



SECTION 21.2 THE VASCULAR SYSTEM Reinforcement

KEY CONCEPT The vascular system allows for the transport of water, minerals, and sugars.

Xylem and phloem are the two main tissues of the vascular system. Water and dissolved minerals move from the roots to the rest of the plant through xylem. Plants don't use any energy to move water through xylem. Instead, the cohesion-tension theory proposes that the physical properties of water allow the rise of fluids through a plant.

- The tendency of hydrogen bonds to form between water molecules creates a force called cohesion.
• The attraction of the water molecules to the xylem walls is due to adhesion, a force made by hydrogen bonds forming between water molecules and other substances.
• Cohesion and adhesion create tension that moves water upward in xylem.

Although the forces of cohesion and adhesion can keep a water column together inside of a plant, they are not the main force moving water upward through a plant. Upward force is also provided by the evaporation of water from leaves. This loss of water vapor from plants is called transpiration. As leaves transpire, the outward flow of water lowers the pressure in the leaf xylem, creating a vacuum that pulls water upward.

The second tissue in a plant's vascular system is phloem tissue. Phloem carries plant nutrients, including minerals and sugars, throughout the plant. Phloem moves the products of photosynthesis out of the leaves to stems and roots. While fluids in xylem always flow away from the roots toward the rest of the plant, phloem fluids—or sap—can move in any direction, depending on the plant's need. The pressure-flow model explains how sugars from photosynthesis move through the plant within the phloem. Phloem sap moves from a sugar source to a sugar sink. A source is any part of the plant that has a high concentration of sugars. Most commonly this source is the leaves, but it can also be where sugars have been stored, such as the roots. A sink is the part of the plant using or storing the sugar, such as growing stems, a fruit, or even the storage roots that will be a sugar source later in the season. The locations of sugar sources and sinks in a plant can change as the plant grows and as the seasons change.

1. Xylem and phloem are both plant vascular tissues. How are the functions of xylem and phloem different?

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2. What is the main process moving water upward through plants?

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3. Why are leaves the most common source for sugars in a plant?

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