The movement of organic solutes through the plant

Scientists and models

- Scientific advances begin with a model to explain something
- Based on available evidence at that time
- Debates stimulate, make predictions (what would happen if model is correct)
- Collaboration, ingenuity, think objectively= reliable investigations to test a model
- More predictions shown correct= widely accepted
- Sometimes it takes just one investigation to show a prediction is incorrect

- Cohesion-tension model offers a wide range of scientific explanations= widely accepted
- Transport in the phloem is less clear and mass-flow model has many unanswered questions/incomplete explanation or better explanations out there

The movement of solutes through phloem tissue

- Transport of sugars (sucrose) through sieve tubes is easily demonstrated using radioactively labelled carbon dioxide.
- Collect contents by aphids (greenfly)- pierce stems with fine mouthparts (feed on phloem)
- Feeding insects anaesthetised/mouthparts cut off- sieve tube content flows out- analysed
- Radioactively labelled sugars can be traced throughout plant= show movement
- Solute movement can be in different directions
- Storage organs such as bulbs/stem tubers of potatoes/daffodils- transport containing components to shoots in spring to begin photosynthesis and grow
- Translocation is when manufactured solutes are transported (sucrose, amino acids, sugars from sieve tubes come from photosynthesis in leaves) in the phloem.

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Page 1 of 2

The mass-flow hypothesis of phloem transport

- Method of transport in which pressure differences are used to move a fluid to carry substances in one direction
- Pressure differences generated in different parts of the plant
- Sugars made by photosynthesis dissolve in cytoplasm= lowered water potential
- So, water enters cell by osmosis= high hydrostatic pressure (source area)
- Sugars used up rapidly in respiration/converted to starch (insoluble, forms starch grains which have no osmotic effect)
- Water potential raises- water flows out= low hydrostatic pressure (sink area)
- Pressure difference forces sugars into sieve tubes at source, induces mass-flow through phloem towards sink.
- Remaining fluid in sink returned through xylem vessels

Strengths of mass-flow hypothesis

- Measure gradients suggested and show they are present
- If pierced by insect mouthparts, contents of sieve tubes flow out= under pressure
- Links phloem and xylem in plausible way