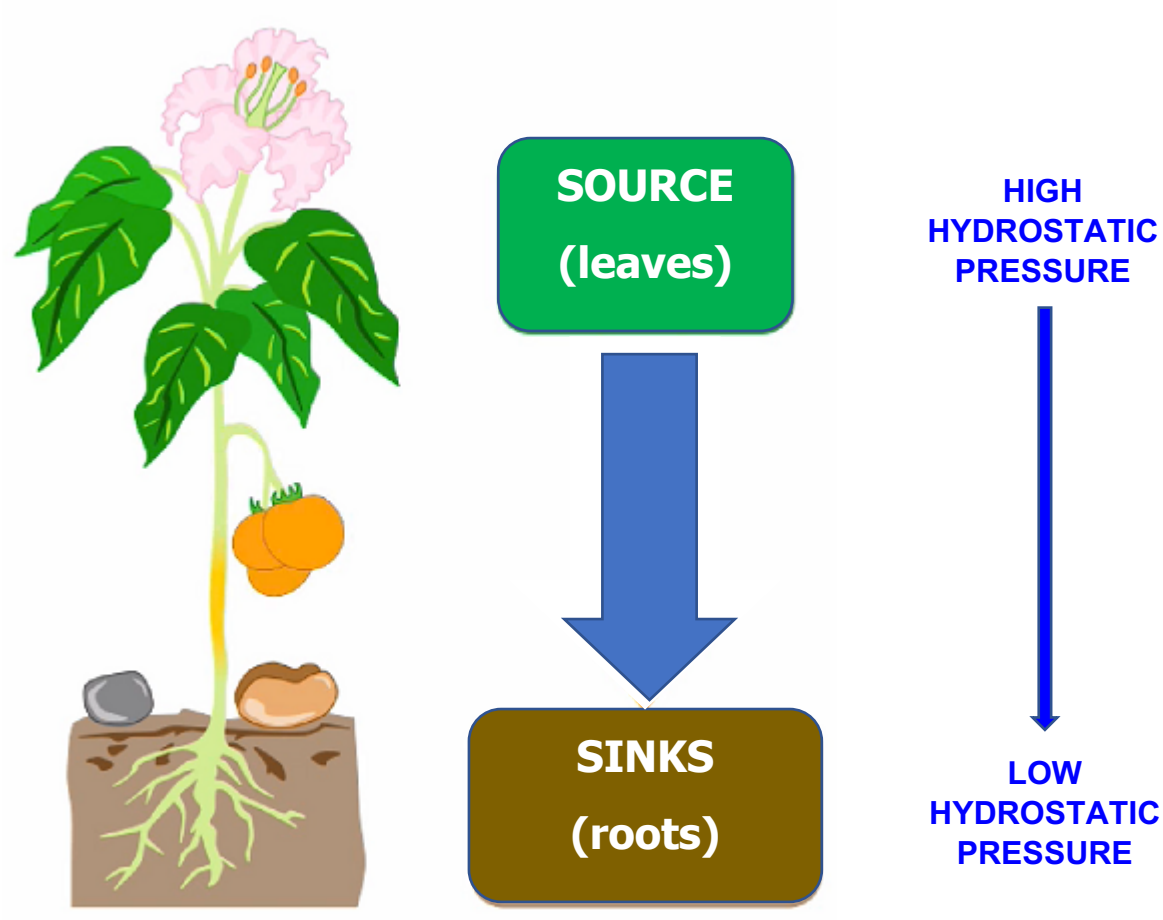
A. TRANSLOCATION

The **MOVEMENT** of **SUCROSE** and **AMINO ACIDS** from the **LEAVES** (the **SOURCE**) to **GROWING REGIONS** that are **RESPIRING** (the **SINKS**)

B. HOW SUCROSE IS TRANSPORTED IN THE PHLOEM

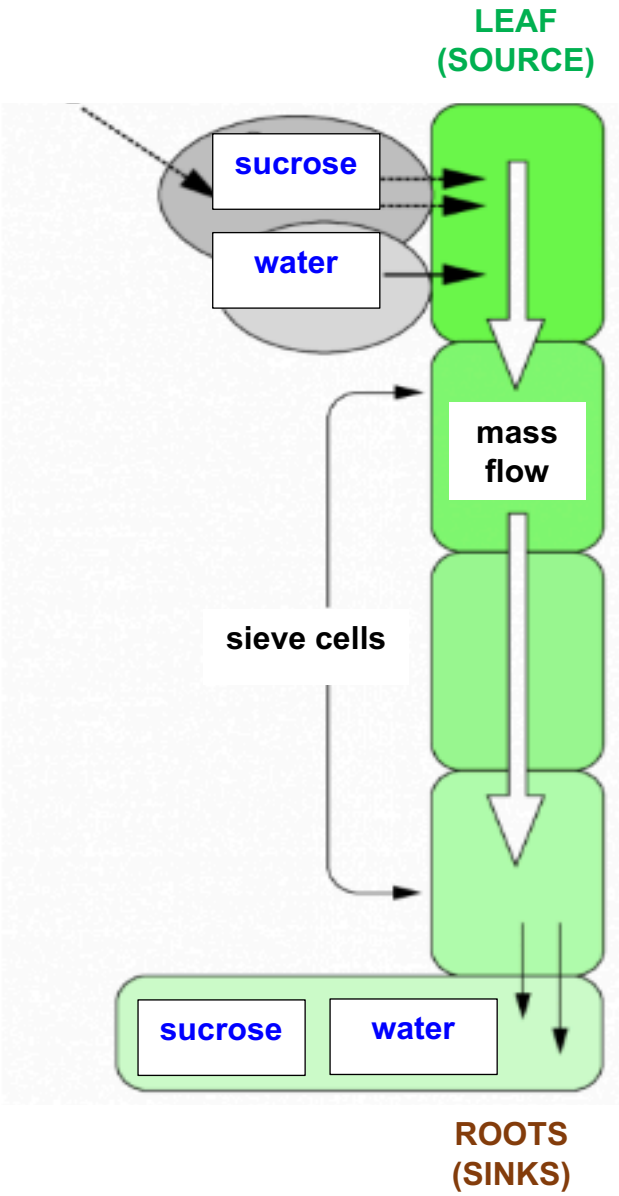
General principle

- **Hydrostatic pressure** is the **pressure** of a **liquid** – in this case, **water.**
- This is all about creating a **hydrostatic (liquid) pressure gradient** between the **source** (**leaves**) and the **sinks** (**growing regions = roots**) from top to bottom.



Specifics

- The diagram represents the **leaves**, **phloem tissue** and **roots**.
- Remember that **water molecules** always move from a **low → high solute concentration** by **osmosis**.



AT THE LEAF (SOURCE)

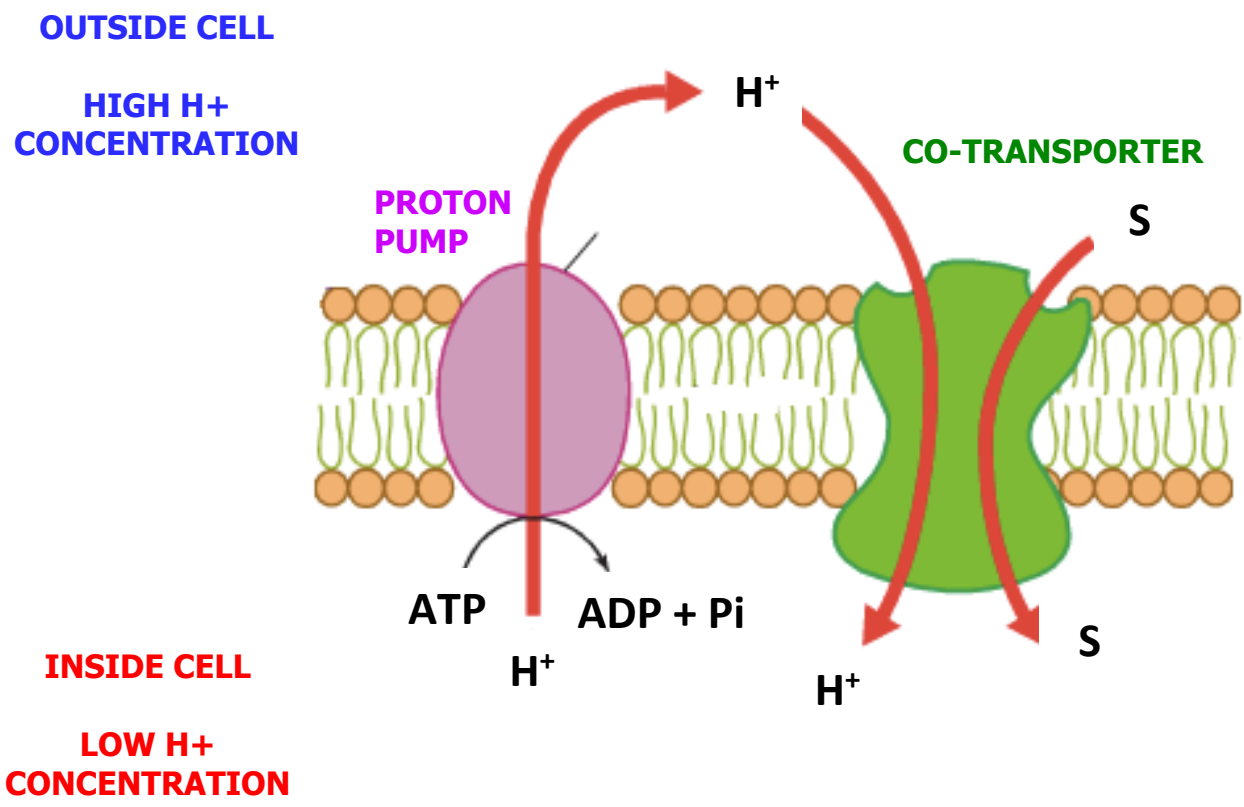
- sucrose enters the phloem companion cells by active transport at the source (leaf)
- sucrose then enters the sieve elements through the plasmodesmata
- this increases the solute concentration in the sieve elements
- (so) water enters the phloem by osmosis
- this increases the hydrostatic pressure in the phloem, which pushes the sucrose solution 'down' to the sinks (roots)

AT THE ROOTS (SINKS)

- sucrose leaves the phloem (and enters the roots) by active transport
- this lowers the solute concentration in the phloem
- (so) water leaves by osmosis.
- this lowers the hydrostatic pressure in the phloem
- and makes sure that there is a hydrostatic pressure gradient between the leaves and roots

C. HOW PHLOEM SIEVE TUBES ARE LOADED WITH SUCROSE

- **Sucrose (S)** is **not loaded** into **sieve tubes** on its **own** – **help** is needed.
- **Hydrogen ions** (**H+**), also called **protons**, provide this **help**.

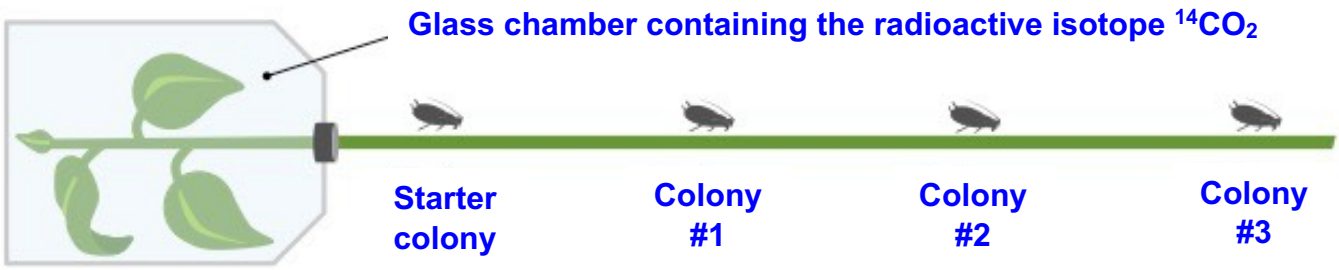


- A **proton pump** transports **H^+ out** of **phloem cells** by **active transport**.
- This **creates** a **high concentration** of **H^+ outside** the **phloem cell**.
- This creates an **H+ concentration gradient**.
- **Co-transporter proteins** in the **membrane** then **use** the **energy** in this **proton gradient**.
- To **move** a **sucrose molecule into** the **phloem cell**.
- At the **same time**, it **also transports** an **H+ into** the **cell**.

D. MEASURE THE RATE OF TRANSPORT IN THE PHLOEM USING APHIPDS

Background

- **Aphids** are **insects** that have **long piercing mouthparts** called **stylets**.
- Their **stylets** are **inserted** into **phloem sieve tubes** to extract the **sweet liquid**.
- **Stylets** can then be **cut off** to **analyse** the **liquid inside**.



Colony Number	1	2	3
Distance from starter colony (cm)	20	40	60
Time for radioactivity to travel from starter colony (hours)	1.25	2.40	3.80
Rate of phloem transport (cm hr^{-1})	16.0	16.7	15.8

What is done

- Supply the **leaf** with **radioactive CO_2** ($^{14}CO_2$).
- Plant will **use this** to **make radioactive sucrose**, which will enter the **phloem**.
- **Time** how long it takes for the **radioactive sucrose** to **appear** in the **cut stylets** of **aphids** at **different distances from** the **leaf**.
- **Rate of transport = distance from starter colony ÷ time for radioactivity to travel there**