

TRANSPORT WITHIN THE PLANT

Plants, like animals, have a need to transport materials. Water and minerals must be transported through the roots to the rest of the plant. Nutrients from photosynthesis must be transported from the palisade layers of the leaves to the rest of the plant. Water and nutrients are carried through vessels called veins, but they are carried by specific tissues within those veins called *xylem* and *phloem*.

LET'S START AT THE BOTTOM

Roots anchor a plant to the grounds and absorb both water and minerals from the soil. The water and minerals are transported through the xylem upwards, to the rest of the plant. Xylem tissue is made of several types of cells. The specific cells that transport water are called *tracheids* and *vessel elements*. Food from photosynthesis (carried out in the palisade layers of the leaves) is transported through the plant in tissue called phloem. Phloem contains two types of cells, *sieve cells* and *companion cells*. Sieve cells are the ones that actually carry out the transport, and companion cells help the sieve cells with their metabolic functions.

An easy way to remember which type of tissue carries food and which carries water is to remember that the "ph" sound is like the "f" sound, so phloem carries food. Xylem, then, must carry water.

However, all multicelled organisms, including animals and plants, must transport materials around their bodies. One of the largest plants on Earth is the redwood tree. Materials have to travel over 100 meters, the height of a 30-story building, between the redwood's roots in the soil and the leaves at the top of the plant. The redwood tree absorbs water through the cells of its roots. The plant's root cells have extensions, root hairs, which increase their surface area, similar to the villi that increase the surface area of the small intestine. The water and minerals dissolved in the water travel upward along pathways formed from xylem cells, which are lined up one after another to form long, hollow tubes. Water leaves a plant by evaporation from the stomates in its leaves, a process called *transpiration*. At the same time, food produced in leaves high above the ground is moved downward through tubes made of phloem cells. Plants have two sets of transport vessels: xylem for water and minerals, phloem for food. However, they do not have pumps. Instead, fluids are moved by the interactions of molecules. In xylem tubes, the interactions involve water molecules; in phloem tubes, the interactions involve sugar molecules. (See Figures 9-10a and 9-10b.)

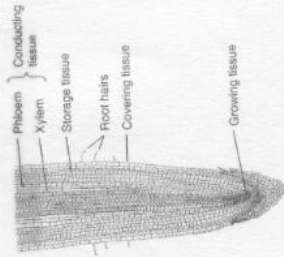


Figure 9-10b Root hairs increase the surface area of the roots.

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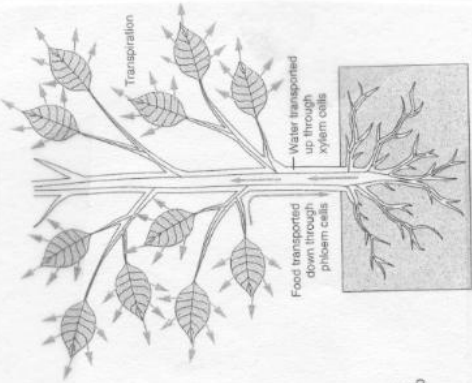


Figure 9-10a The transport system of a plant is made up of the roots, xylem, and phloem.

FIGURE 24-22 The cohesion-tension theory of water flow from root to leaf in xylem

- ① As water molecules evaporate out of the leaves through transpiration, other water molecules replace them from the xylem of the leaf veins.
- ② As the top of the "water chain" is pulled up by evaporation, the rest of the chain, all the way down to the roots, comes along as well.
- ③ As the molecules of the water chain retreat up the xylem in the roots, the decreased water pressure within the root xylem and the surrounding extracellular space causes water to enter from the soil water, thus steadily replenishing the bottom of the chain.

