



Transport in Plants

QOD

List as many strategies as you can that a plant might use to limit water loss



Transport Overview

- 1- uptake and loss of water and solutes by individual cells (root cells)
- 2- short-distance transport from cell to cell (sugar loading from leaves to phloem)
- 3- long-distance transport of sap within xylem and phloem in whole plant



Fig. 38.1

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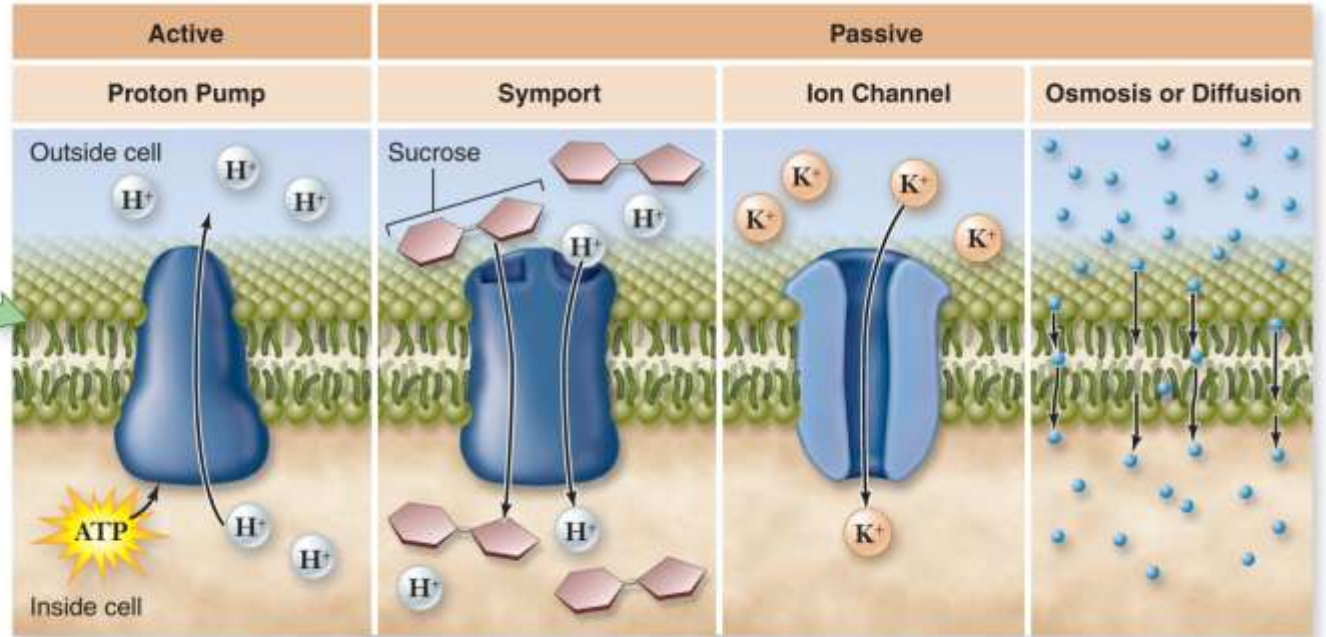
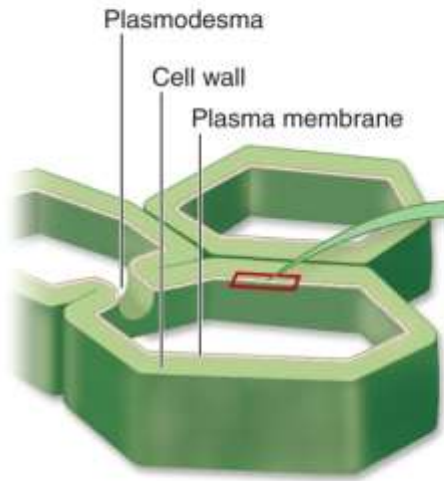
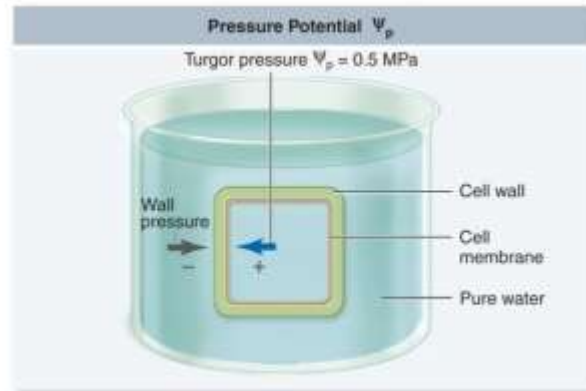
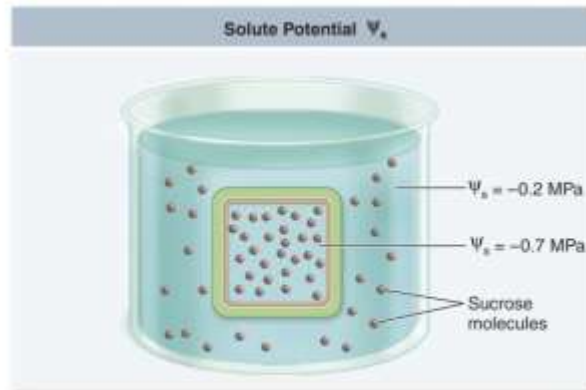


Fig. 38.3

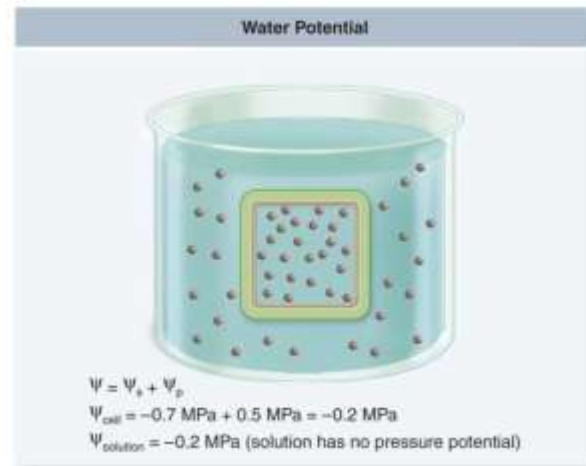
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a.



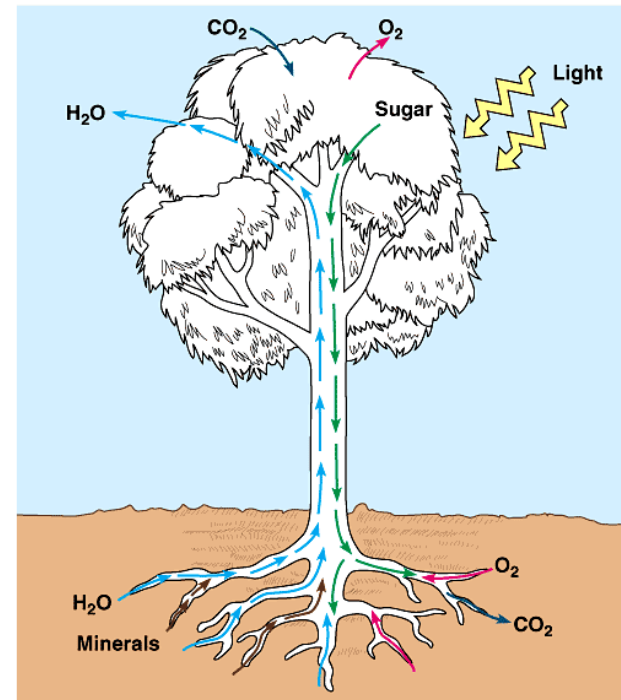
b.



c.

Whole Plant Transport

- 1- Roots absorb water and dissolved minerals from soil
- 2- Water and minerals are transported upward from roots to shoots as xylem sap
- 3- Transpiration, the loss of water from leaves, creates a force that pulls xylem sap upwards
- 4- Leaves exchange CO_2 and O_2 through stomata
- 5- Sugar is produced by photosynthesis in leaves
- 6- Sugar is transported as phloem sap to roots and other parts of plant
- 7- Roots exchange gases with air spaces of soil (supports cellular respiration in roots)



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Cellular Transport

- Water transport
- Osmosis; hyper-; hypo-; iso-
- Cell wall creates physical pressure: water potential solutes decrease; pressure increase
- Water moves from high to low water potential
- Flaccid (limp, iostonic);
- Plasmolysis (cell loses water in a hypertonic environment; plasma membrane pulls away);
- Turgor pressure (influx of water due to osmosis; hypotonic environment)



Transport within tissues/organs

Tonoplast

vacuole membrane

Plasmodesmata (components)

cytosolic connection

Symplast route (lateral)

cytoplasmic continuum

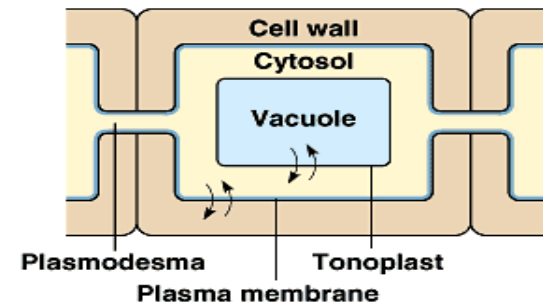
Apoplast route (lateral)

continuum of cell walls

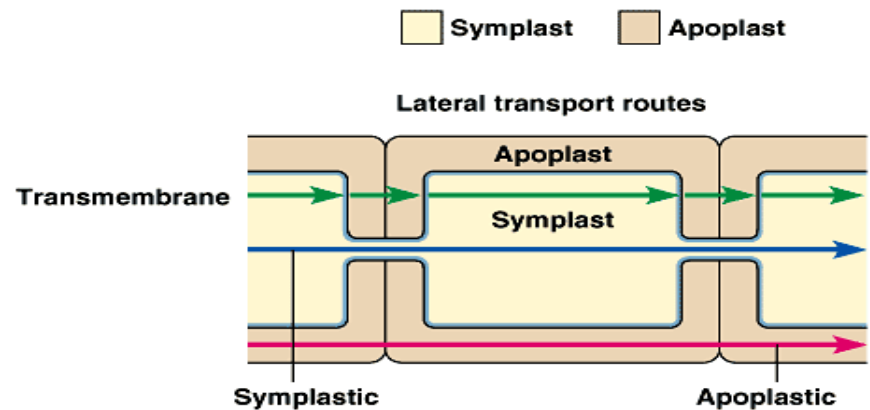
Bulk flow (long distance)

movement of a fluid by pressure (xylem)

(a) Cell compartments



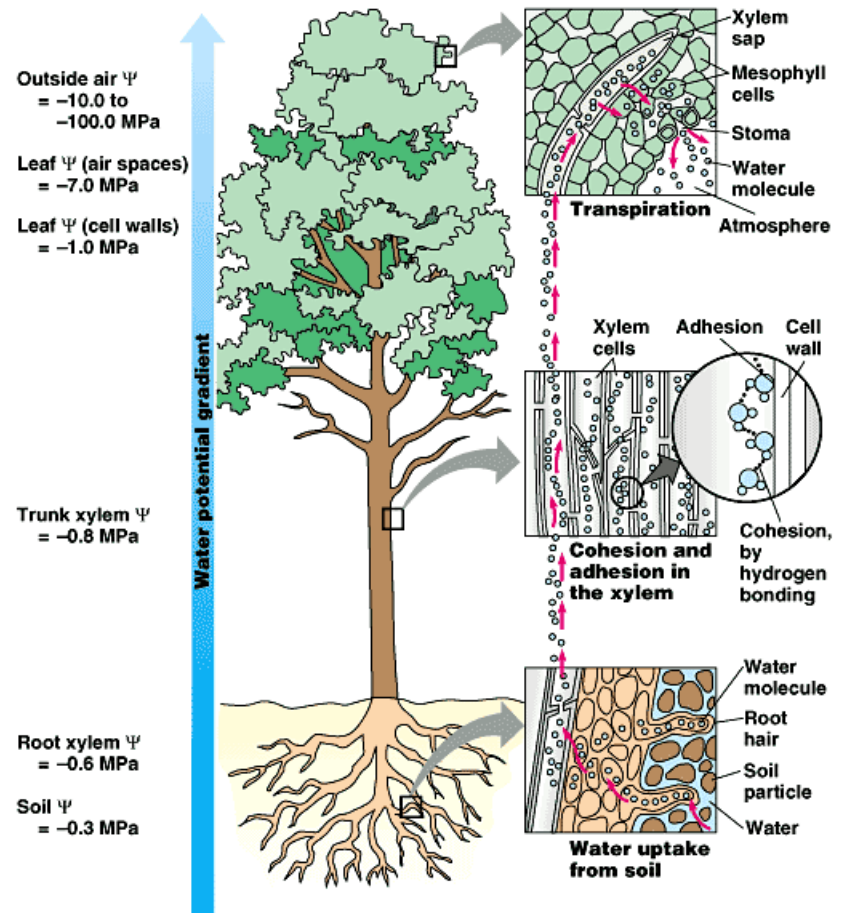
(b) Tissue compartments



Transport of Xylem Sap

Transpiration: loss of water vapor from leaves *pulls* water from roots (transpirational pull); cohesion and adhesion of water

Root pressure: at night (low transpiration), roots cells continue to pump minerals into xylem; this generates pressure, *pushing* sap upwards; guttation

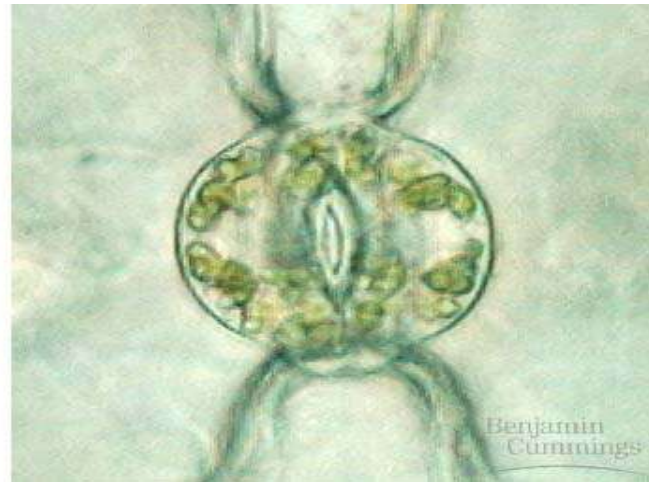
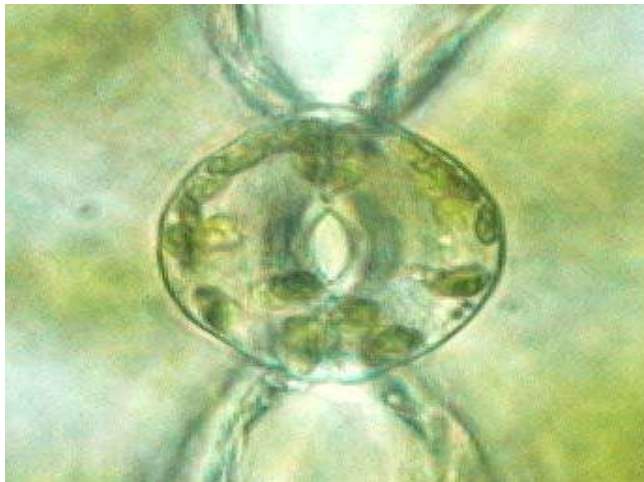


Transpirational Control

Photosynthesis-Transpiration compromise....

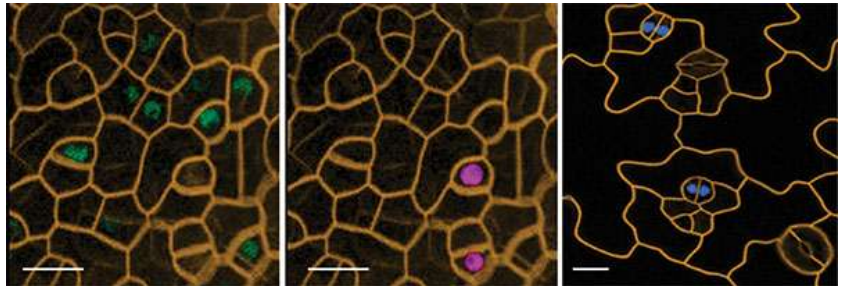
Guard cells control the size of the stomata

Xerophytes (plants adapted to arid environments)~ thick cuticle;
small spines for leaves



Stomatal Development

- Images from a time series in stomata formation. Cells at different developmental stages are marked by nuclei labeled green (SPCH, stem-cell like), pink (MUTE, committed), or blue (FAMA, differentiating). The first two panels show the same group of cells at an early time point; in the third panel, taken a day later, cells are maturing. Scale bar in each is 5 microns. Images courtesy of Bergmann lab.



Source: http://www.hhmi.org/bulletin/spring-2015/open-and-shut-case?utm_source=HHMI+Bulletin&utm_campaign=6805c8788e-HHMI_Bulletin_Spring_2015&utm_medium=email&utm_term=0_c8d2a543bc-6805c8788e-69869733

Translocation of Phloem Sap

Translocation: food/phloem transport

Sugar source: sugar production organ (mature leaves)

Sugar sink: sugar storage organ (growing roots, tips, stems, fruit)

1- loading of sugar into sieve tube at source reduces water potential inside; this causes tube to take up water from surroundings by osmosis

2- this absorption of water generates pressure that forces sap to flow along tube

3- pressure gradient in tube is reinforced by unloading of sugar and consequent loss of water from tube at the sink

4- xylem then recycles water from sink to source

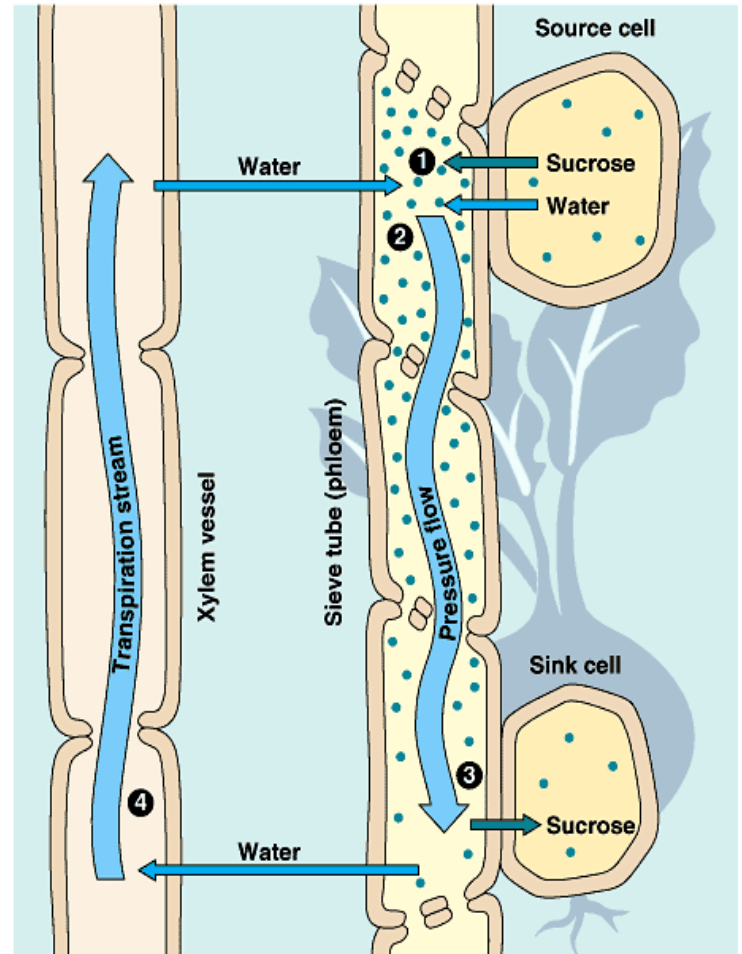


Fig. 38.12

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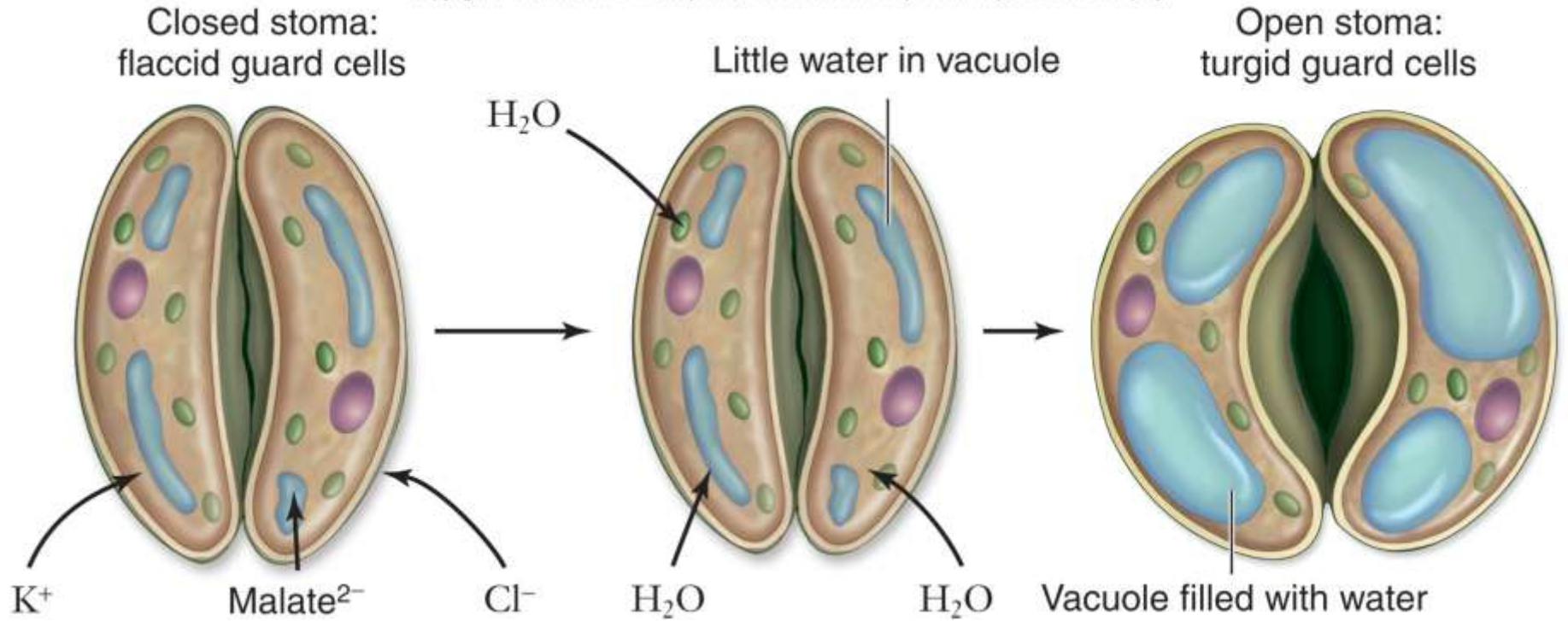
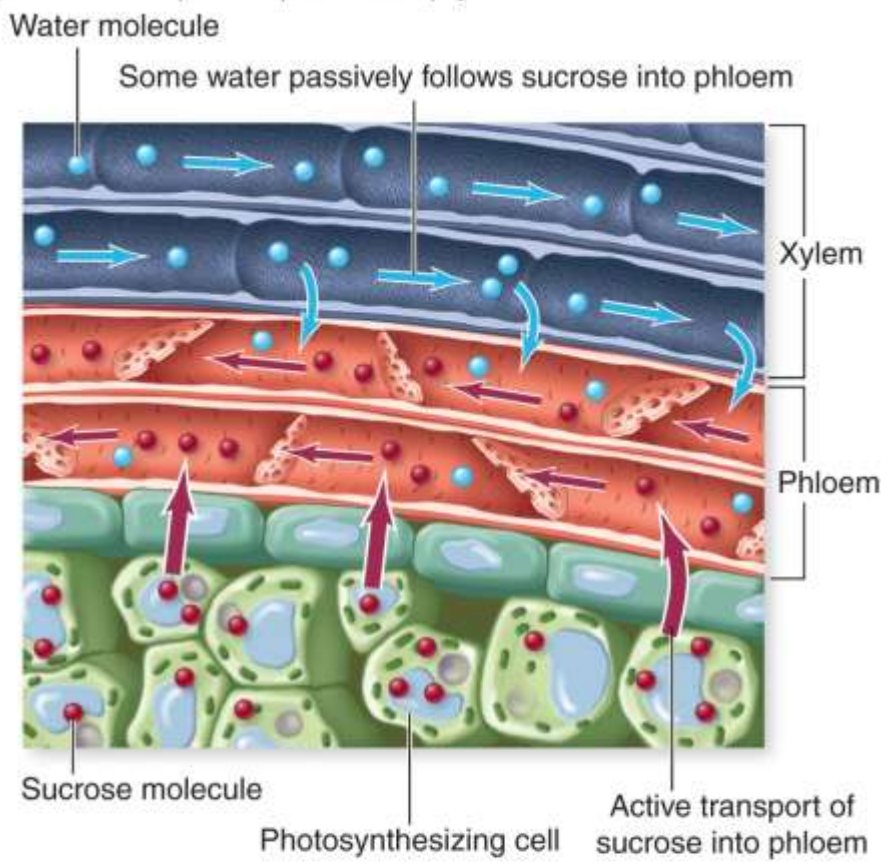
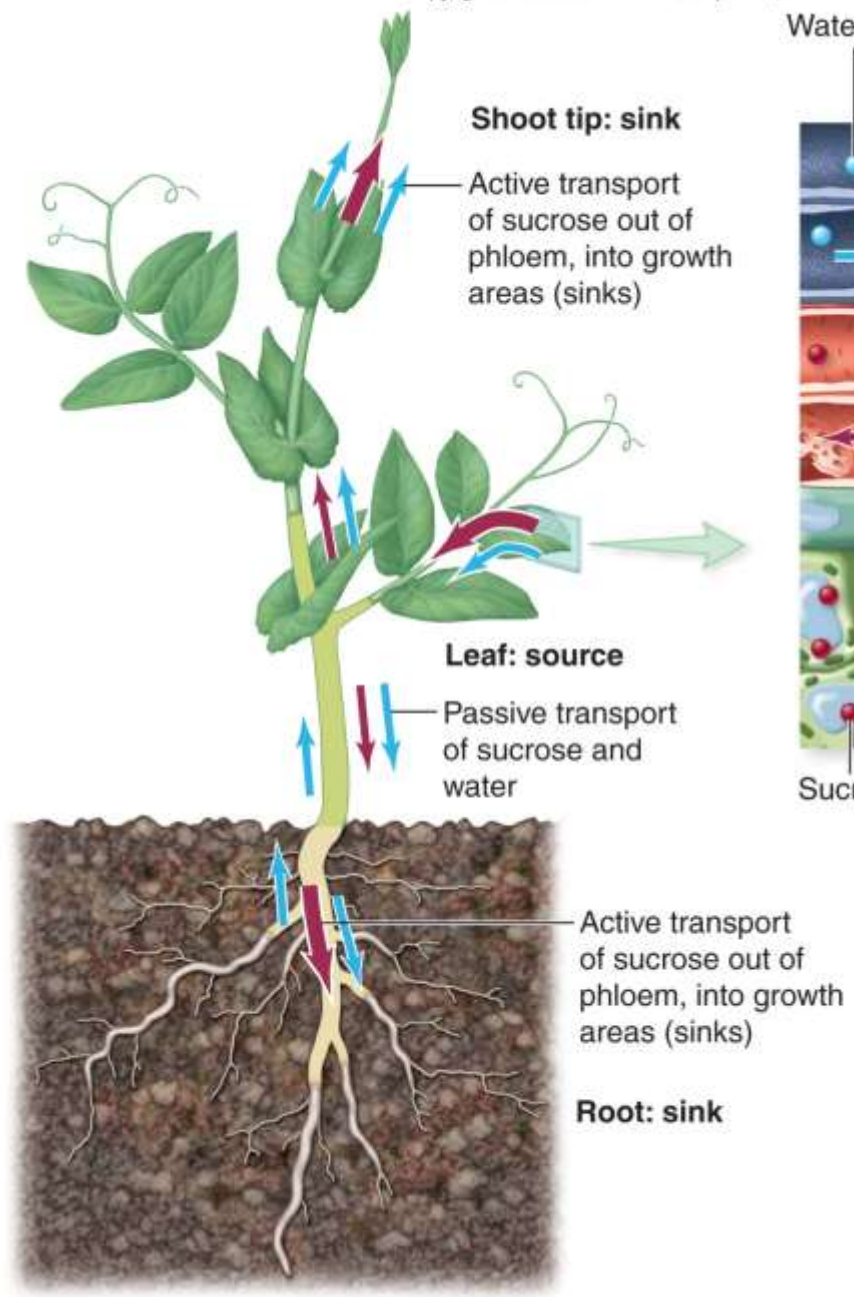


Fig. 38.19

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- water (passive transport)
- sucrose (passive transport)
- sucrose (active transport)