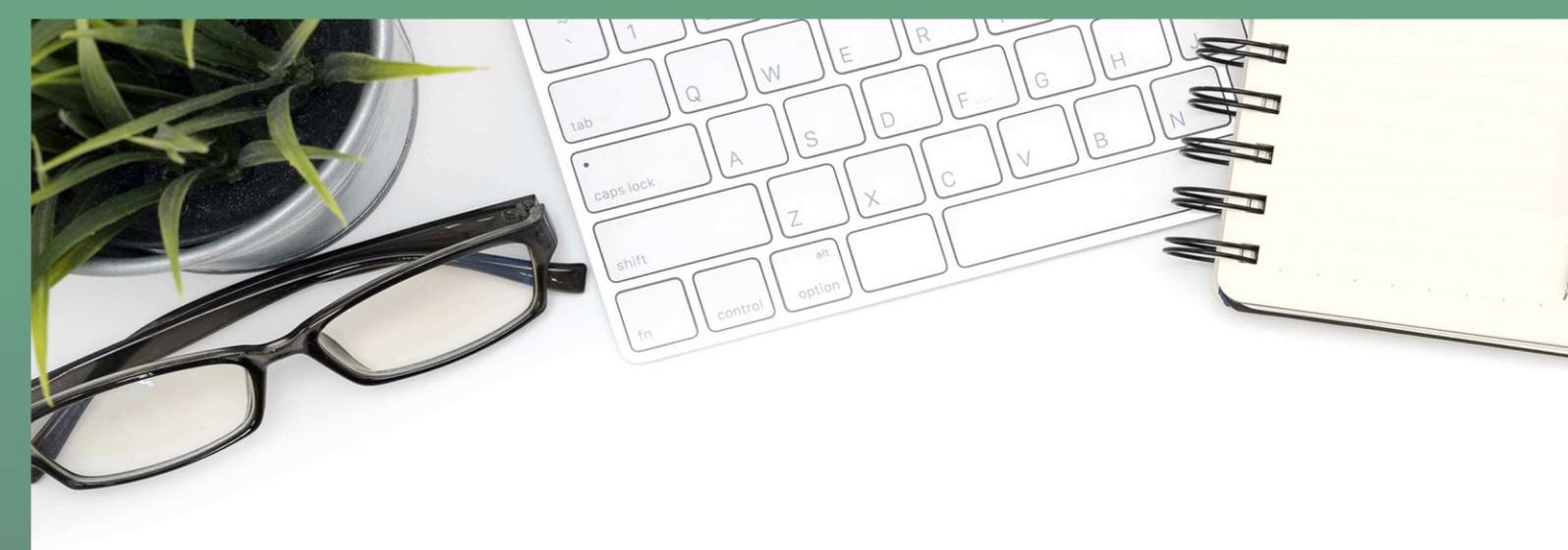
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