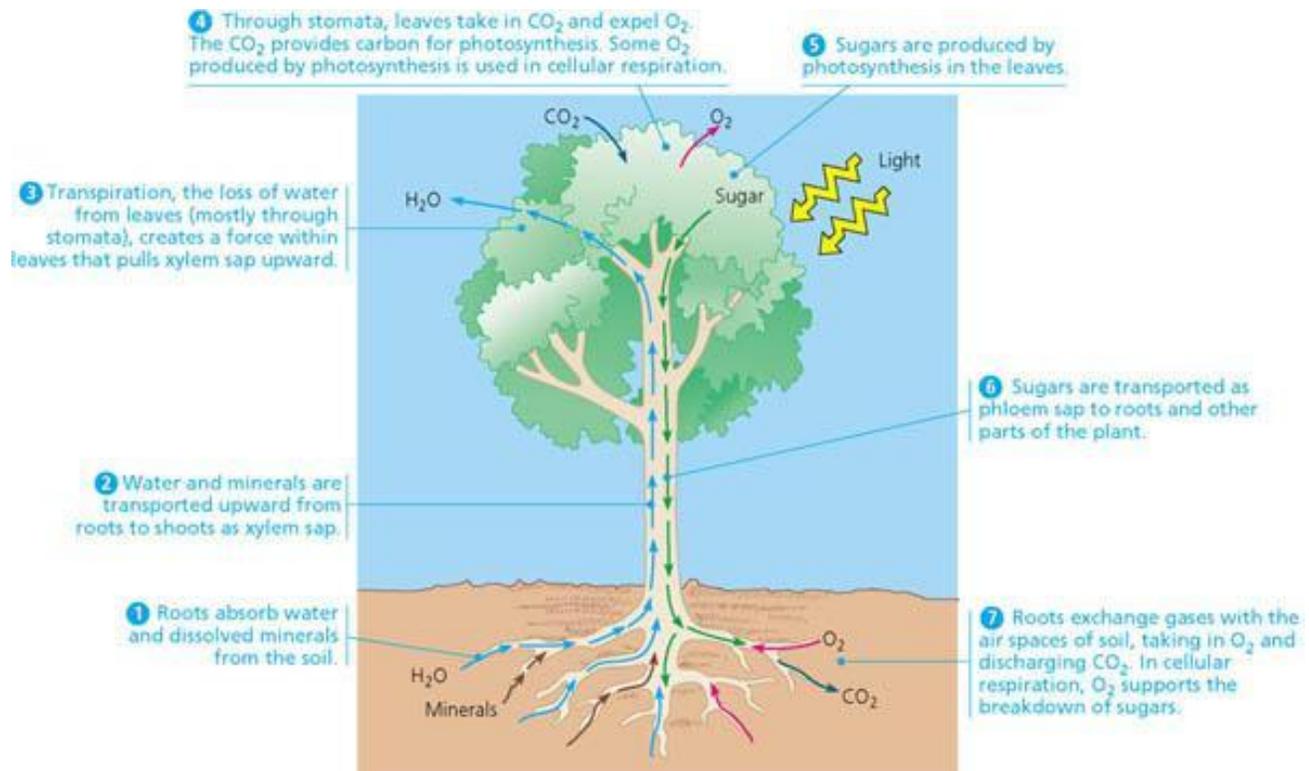


Overview of Transport in Plants

This figure demonstrates an overview of the processes involved in the movement of substances in the plant.



A) Transport of water and nutrients

Moving water and nutrients from the surface of a root hair all the way to the parenchyma cells in the leaves is a complex process. Water and nutrient transport involves three stages:

- i) From the soil into the roots
- ii) From the roots to the stem
- iii) From the stem to the leaves

Stage 1: Transport into the Root

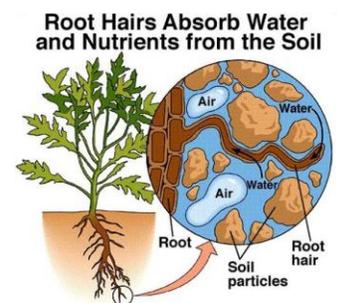
Transport of water and nutrients into the root happens by two different processes:

- a. Water enters the root cells by osmosis
- b. Nutrients enter the root cells by active transport

Recall that osmosis is the diffusion of water molecules across a selectively permeable membrane from an area of higher concentration to an area of low concentration.

Since the cytoplasm of plant cells have a lower concentration of water molecules than the soil water, the plant cell membrane allow the water molecule to cross freely.

The concentration of nutrients in the cytoplasm of the plant cell is higher than the concentration of nutrients in the soil water. The plant must then use active transport to move nutrients from the soil water to the root cells.



Stage 2: Transport into the Stem

Once the water and nutrients have crossed the cells membrane, the liquid is called the xylem sap. Substances in the xylem sap move up the root toward the stem. ***But how does the liquid sap move against gravity?***

As more nutrients are actively pumped into the xylem, their concentration increases which helps create a root pressure that help push the sap upward.

Stage 3: Transport to the leaves

The main driving force of transport up the xylem actually comes from the leaves themselves. Recall that the epidermis of leaves contain many stomata (pores formed by guard cells). Plant release water vapour through their stomata during transpiration, which is the evaporation of water from plant leaves.

Because of the attractive force of the hydrogen bond found between water molecules, when a water molecule moves up the xylem column, it pulls the neighbouring water molecule with it. The next one pulls another, which continues down the length of the xylem

B) The Transport of Sugars

Plant cells use glucose and other sugars as a source of energy. In plant, sugars may be produces by photosynthesis of from breaking down carbohydrates in storage.

A source: A plant cell with a high concentration of sugars and other solutes

A sink: A plant cell with a low concentration of sugars

Sinks may convert their sugars to starch for storage or use them rapidly. For example, cells that are rapidly growing are sinks, since they us up their sugar supply very quickly.

Direction of sugars

Unlike water and nutrients, which always move up, sugars can move up and down the plant. The direction depends on the location of source cells relative to the sink cells.

In general, sugars are transported from a source to a sink cell, which are connected by columns of phloem. However, the location of sink and source cells change depending on the time of year (*especially in area which have four seasons*).

In the **spring**, plants usually depend on carbohydrates stored in the stem or in the root of the plant as starch. As the plant begins to grow after a dormant winter, the plant breaks down the starch into sugars. As a result, roots and stems are the source, and the upper portion of the plant needs energy to grow leaves. It is then considered as a sink.

In the **summer/fall** the leaves are photosynthesized and the sugars they produced need to be stored in the stem and in the roots. Therefore, the source cells are now at the top of the plant, and the phloem sap moves downward.