



Bachelor 2: Plant physiology

Lesson 2:

TRANSPORT AND TRANSLOCATION OF WATER AND SOLUTES

Instructor: LE Thi Van Anh

le-thi-van.anh@usth.edu.vn

Learning outcome

By the end of this course, students are able to:

- Describe some basic terms: **transportation, translocation** and **transpiration**
- Understand 2 processes: passive and active **cellular transport**
- Describe the different routes of water and solute mineral **absorption from soil to root**
- Analyze the different forces ensuring the **transport in xylem**
- Describe the process of **transpiration** through stomata

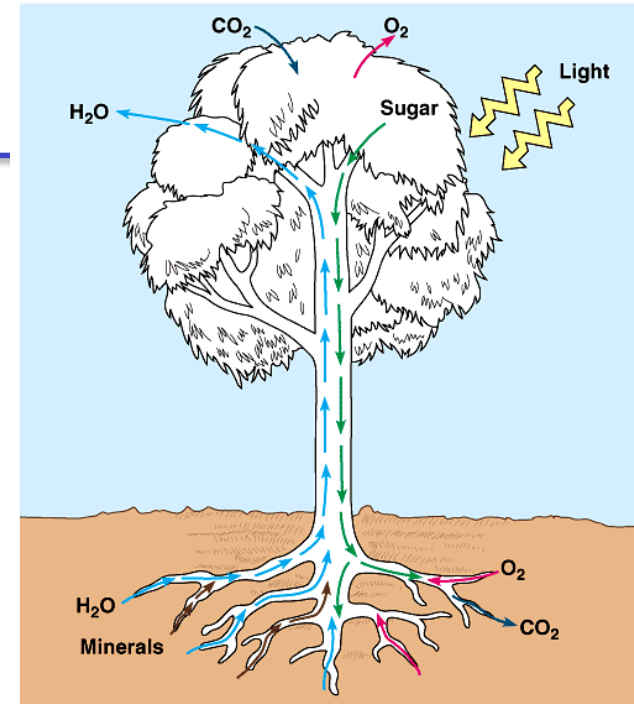
Concept:

What must be transported in plants?

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What kind of transport in plants:

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Focusing...

- 1) Cellular transport
- 2) Water & Mineral Absorption of Roots
- 3) Transport of Xylem Sap
- 4) Control of Transpiration
- 5) Translocation of Phloem Sap

Cellular transport...

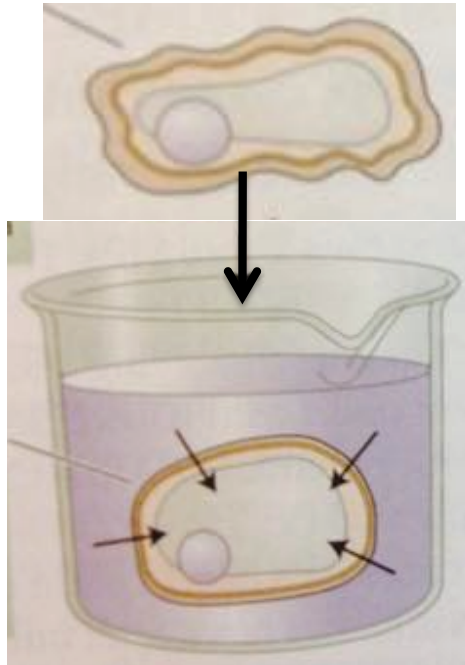
Passive

Active

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Cellular transport: passive water transport...

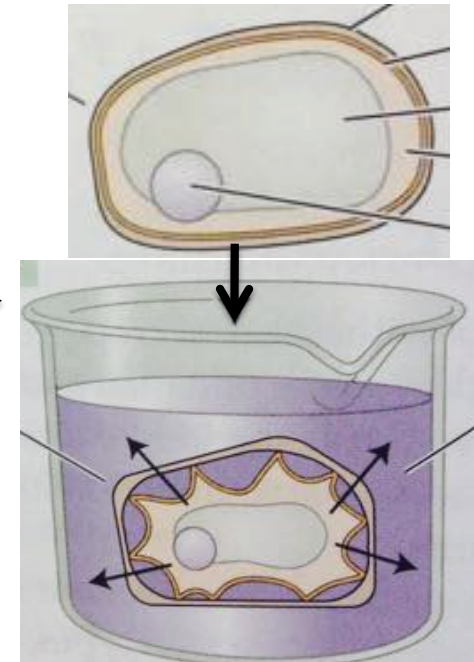
Flaccid cell dropped into
0.1M sucrose solution



Water come into cell

Add more sucrose

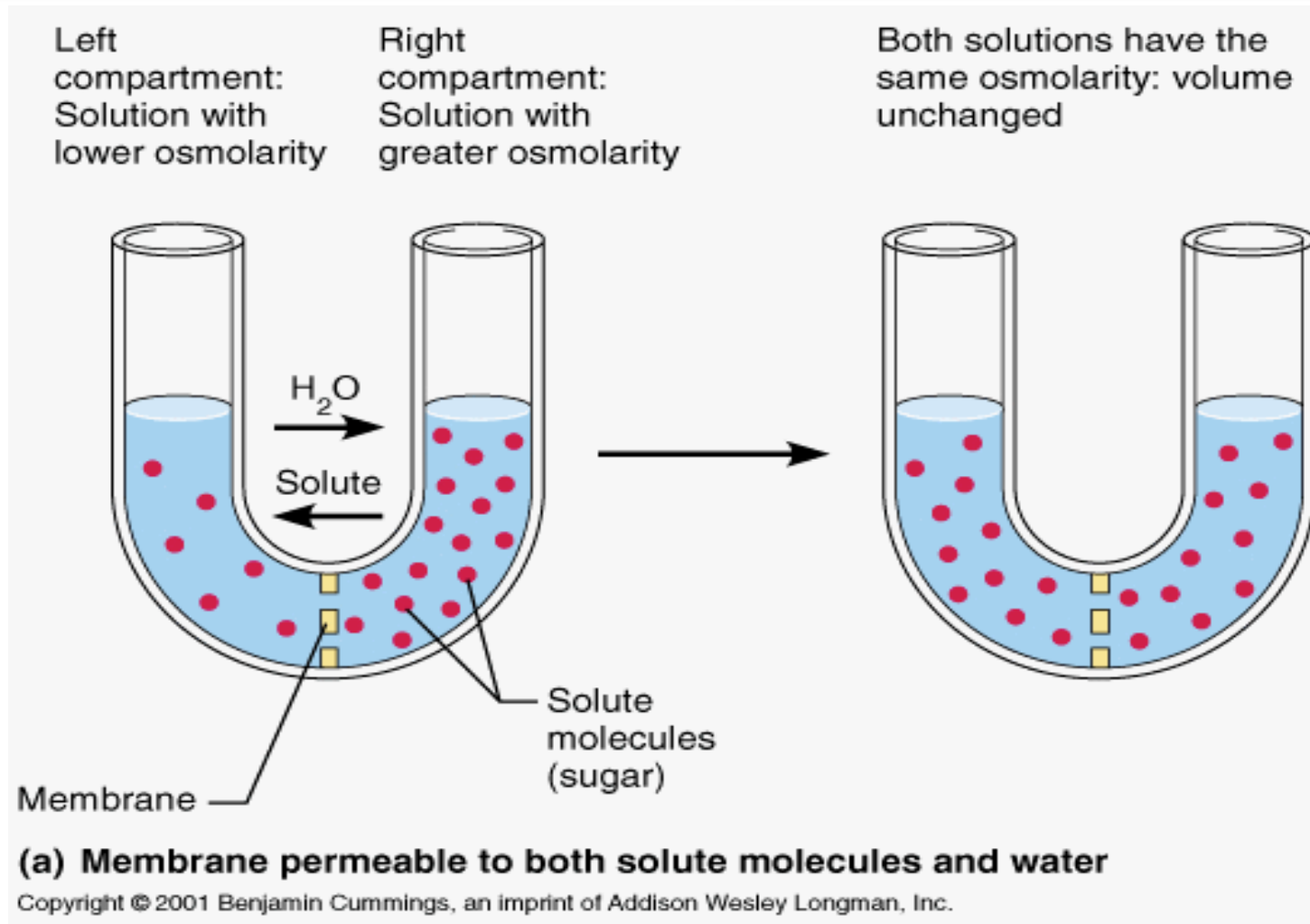
Turgid cell



Water go out

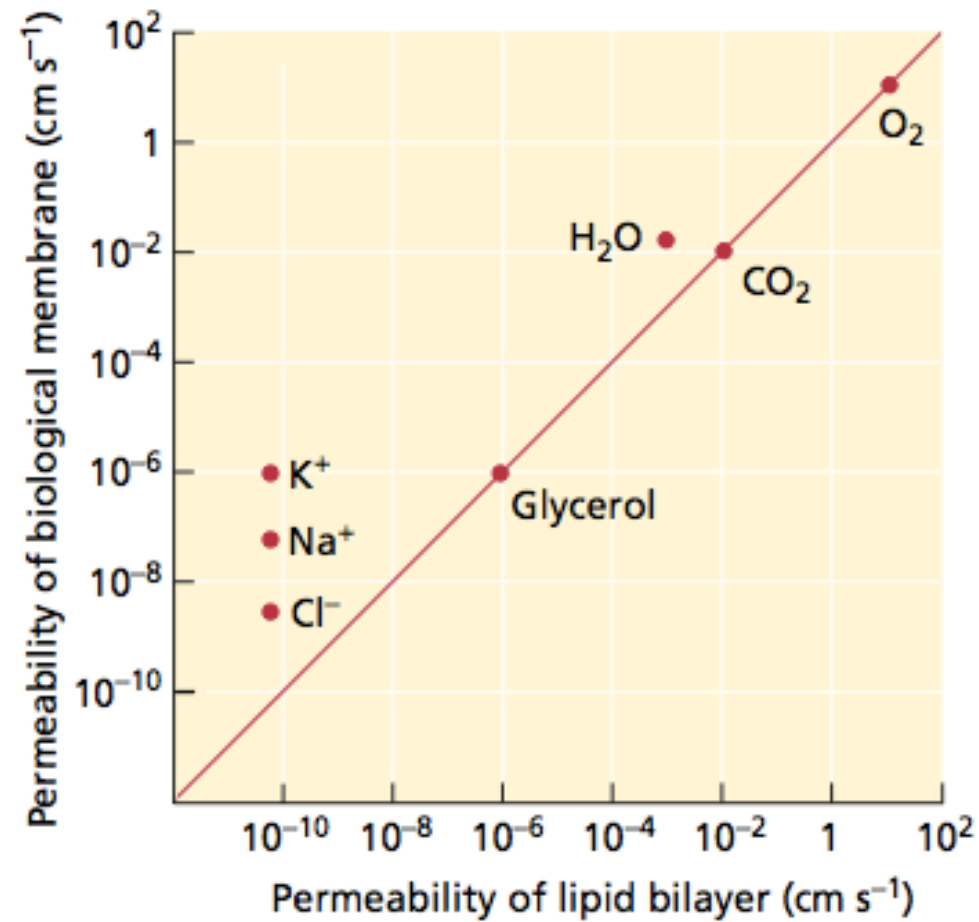
Moves from high H_2O potential to a low H_2O potential

Cellular transport: passive solute transport...



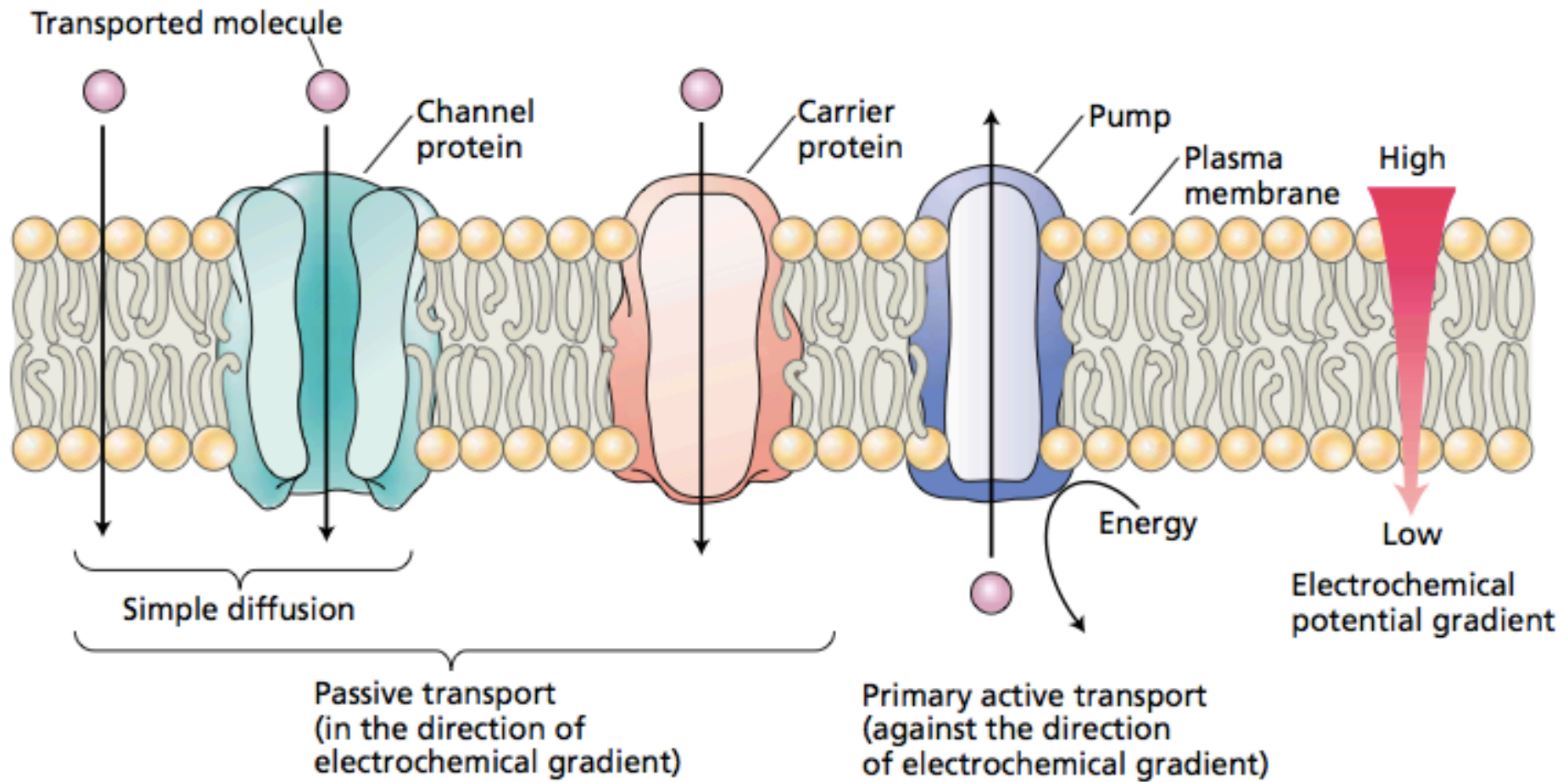
Solutes move from greater to lower osmolarity

Permeability of cellular membrane



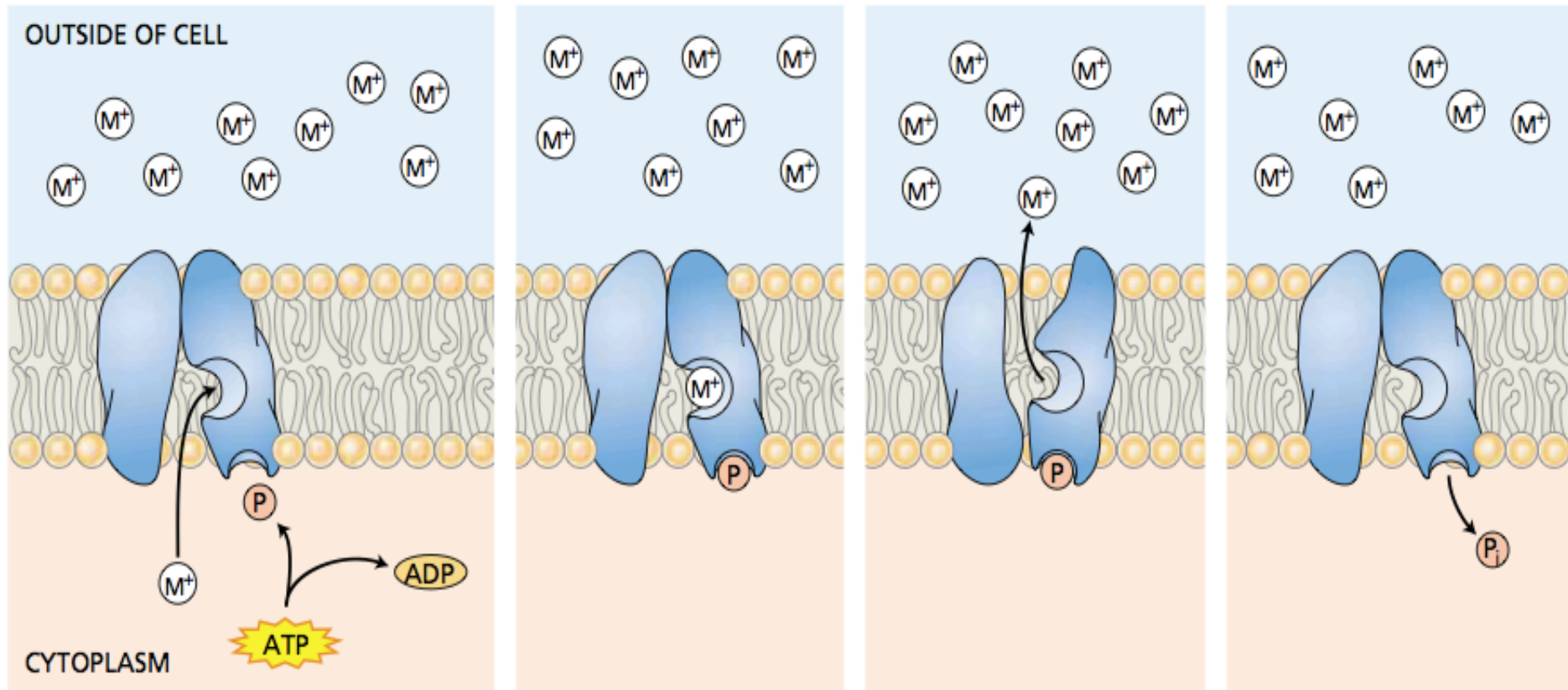
Why???

Cellular transport: transport protein



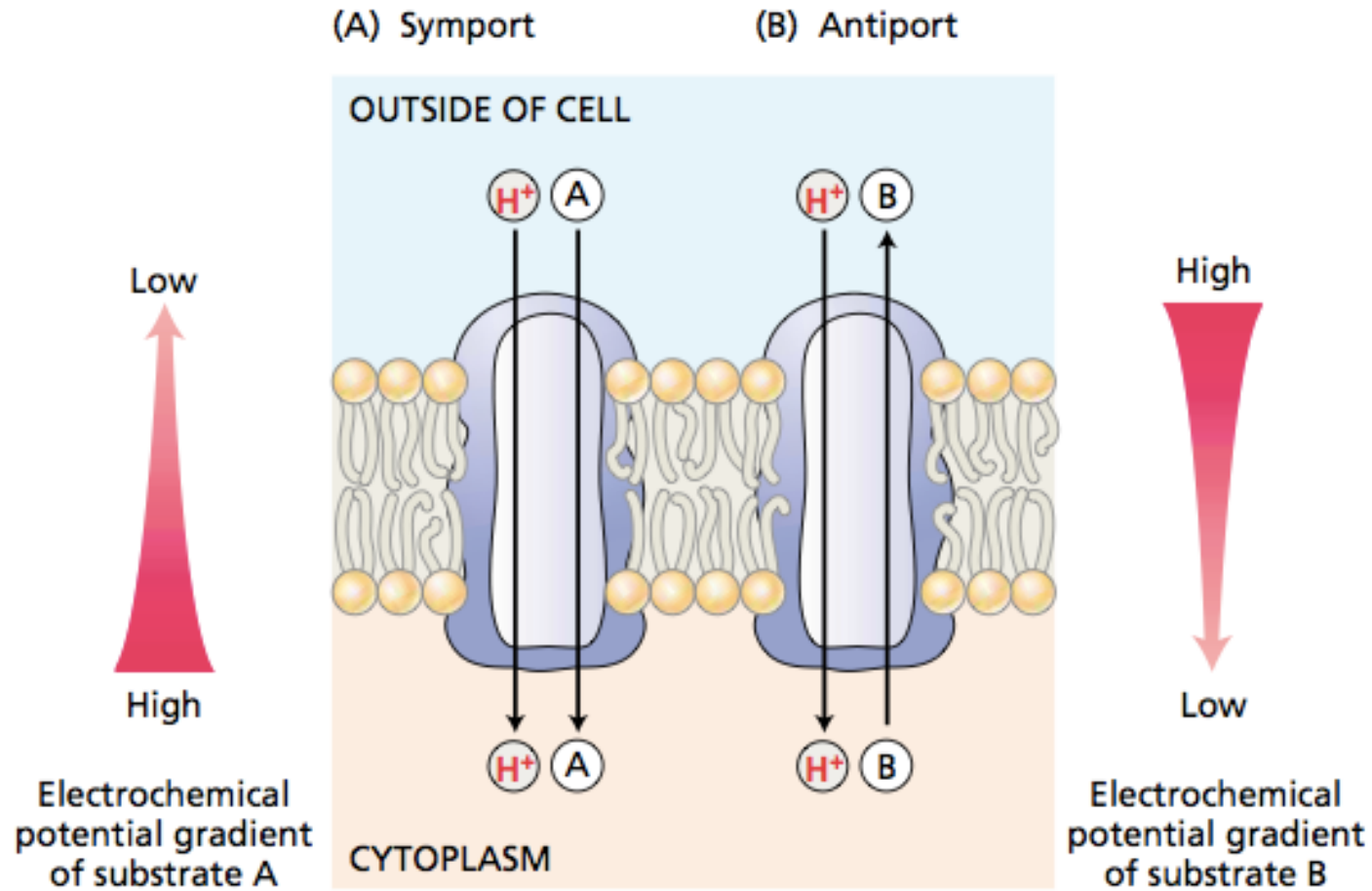
Three classes of membrane transport protein

Cellular transport: carrier protein



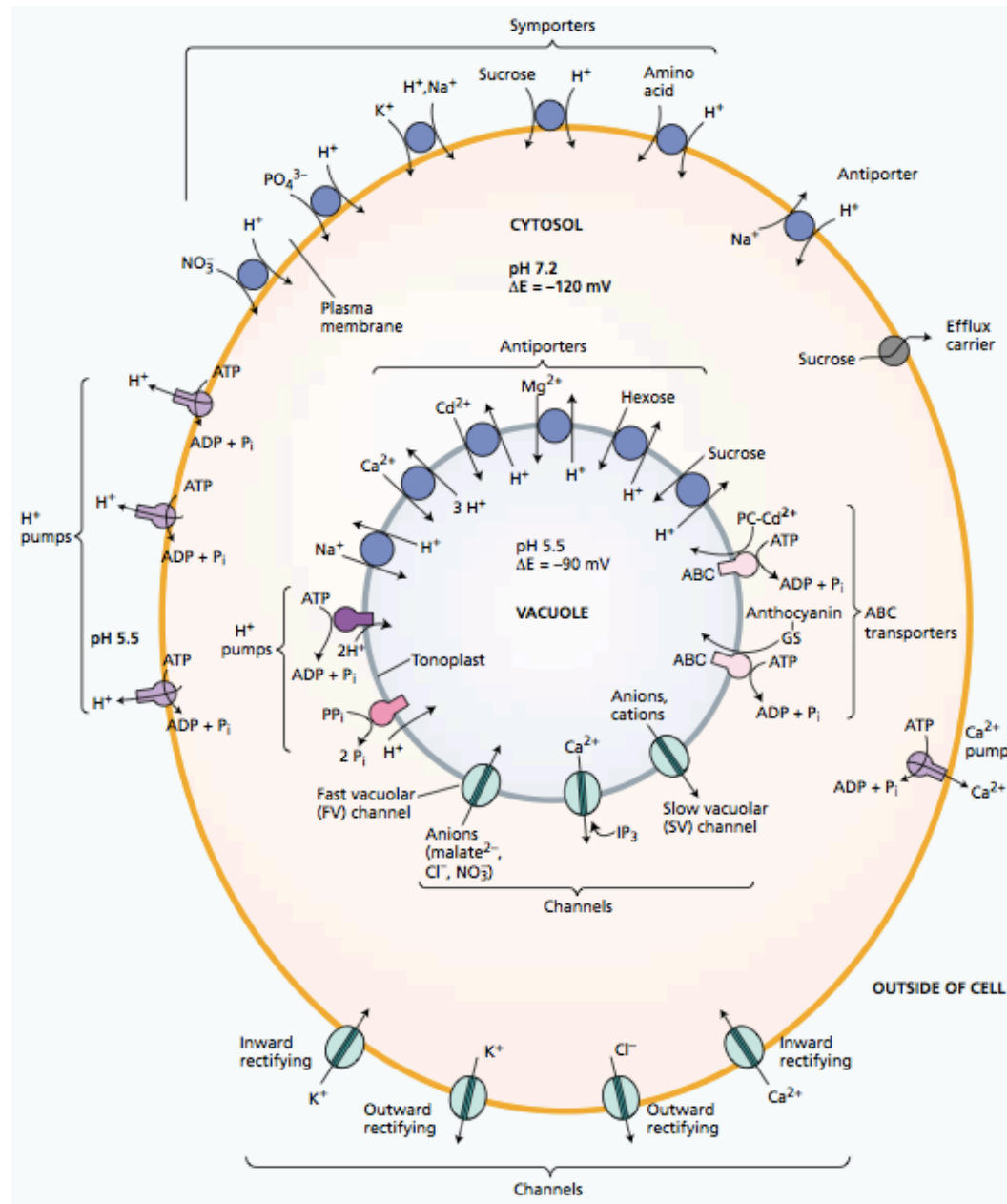
Hypothetical model for cation transport by a pump:
Energy comes from ATP hydrolysis
« **primary active transport** »

Cellular transport: pump protein

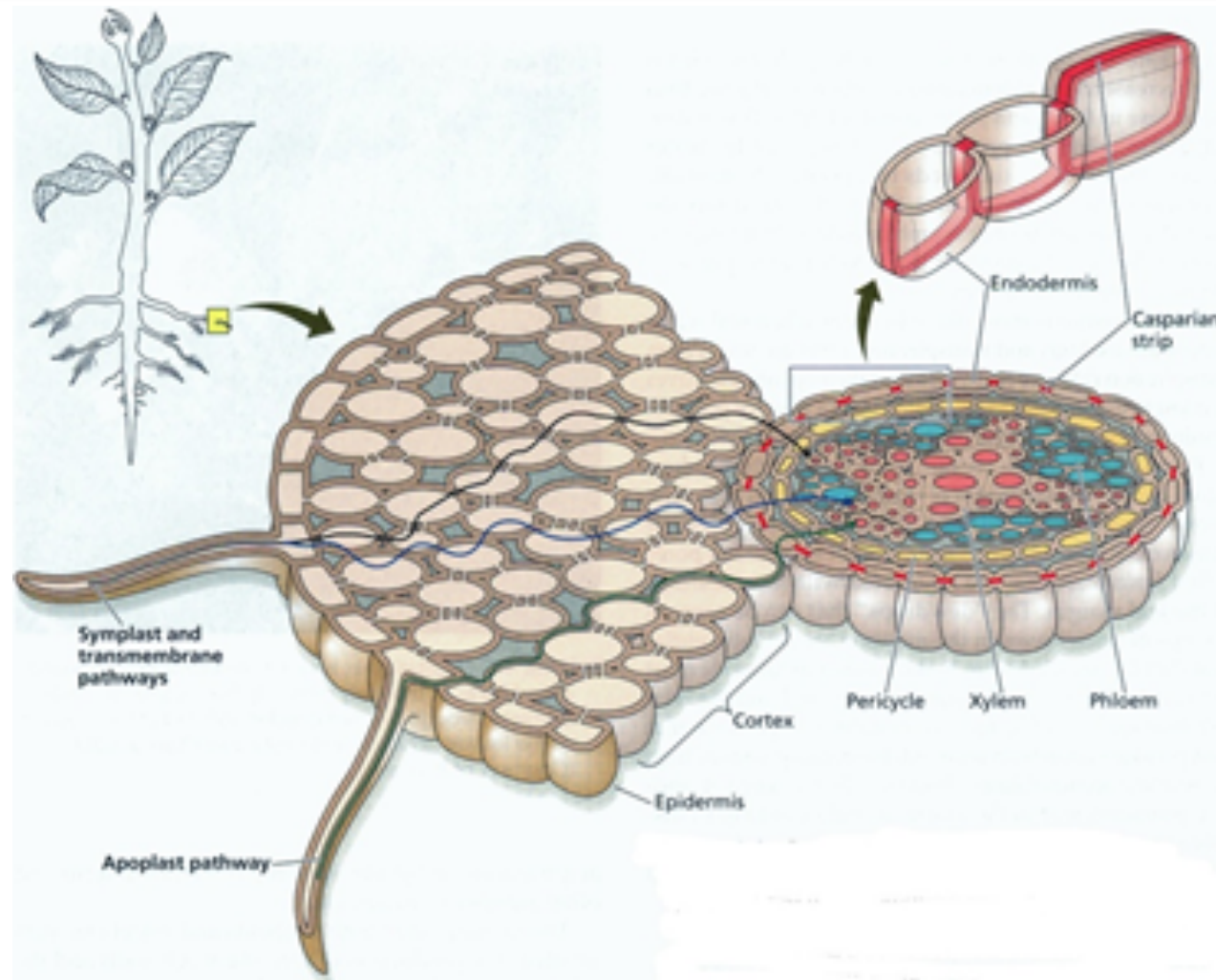


Two types of secondary transport

Overview of the various transport processes on the plasma membrane and tonoplast of plant cells



Water Absorption of Roots



Water Absorption of Roots

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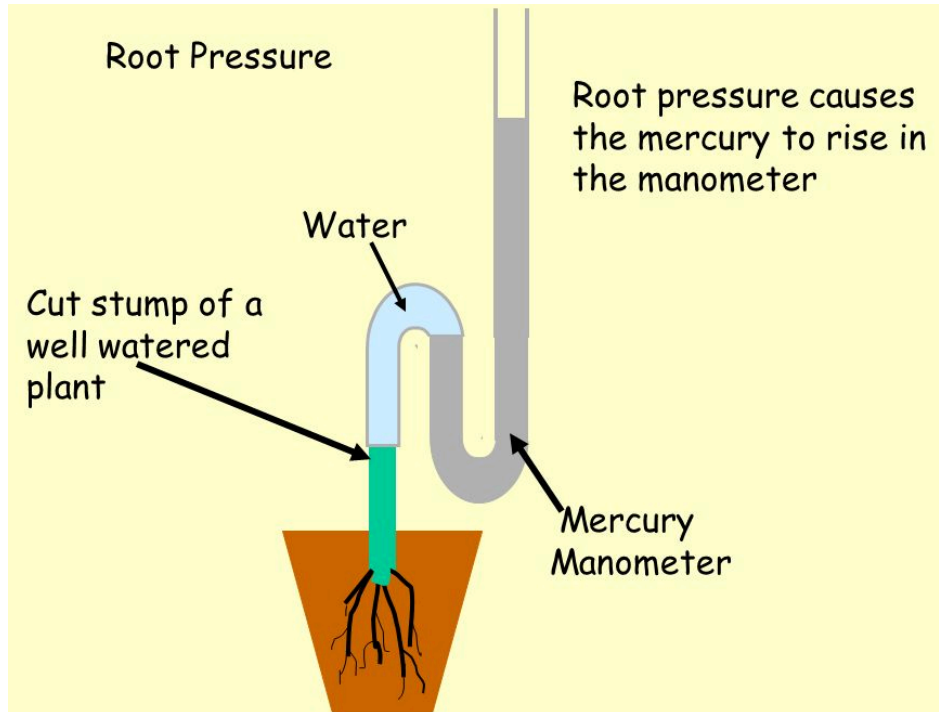
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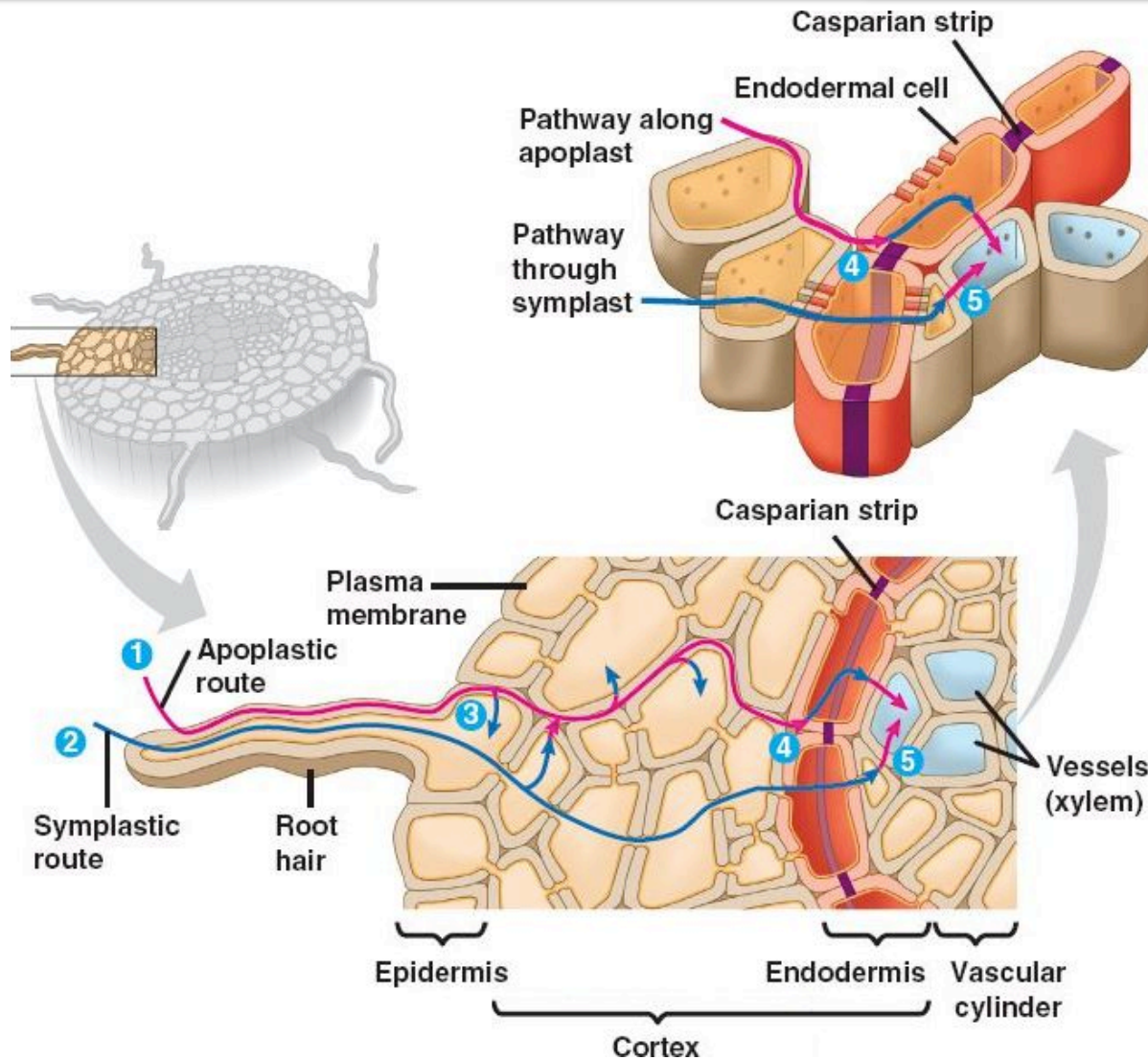
Root pressure



- Force (pressure) caused by water bulk flow from soil to xylem.
- Manometer can measure positive pressure about 0.05 to 0.2 MPa

Guttation: exudation of xylem sap through hydrathodes

Ion Absorption of Roots and xylem loading



1. Cortex:

2. From endodermis to xylem parenchyma:

3. Enter to tracheary elements

Transport in xylem

How does water move up to xylem?

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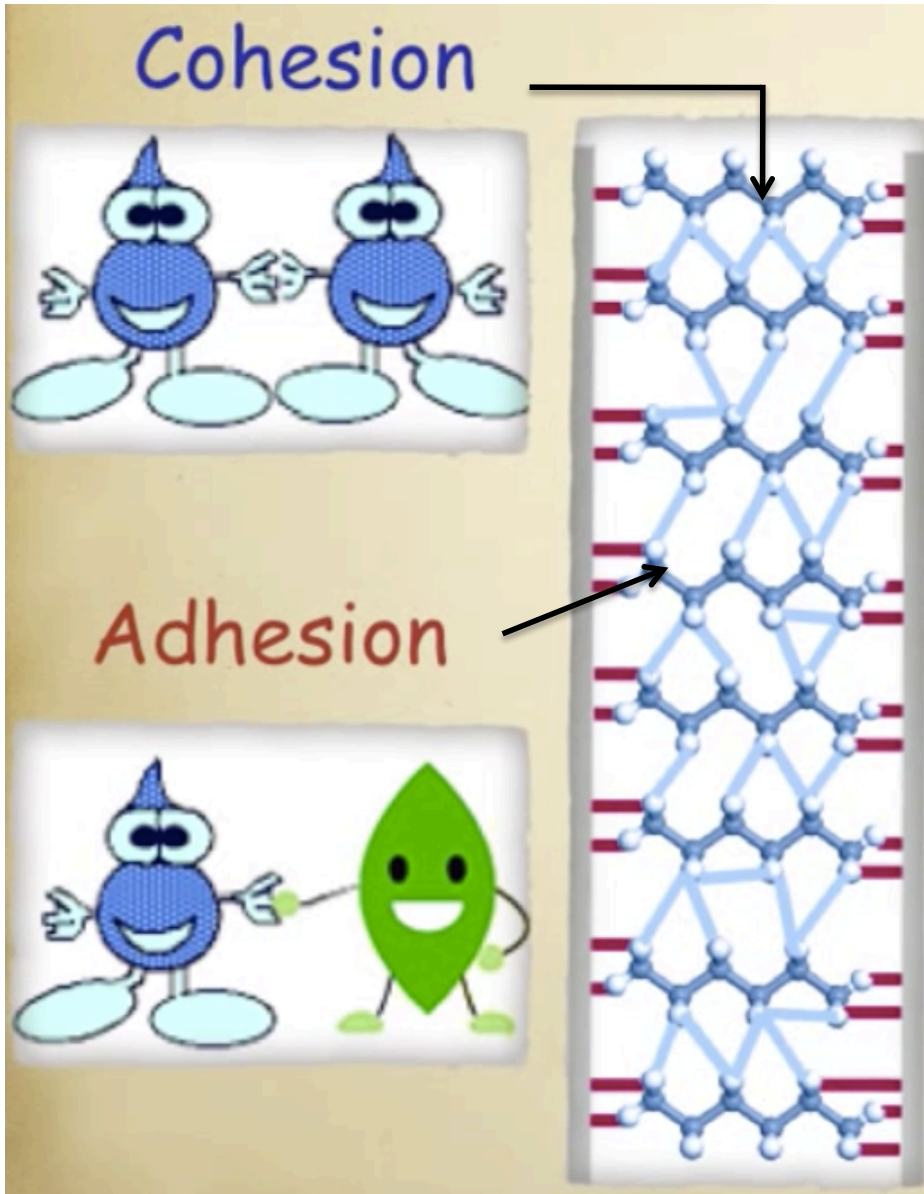
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Cohesion-tension theory



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Transpiration: water movement to atmosphere

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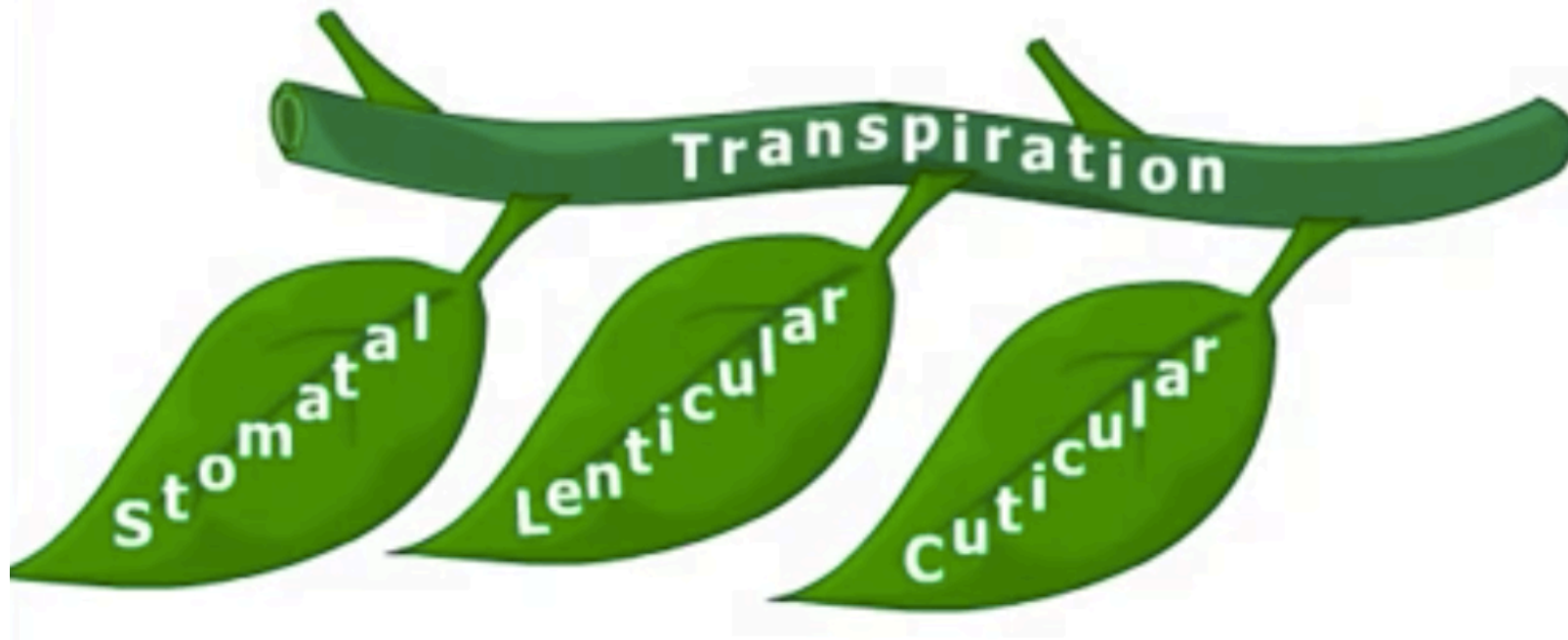
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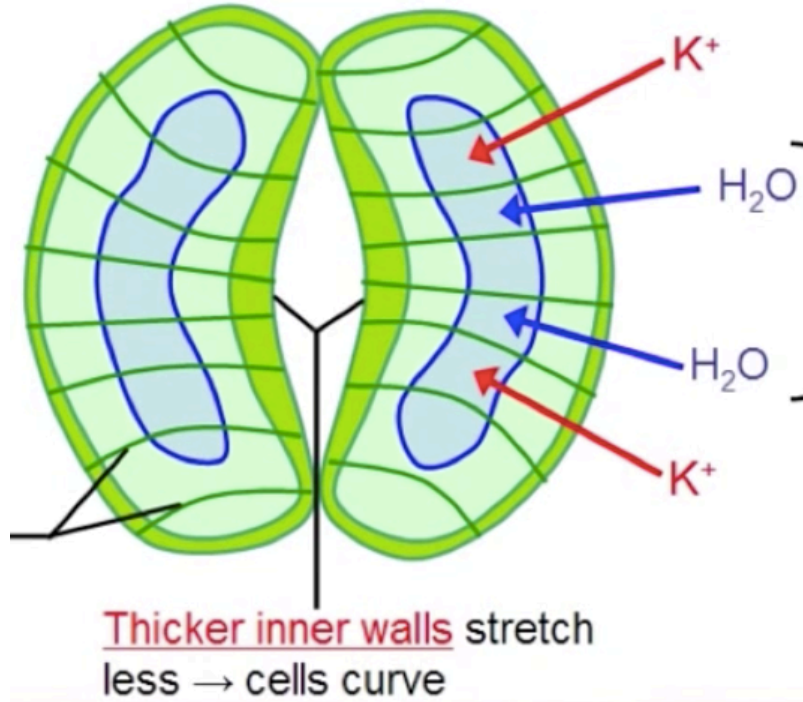
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Types of transpiration

How many types of transpiration?



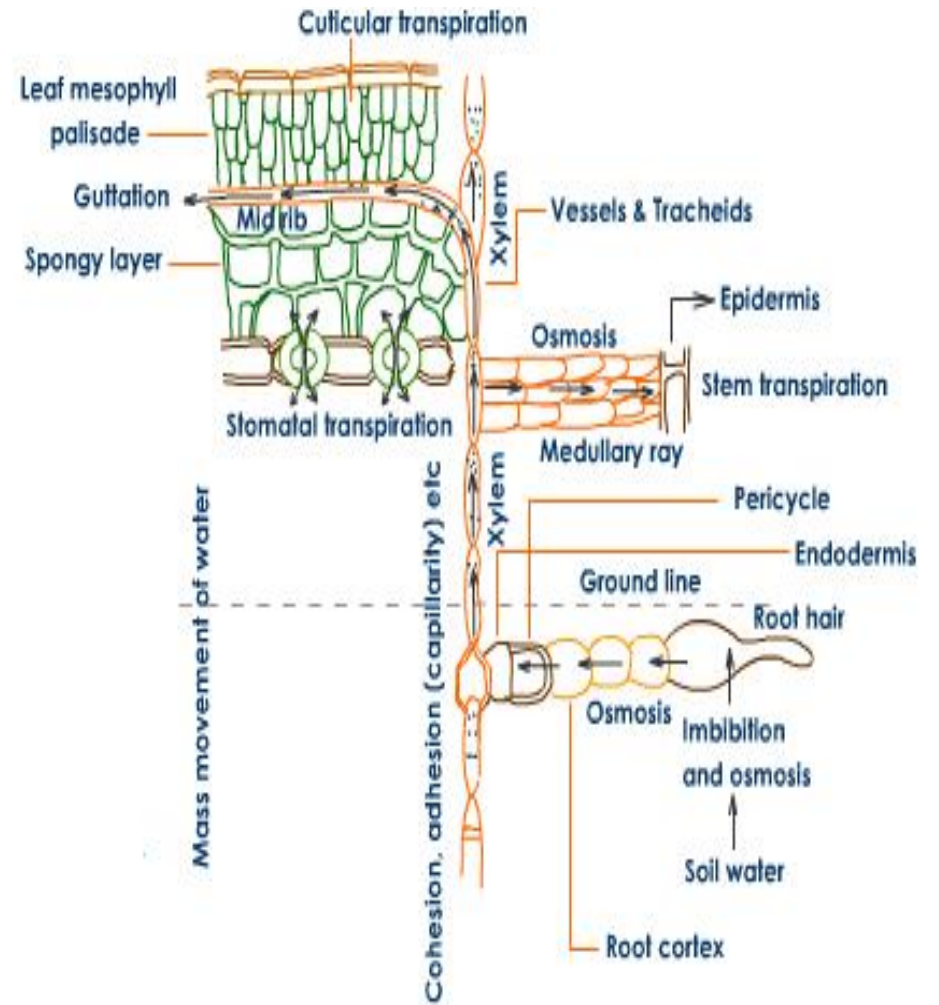
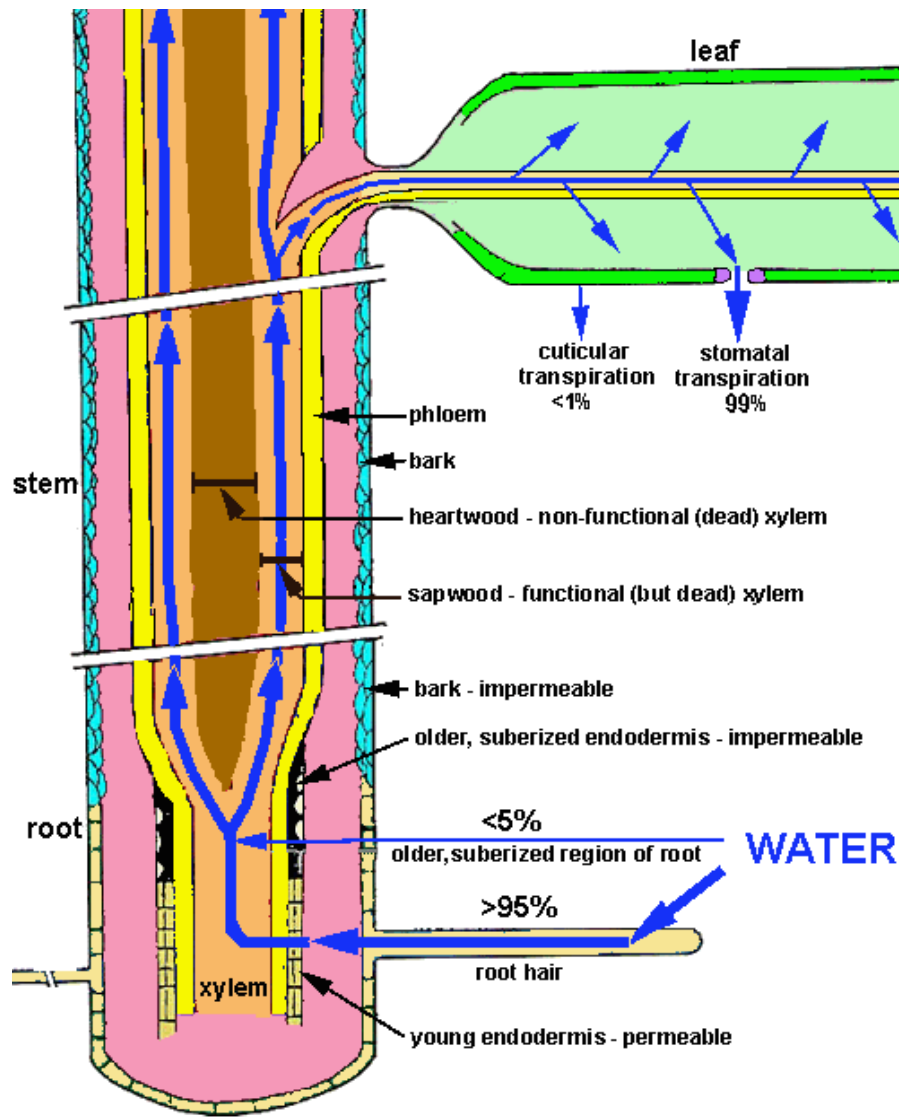
Transpiration through stomata



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Water pathway through the leaf

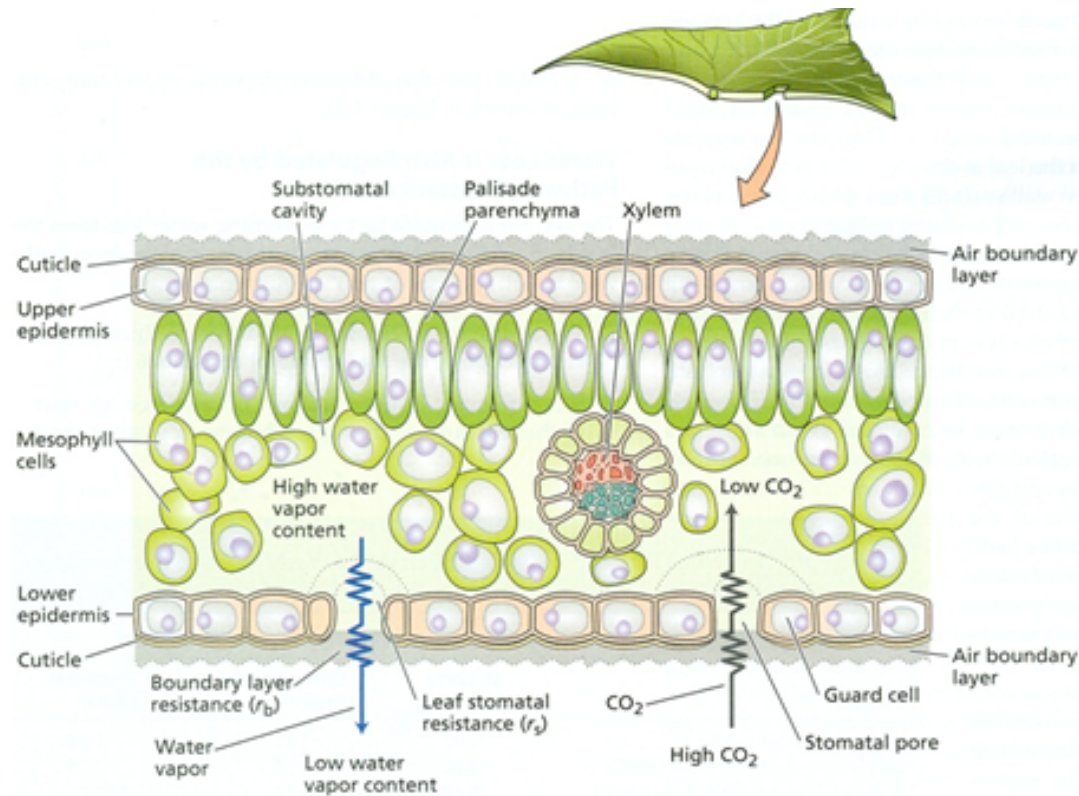


Transpiration ratio

Transpiration ratio (TR) = water transpired/carbon dioxide assimilated

For C3 plant, TR= 1/400

TR is used to evaluate the “water use efficiency”



How to increase “water use efficiency”?

Adaptation for using water efficiently

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