

2.6 Describe current theories about processes responsible for the movement of materials through plants in xylem and phloem tissue

Both xylem and phloem are involved in the transport of materials within plants:

1. **Xylem** → transports water and solutes (minerals and ions)
2. **Phloem** → transports products of photosynthesis (sugars in the form of sucrose)

Features	XYLEM (ONE WAY)	PHLOEM (TWO WAYS)
Process	TRANSPIRATION STREAM → 1 WAY MOVEMENT OF WATER FROM THE ROOTS	TRANSLOCATION → 2 WAY MOVEMENT OF SUGARS IN THE PHLOEM OF PLANTS
Active or Passive?	Passive	Active & Passive
Materials Moved	Water and Ions	Sugars travel as sucrose in water
Theory of Mechanism	“Evaporation-Tension-Cohesion Mechanism”	“Pressure Flow Hypothesis” (Source → Sink Theory)
Description of Mechanism	<p>Water enters plant through root hairs by osmosis and moves between cells (apoplastic) or through cells (symplastic) to the xylem</p> <p>PATHWAY OF WATER:</p> <ol style="list-style-type: none"> 1. From soil into the root; <ul style="list-style-type: none"> ❖ By osmosis (high H₂O → low H₂O) ❖ Root pressure → water entering pushes the water ahead of it ❖ Mineral ions enter root by diffusion or active transport and then follow path of water 2. Up the xylem in the stem; <ul style="list-style-type: none"> ❖ Water moves up the xylem by passive transport, as evaporation of water from leaves (transpiration) creates an upwards tension in the xylem column (transpiration pull) ❖ Capillary forces force water up xylem column due to: <ul style="list-style-type: none"> • Cohesion: water attracts water (like), due to their polarity, creating tension. As water evaporates, each molecule of water drags another upwards. • Adhesion: attraction of molecules to cellulose xylem wall (unlike), pulling water up, preventing it from falling down 	<p>SUGARS TRAVEL AS SUCROSE:</p> <ol style="list-style-type: none"> 1. At Source (LEAVES) <ul style="list-style-type: none"> ❖ Sugar moves into phloem by active transport at leaves ❖ Water in phloem decreases thus water moves into phloem by osmosis ❖ Pressure (turgor) in phloem increases 2. At Sink (Roots, Buds, Flowers) <ul style="list-style-type: none"> ❖ Sugar moves out of phloem by active transport ❖ Water in phloem increases and thus water flows out of phloem by osmosis ❖ Pressure decreases in phloem <p>✚ The flow of water from source to sink drags sugar molecules</p> <p>✚ Pressure builds up at the source and reduces at sink</p>
Evidence of Theory	Strasburger performed experiments, putting tree trunks (with leaves but no roots) in poisonous liquid and found liquid still rose up the trunks until the leaves were dead (no leaves = no transpiration). Thus, leaves play a major role in allowing water to go from bottom to top of plant. Also, it means that water transport is not only due to root pressure	Aphids (sap eating insects) were placed at different points in phloem as ‘taps’ for sap which can then be analysed. Results showed that closer to the source, there was faster flow and greater concentration