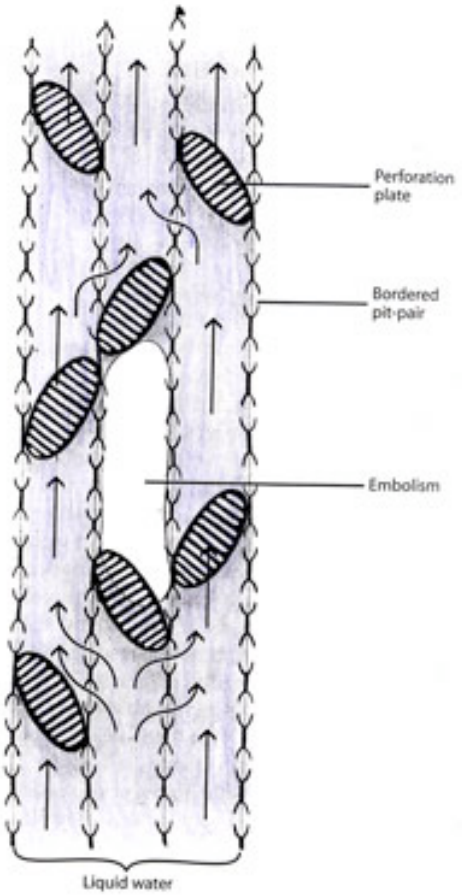
TRANSPORT IN THE XYLEM

Air Bubbles Can Break the Continuity Of Water In The Xylem*

Bubble formation in the xylem, and is a common occurrence in many trees. **Cavitation** (rupture of the water columns) and subsequent **embolism** (filling of the tracheid or vessel with air or water vapor) will stop the upward transport of water in that conduit of the xylem because the cohesion between water molecules is necessary for function. Fortunately, the small pores in the pit membrane between adjacent elements usually prevent air bubbles from squeezing through the pores into adjacent elements and isolate the embolized element (see diagram). Unless the air or vapor is reabsorbed, that particular element can no longer function in transport, but water can detour around and embolized vessel element through the bordered pit pairs between adjacent elements, as shown in the diagram.

A plant is susceptible to embolism any time one of its vessels or tracheids become air-filled by physical damage (e.g., by insect bite or broken branch). Freezing can also induce embolisms because air is not soluble in ice, and the xylem sap contains dissolved air. Recent evidence also shows that xylem dysfunction induced by droughts is a serious problem for plants. Most embolisms actually are triggered by air sucked into the vessel or tracheid via a pore in the wall or pit membrane adjacent to an already embolized conduit. The largest pores are the most vulnerable to the penetration of air, a process called air seeding.



Detours around an embolized vessel element. An embolism consisting of water vapor has blocked the movement of water through a single vessel element. However, water is able to detour around the embolized element via the bordered pit-pairs between adjacent vessels. The vessel elements shown here are characterized by ladderlike perforation plates.

* Adapted from Raven, P., R. Evert and S. Eichorn, 1999. Biology of Plants, 6th edition. W. H. Freeman, New York.