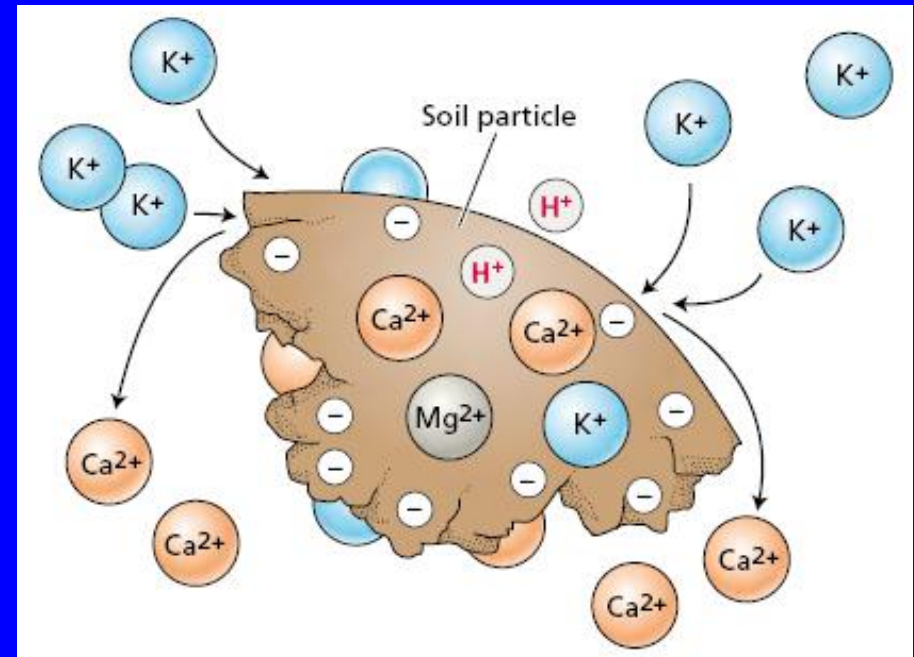


I. Root Absorption of Mineral Elements Adsorbed by Soil Particles

Soil particle surface carries negative charges and tends to adsorb cations, while anions are liable to loss.

The CO_2 released during respiration of roots and H_2O in soil form H_2CO_3 , which is dissociated into H^+ and HCO_3^- to make for ion exchange with soil.





2 Ions enter roots

(1) Both apoplast pathway and symplast pathway may be adopted.

3 Ions enter vessels or tracheids

(1) Negative diffusion: Ions are passively diffused into vessels from peripheric parenchyma cells along the concentration gradient.

(2) Active process: The treatment of protein synthesis inhibitor cycloheximide indicates ion entry into vessels is an active process of metabolism control.

(3) The channels on the plasma membrane of wood parenchyma cells are regulated by electrochemical potential and calcium concentration at the same time. Consequently, ions flow into vessels or tracheids.

Chapter VI Mineral Nutrients - Absorption of Mineral Elements

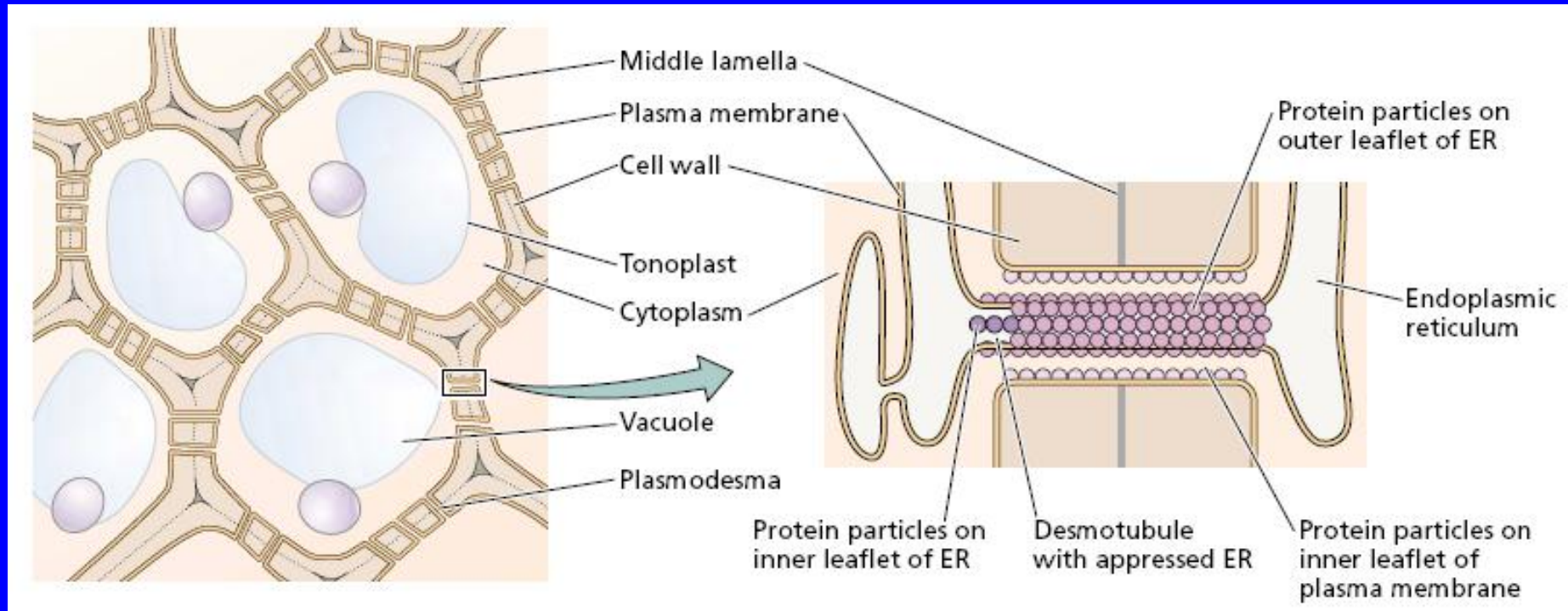


Diagram illustrating how plasmodesmata connect the cytoplasms of neighboring cells. Plasmodesmata are about 40 nm in diameter and allow diffusion of water and small molecules from one cell to the next. In addition, the size of the opening can be regulated by rearrangements of the internal proteins to allow the passage of larger molecules.



Chapter VI Mineral Nutrients - Absorption of Mineral Elements

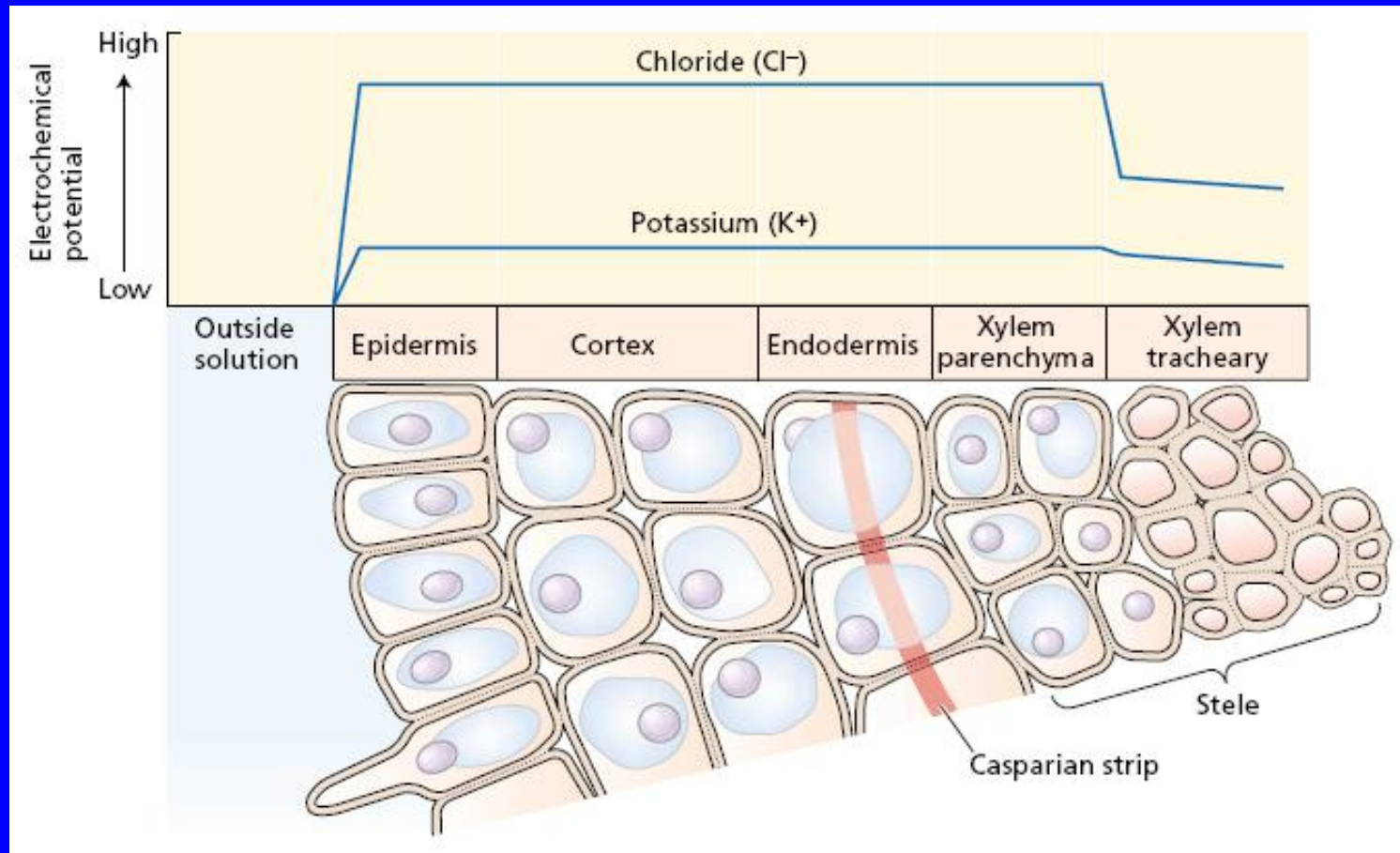


Diagram showing electrochemical potentials of K^+ and Cl^- across a maize root (Dunlop & Bowling, 1971).



III. Conditions Influencing Root Absorption of Minerals

(I) Temperature

1. Temperature \uparrow \rightarrow Respiration rate \uparrow \rightarrow Active absorption \uparrow
2. High temperature \rightarrow Enzymatic inactivation \rightarrow Respiration rate \downarrow \rightarrow Absorption element \downarrow
 \downarrow
 \rightarrow Membrane permeability \uparrow \rightarrow Outflow \nearrow
3. Low temperature \rightarrow Metabolism \downarrow \rightarrow Active absorption \downarrow
 \downarrow
 \rightarrow Viscosity \uparrow \rightarrow Ion absorption \downarrow

(II) Ventilation condition

$\left. \begin{array}{l} \text{O}_2 \uparrow \\ \text{CO}_2 \downarrow \end{array} \right\} \rightarrow \text{Respiration rate} \uparrow \rightarrow \text{Active absorption} \uparrow$

(III) Solution Concentration

1. At low concentration, concentration \uparrow \rightarrow number of absorbed ions \uparrow
2. At high concentration, absorption rate is irrelevant with concentration

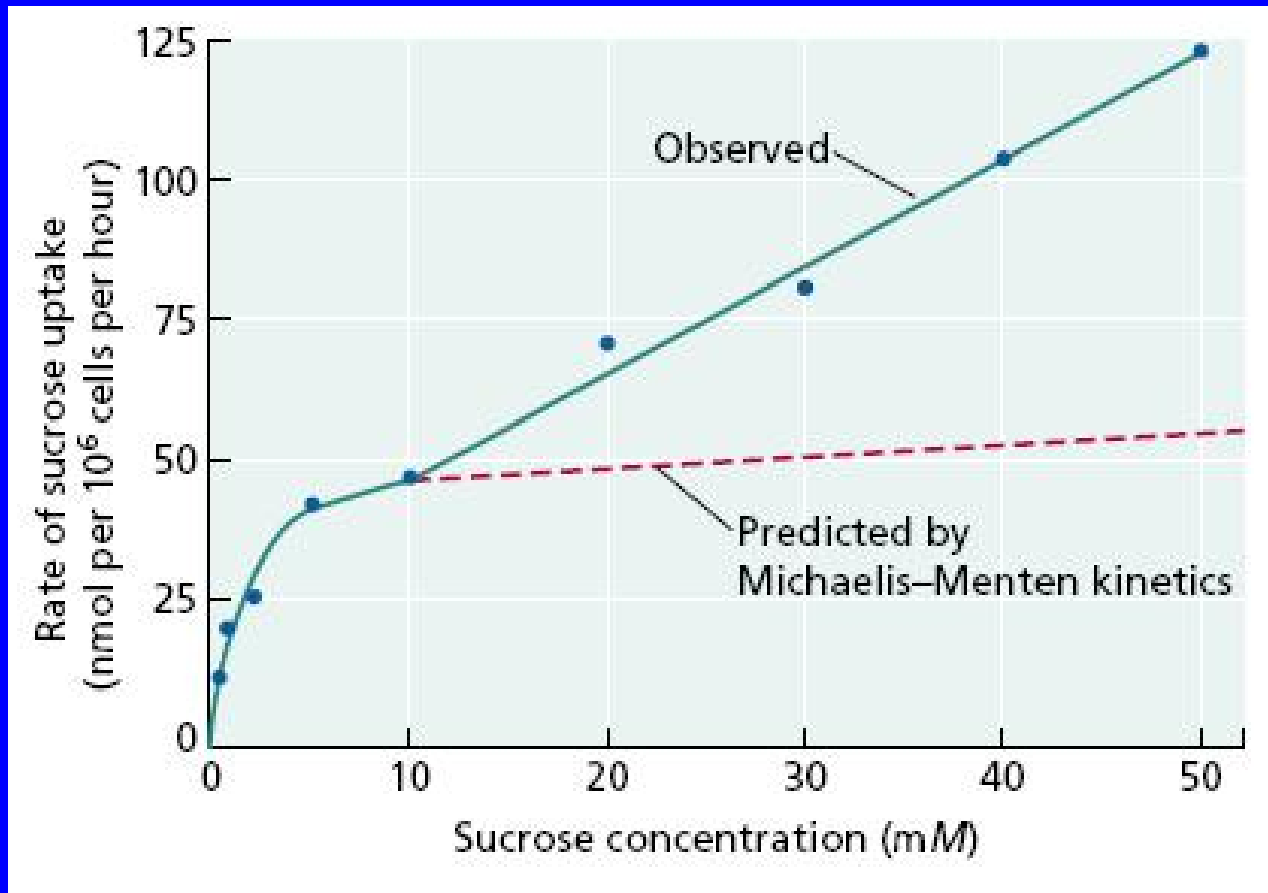
(IV) Concentration of hydrogen ions

1. Direct influence

- ① Weak acid environment \rightarrow protein carries positive charges \rightarrow adsorb negative ions
- ② Weak alkali environment \rightarrow protein carries negative charges \rightarrow adsorb positive ions



Chapter VI Mineral Nutrients - Absorption of Mineral Elements



The transport properties of a solute can change at different solute concentrations.



Chapter VI Mineral Nutrients - Absorption of Mineral Elements

2. Indirect influence

① Cause dissolution or precipitation of nutrients in the solution

a. Alkalinity $\uparrow \rightarrow \text{Fe}^{2+}$, BO_3^{3-} , Mn^{2+} , Cu^{2+} and Zn^{2+} are not soluble

b. Acidity $\uparrow \rightarrow \text{K}^+$, PO_4^{3-} , Ca^{2+} , NO_3^- , Mg^{2+} and SO_4^{2-} are highly soluble and don't have time for absorption; meanwhile Al^{3+} , Fe^{2+} and Mn^{2+} are highly soluble and the plants suffer.

② Influence the activity of microorganisms

a. Acidity \rightarrow rhizobia are dead

b. Alkalinity \rightarrow denitrifying bacteria grow well





Influence of soil pH on the availability of nutrient elements in organic soils. The width of the shaded areas indicates the degree of nutrient availability to the plant root. All of these nutrients are available in the pH range of 5.5 to 6.5. (Lucas & Davis 1961)



IV. Absorption of Mineral Elements by Aerial Parts of Plants

1. Foliage nutrition: The process of absorption of minerals by the aerial parts of plants, also called leaf nutrition.
2. Absorption process:
Fractures or stomata of cuticle→cell wall→ ectodesma → plasma membrane→ inside cells → → →vein phloem
3. Internal and external factors influencing absorption
 - (1) The absorption of tender leaves is fast and large
 - (2) The longer the solution retention time is, the larger the absorption amount will be
 - (3) Solution concentration should be 1.5%-2.0%

4. Advantages:

- (1) When the fertilizer absorption ability of crop roots declines in the later stage of development, or the nutrition-critical stage, foliage fertilization may supplement nutrition.
- (2) The foliage fertilization amount of fertilizers that can be easily fixed by soil, such as Fe^{2+} , Mn^{2+} and Cu^{2+} , is small
- (3) During supplementation of trace elements that the plants lack, the effect is fast and the use level is low.