TOPIC 9.2: PHLOEM TRANSPORT

Active Translocation

Plants transport organic molecules from source to sink

- **Source:** Photosynthetic tissues (e.g. leaves)
- **Sink:** Storage organs (e.g. fruits, seeds, roots)

Organic molecules are transported via vessels called **phloem**

- Organic molecules are loaded and unloaded into the phloem by companion cells at the source and sink

The active loading of solutes at the source creates high solute concentrations within the viscous phloem fluid (sap)

- Water is drawn into the phloem from the xylem (osmosis)

The incompressibility of water causes the sap volume to be increased, creating a pressure gradient (i.e. mass flow)

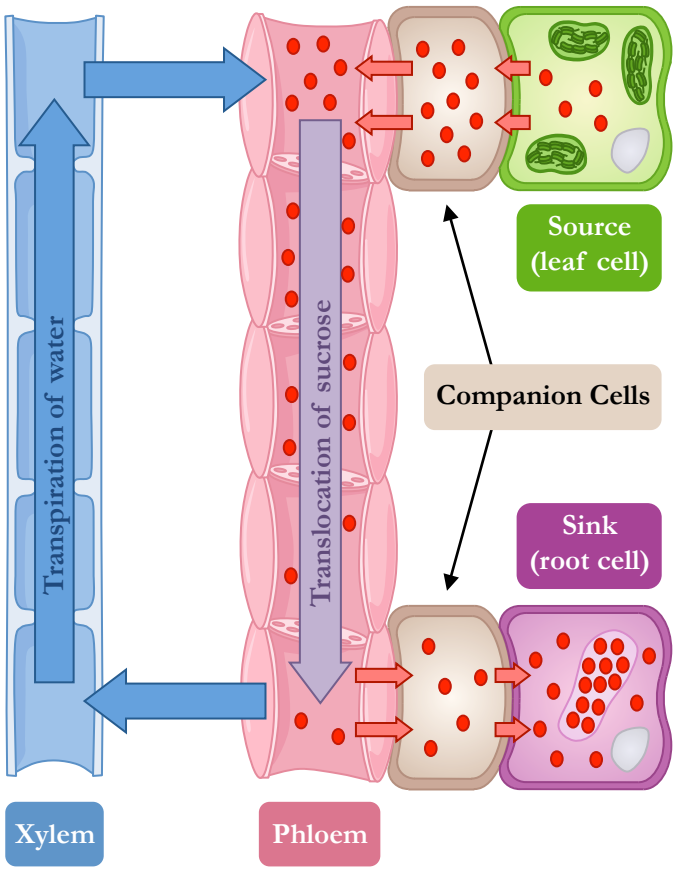
- Mass flow drives sap along the phloem (source to sink)

Organic molecules are actively unloaded at the sink, which lowers solute concentrations (and water returns to the xylem)

- Loss of water lowers the hydrostatic pressure at the sink, maintaining the pressure gradient (and mass flow)

Carbohydrates are usually transported in the phloem as sucrose, but are typically stored within the sink as starch

Active Translocation Within the Phloem



Xylem versus Phloem

Xylem:

- Composed of a perforated inner layer of dead cells that are fused into a continuous tube (vessel element)
- The cell walls have thickened cellulose are reinforced with lignin (spiral or annular arrangement)

Phloem:

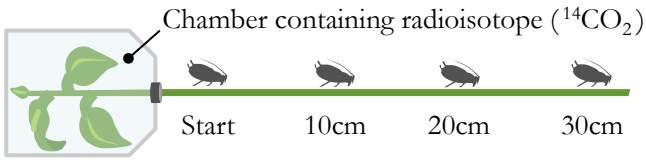
- Composed of living cells connected by porous plates at their transverse ends (sieve elements)
- Are supported by companion cells that are connected via plasmodesmata to mediate material exchange

	XYLEM	PHLOEM
Process	Transpiration	Translocation
Materials	Water, minerals	Organic nutrients
Transport	Unidirectional	Bidirectional
Composition	Vessel element and tracheid	Sieve element and companion cell
Structure	Dead cells form a hollow tube	Living cells form a tube with plates
Location	Inner or central region of bundle	Outer region of vascular bundle

Translocation Rate

Translocation rates can be measured using aphid stylets

- Aphids are insects that feed on the sap in phloem via a protruding mouthpiece called a stylet
- If the stylet is severed, the sap will continue to flow from the plant and can be collected and measured
- Plants exposed to radioactive carbon dioxide will produce radioactively labelled sugars within the phloem
- The rate of translocation can be identified by the time taken for radioisotopes to be detected along the phloem



Distance from start	10 cm	20 cm	30 cm
Time ^{14}C detected	1.25 hr	2.5 hr	5.0 hr
Translocation Rate	8 cm/hr	8 cm/hr	6 cm/hr