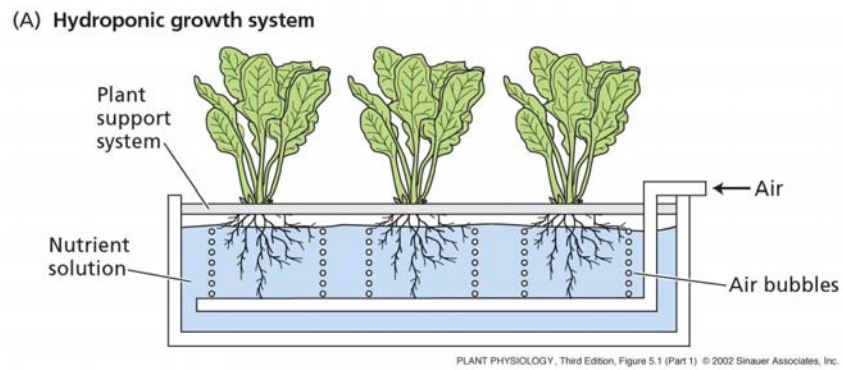
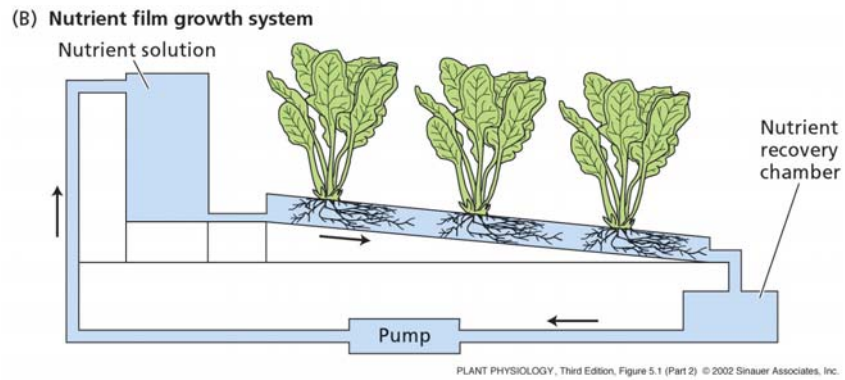
Ion Transport

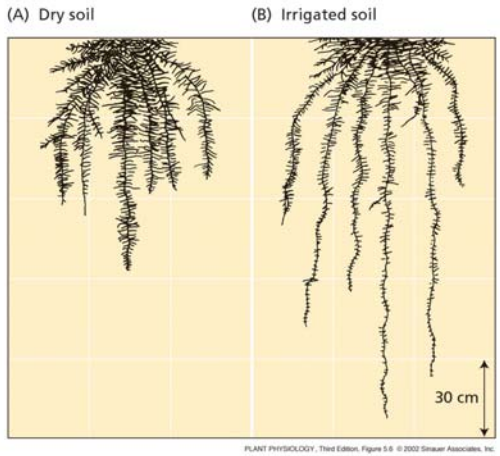
- Root Anatomy
- Ions in Soil
- Movement of ions into cells
- Active transport

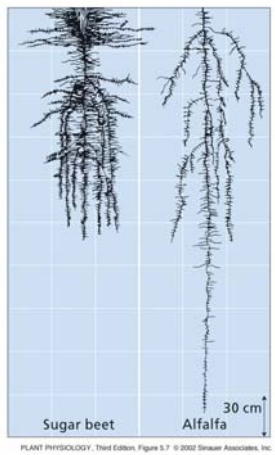




Roots

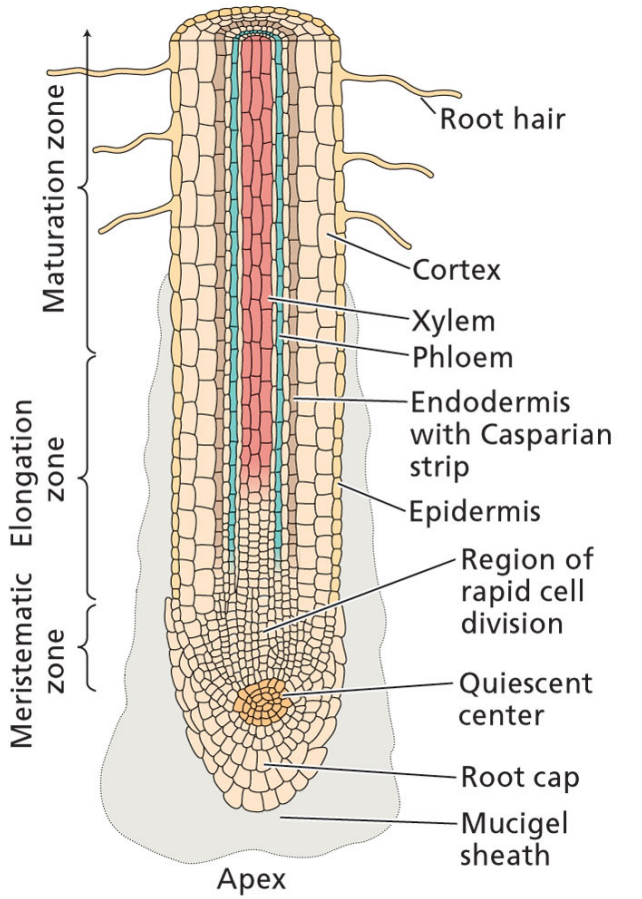
- Function
- absorption
- anchorage
- storage
- conduction of water
- hormone synthesis





Root Anatomy

- Anatomy
- three regions
  - meristematic
  - elongation
  - differentiation: root hairs
- root hairs increase surface area
- zone of depletion around root hairs



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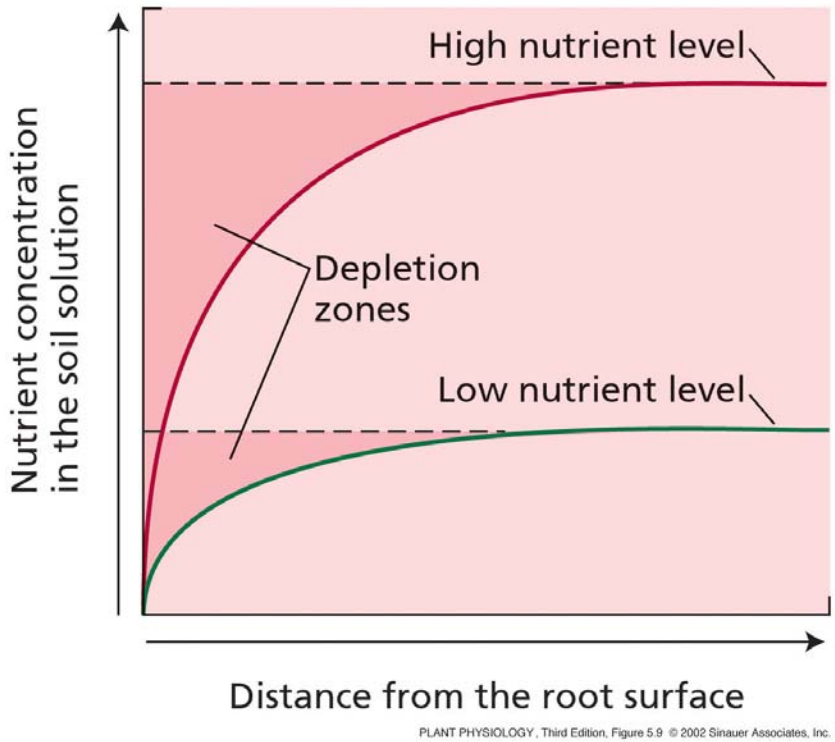
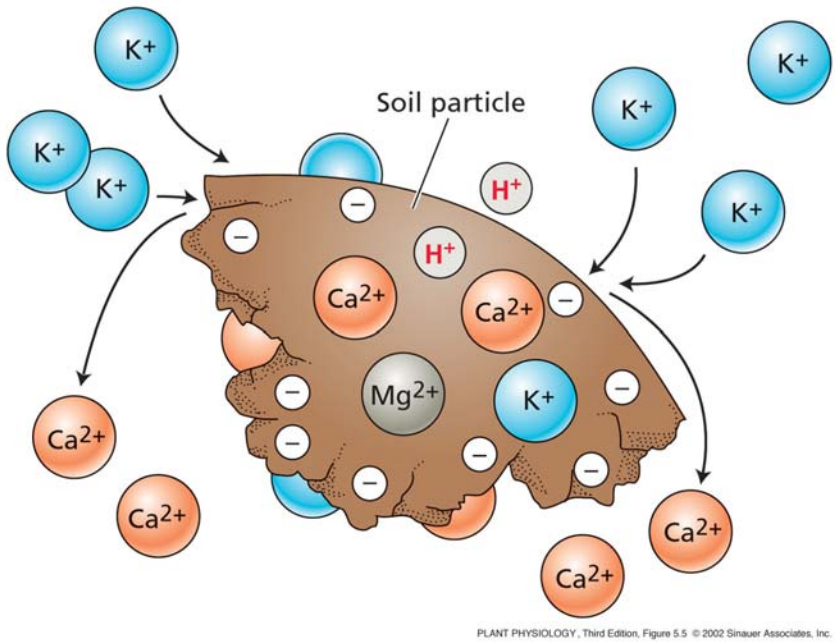
Depletion zone

- zone of depletion around root hairs

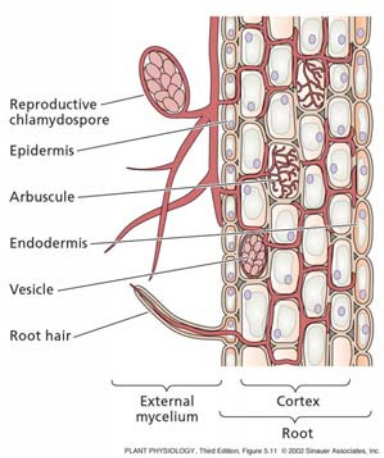


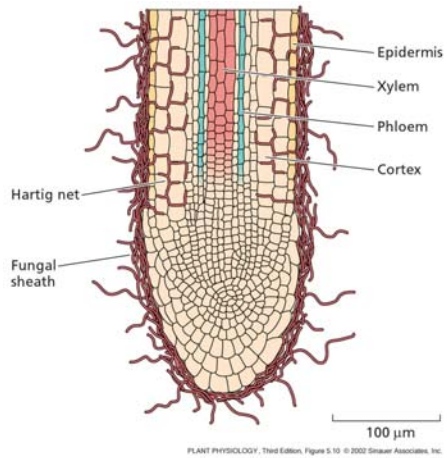
Ions in Soil

- **Root interception**
  - **root grows and intercepts ions**
- **simple diffusion**
  - **concentration gradient**
  - **delivers K**
- **mass flow**
  - **bulk flow of water carries ions to root**
  - **delivers N, Ca, Mg, S**



Fungi

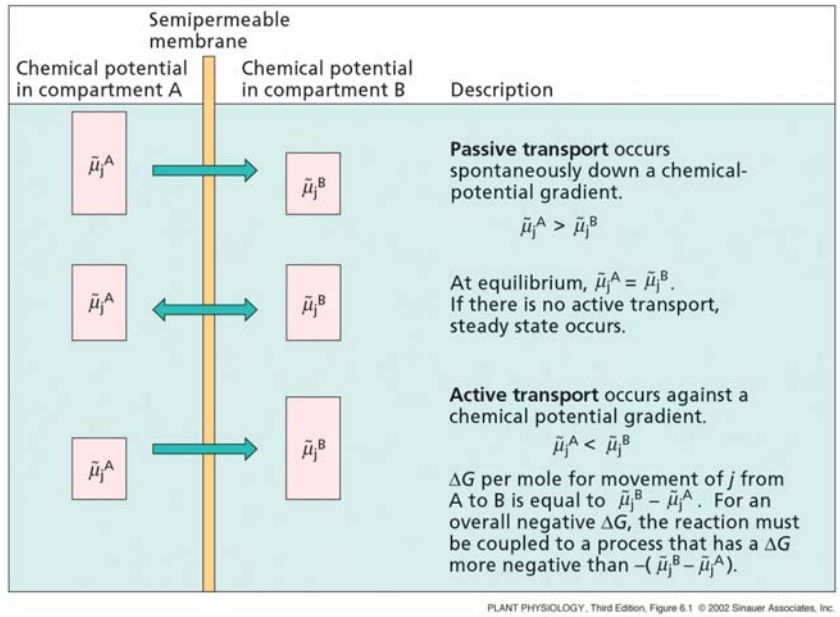




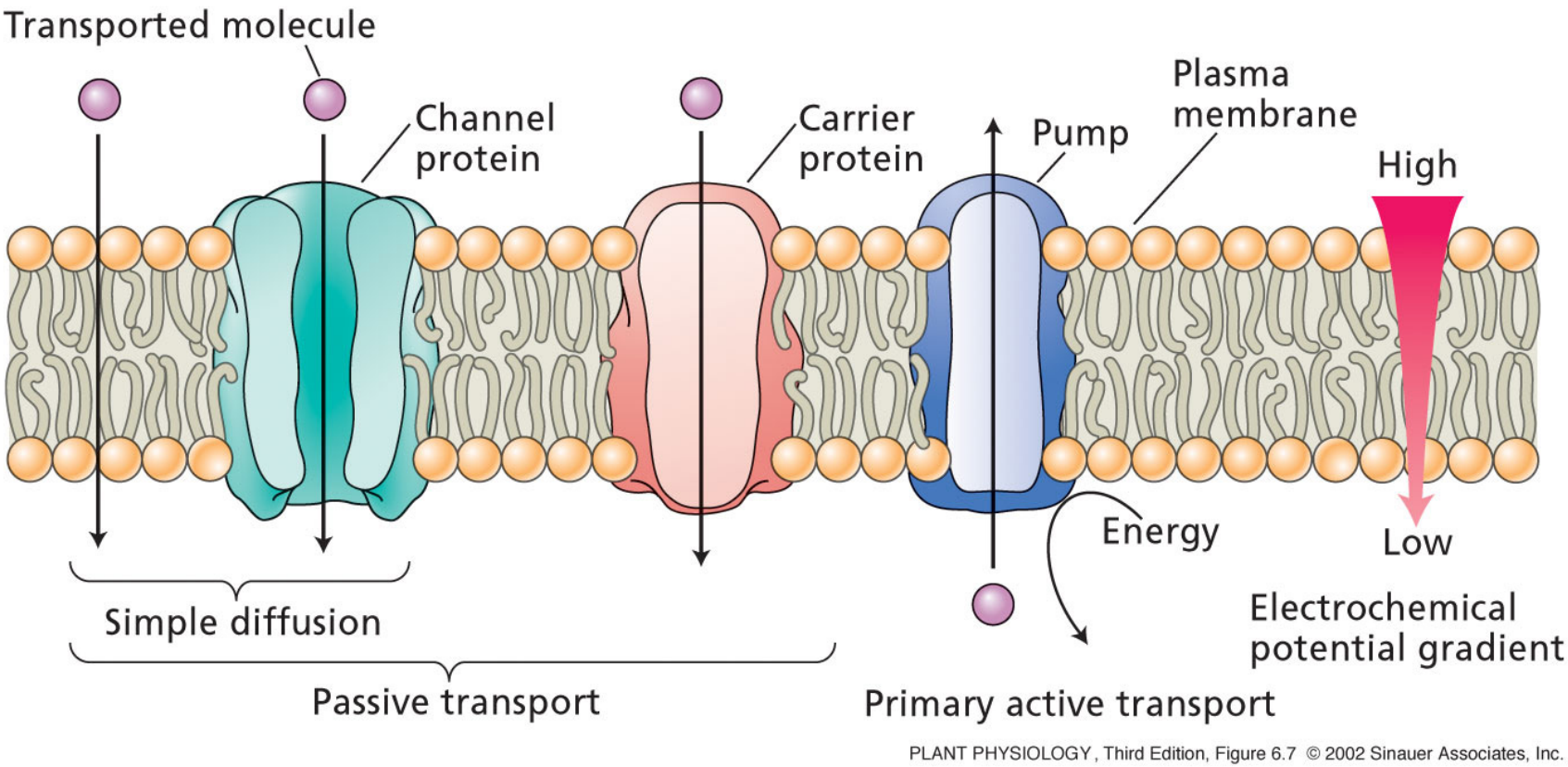
- **mycorrhizal fungi**
  - **two types**
  - **endo**
  - **ecto**
  - **deliver P, Fe and other immobile nutrients**
  - **if added P to soil, inhibits fungal infection**

Movement of ions into cells

- Diffusion
- Facilitated difffusion with a protein
  - know rate graph of facilitated difffusion and simple diffusion
- Active Transport
  - Movement of ions against gradient



Cell Membrane & Transport



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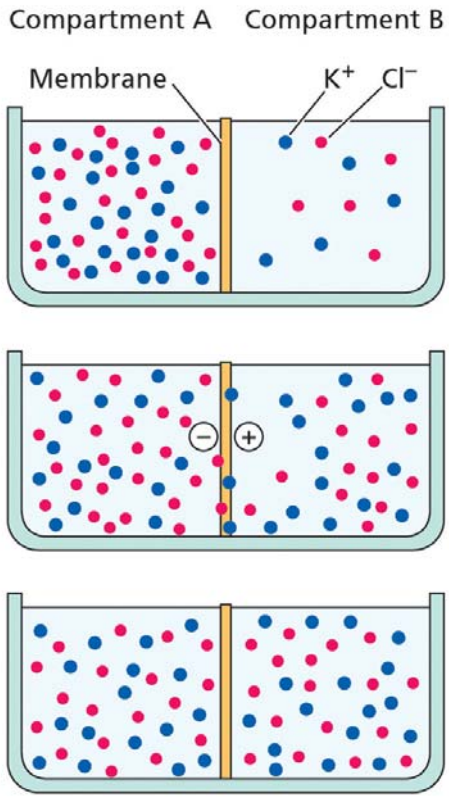
Diffusion

Initial conditions:
$[KCl]_A > [KCl]_B$

Diffusion potential exists until chemical equilibrium is reached.

Equilibrium conditions:
$[KCl]_A = [KCl]_B$

At chemical equilibrium, diffusion potential equals zero.



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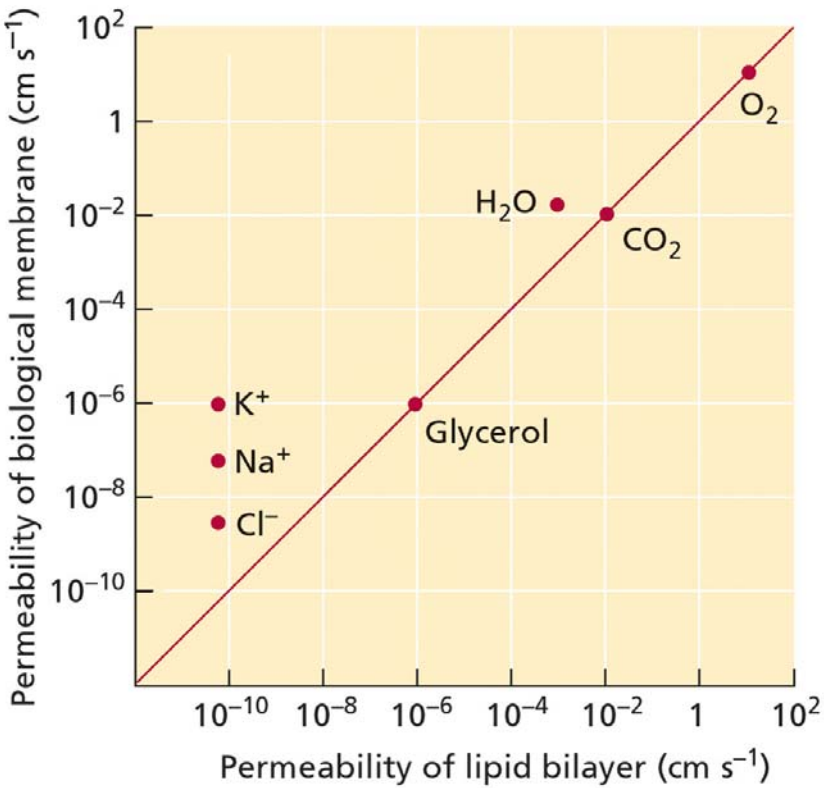

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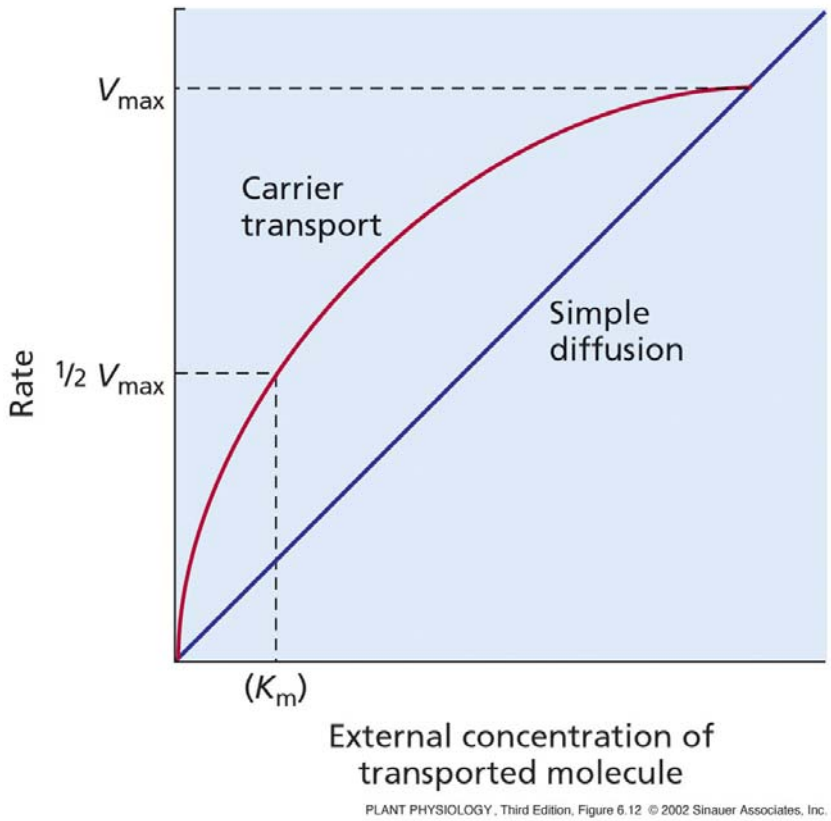
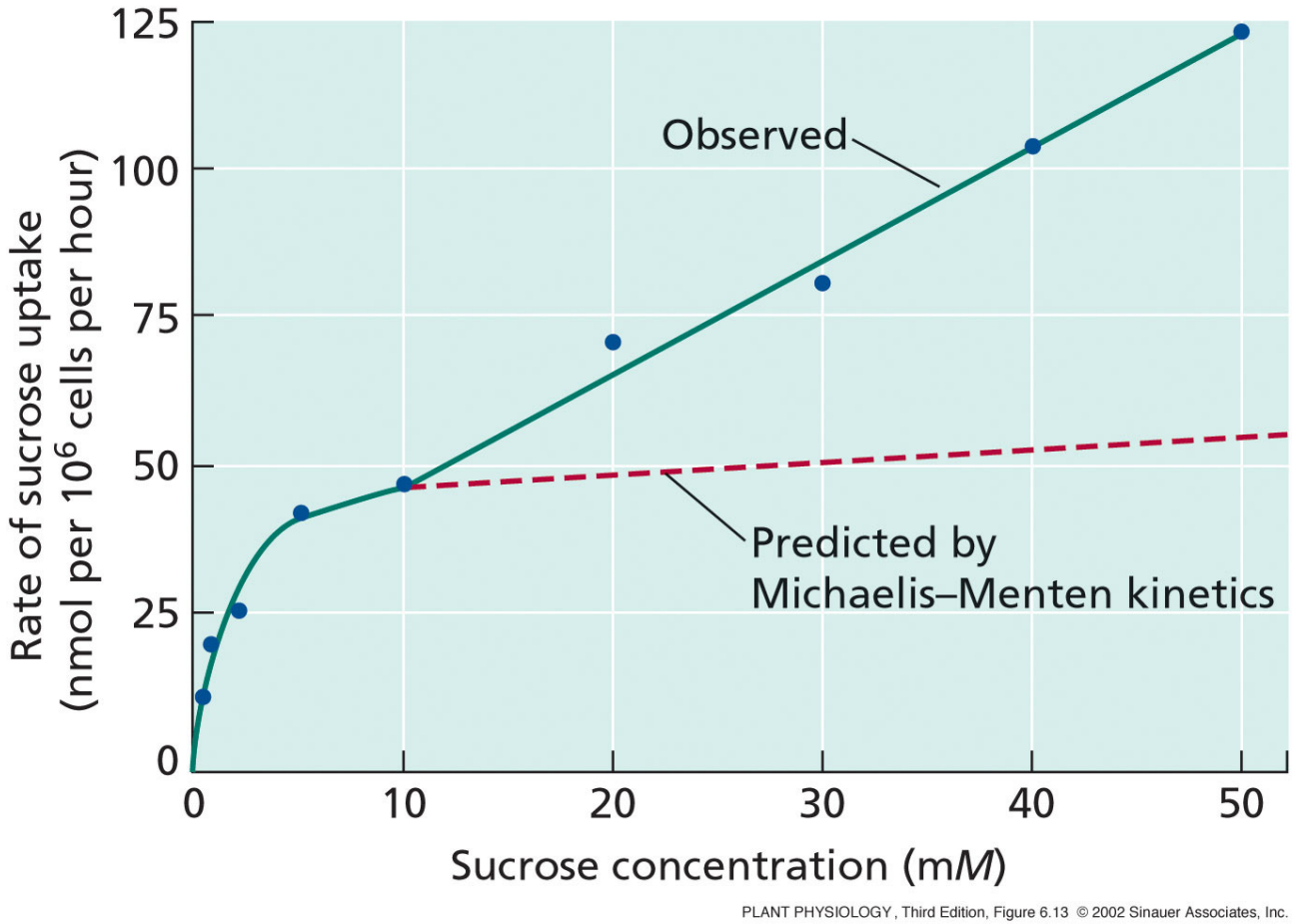
Facilitated Diffusion

- Protein mediated
- With concentration gradient
- Kinetic analysis



Facilitated diffusion



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Active transport

- **Movement of ions against gradient**
- **Voltage difference across a membrane**
  - **100-300 mv difference**
  - **inside negative to outside of cell**
- **Nernst Equation**
  - **Predict how ions get in/out of cell**
  - **Log [ion]in/[ion]out = -(delta E (z)/ 59)**
  - **calculate predicted vs actual conc in cell given outside conc**

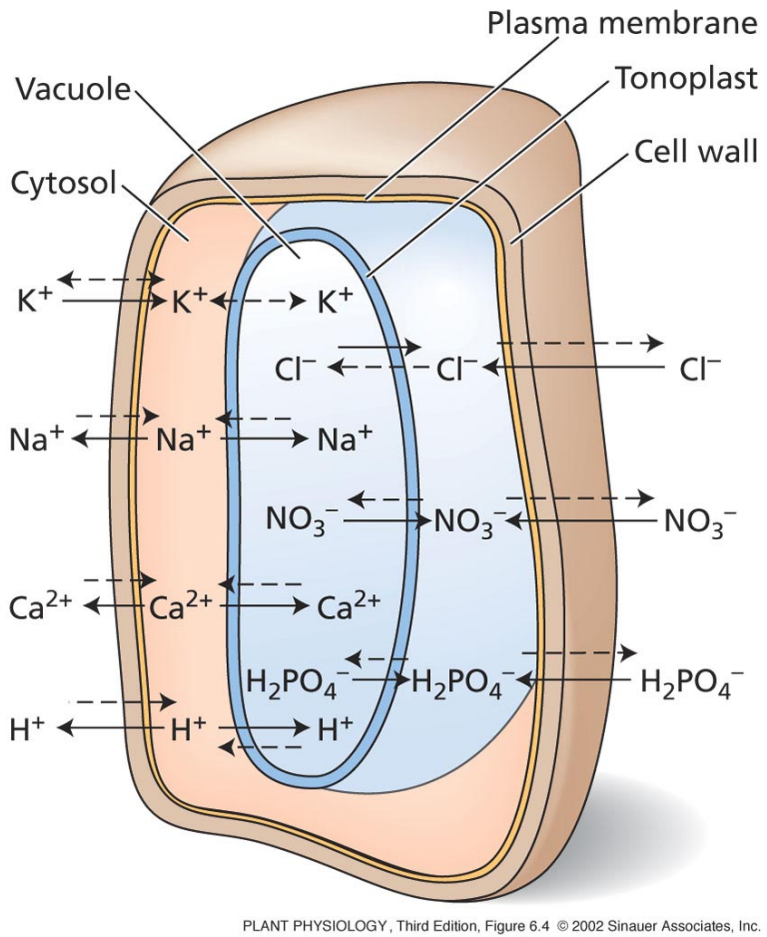
TABLE 6.1
Comparison of observed and predicted ion concentrations in pea root tissue

Ion	Concentration in external medium (mmol L^{-1})	Internal concentration (mmol L^{-1})	
		Predicted	Observed
K^+	1	74	75
Na^+	1	74	8
Mg^{2+}	0.25	1340	3
Ca^{2+}	1	5360	2
NO_3^-	2	0.0272	28
Cl^-	1	0.0136	7
$H_2PO_4^-$	1	0.0136	21
SO_4^{2-}	0.25	0.00005	19

Source: Data from Higinbotham et al. 1967.
Note: The membrane potential was measured as –110 mV.

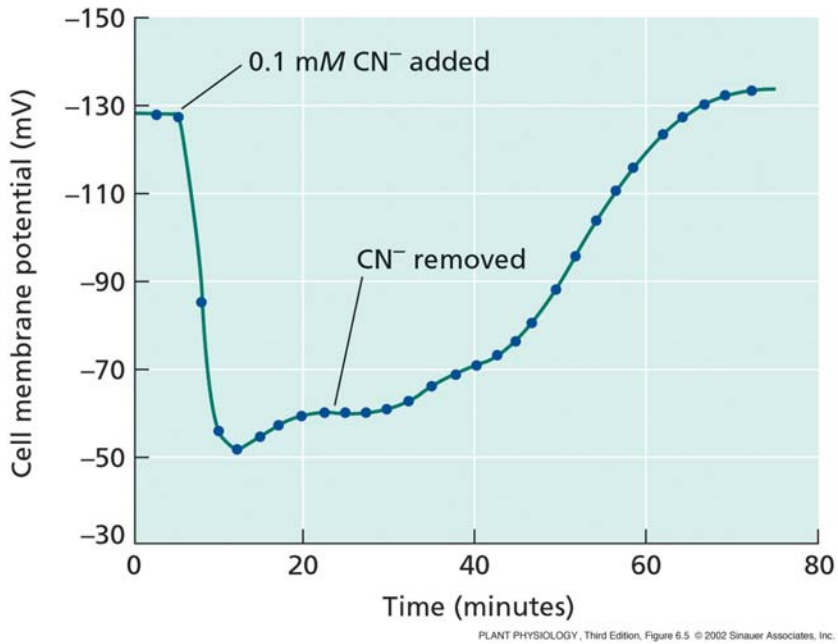
Transport of ions into cell

- K^+ passive
- Na^+ active out
- H+ pumped out of cytosol
- All anions actively transported in
- Ca^{+2} active out

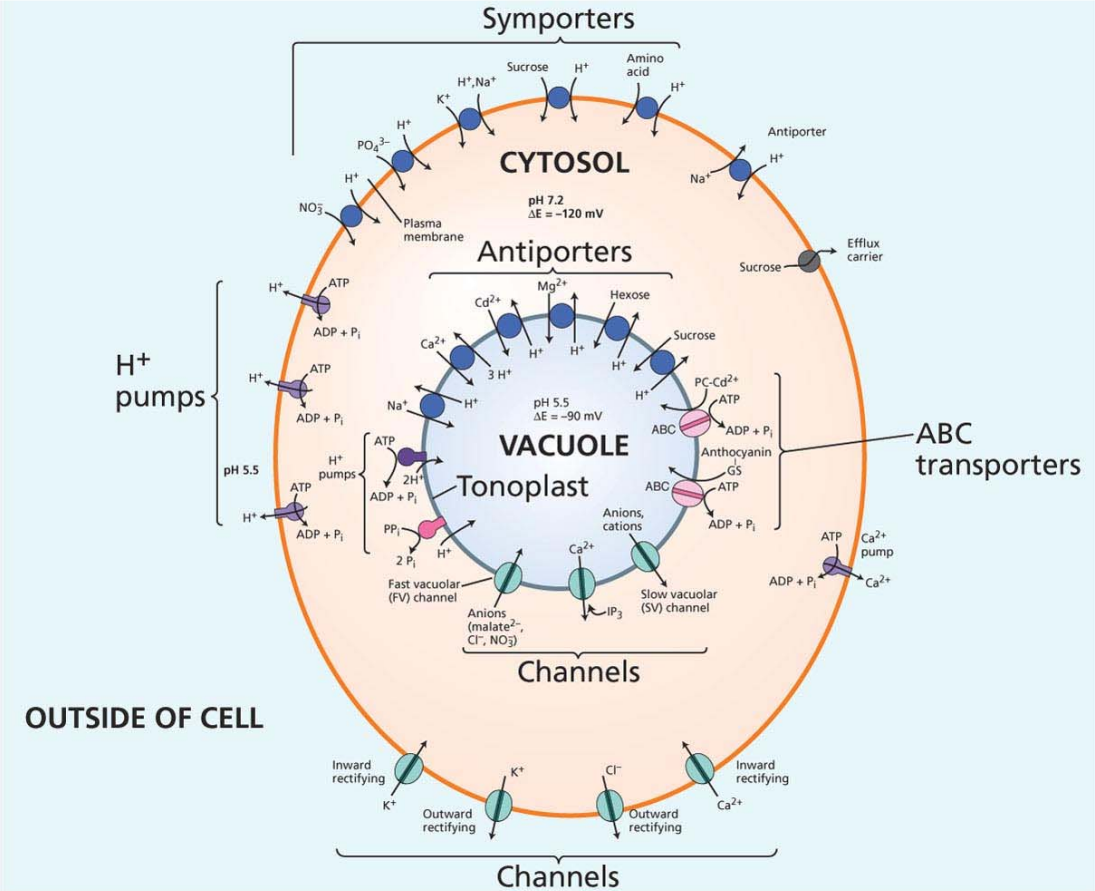


Proton pumping

- ATPase on Plasma membrane
  - pumps H+ ions out of cell
  - creates pH gradient
  - evidence (see handout)
- ATPase on vacuole membrane
  - vacuole less negative than cytoplasm
  - transport of ions into vacuole
- Types of transport
  - symport
  - antiport



Summary



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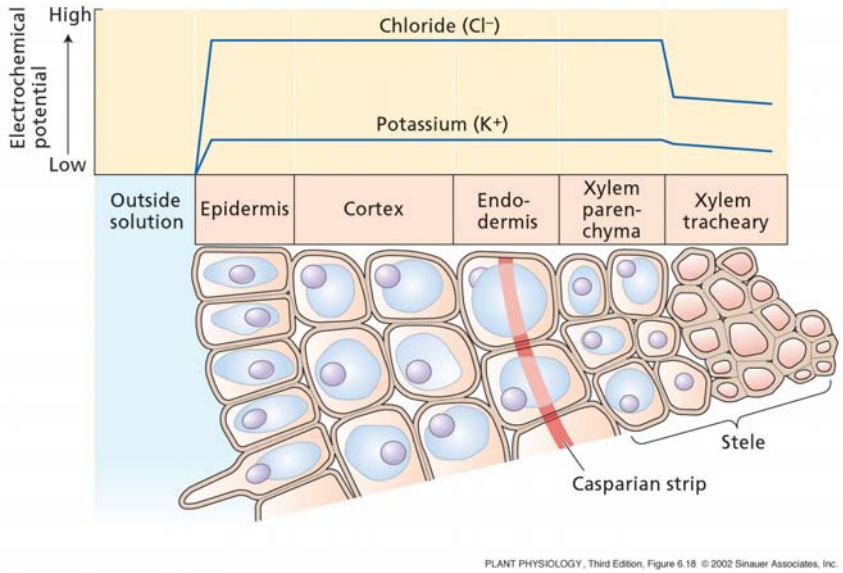
Xylem loading



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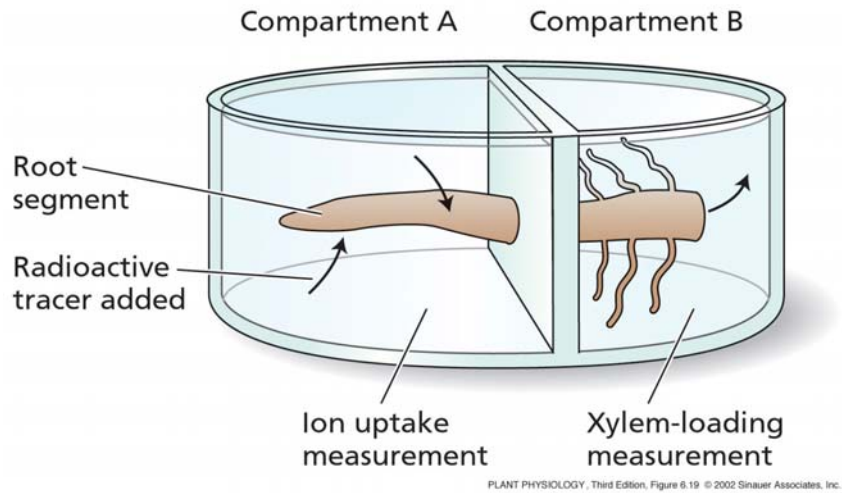

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