

# UPTAKE OF WATER AND MINERAL SALTS BY THE PLANTS

- ◉ Absorption of water and mineral salts by the plant can be explained in 3 steps
  1. Uptake of water and mineral salts
  2. Movement of water to the xylem of the root
  3. Upward movement of water in the xylem from the roots to the leaves

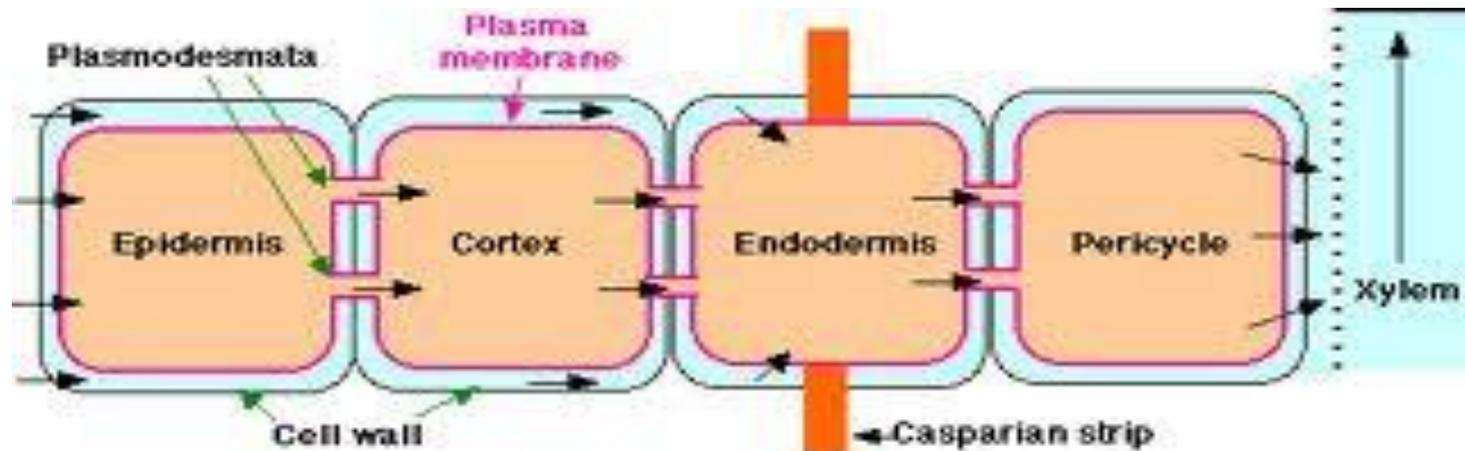
# UPTAKE OF WATER AND MINERAL SALTS BY THE PLANTS

- The soil water between the soil particles contain less dissolved substances than the cell sap in the vacuoles of the root hairs
- The water potential of the soil solution is higher than the water potential of the cell sap. This causes a water potential gradient between the soil solution and the cell sap
- Water molecules move by **osmosis** down a water potential gradient through the permeable cell wall through selectively permeable cell membrane
- Because of the influx of the water molecules the water potential of the cell sap increases

- The vacuole swells and the pressure within the root hair, known as **turgor pressure** increases
- Mineral salts are absorbed **against** the concentration gradient, because there is a higher concentration of dissolved nutrients in the cell sap than in the soil solution.
- Therefore mineral salts are **actively** absorbed out of the soil which means **energy** is required for the process.

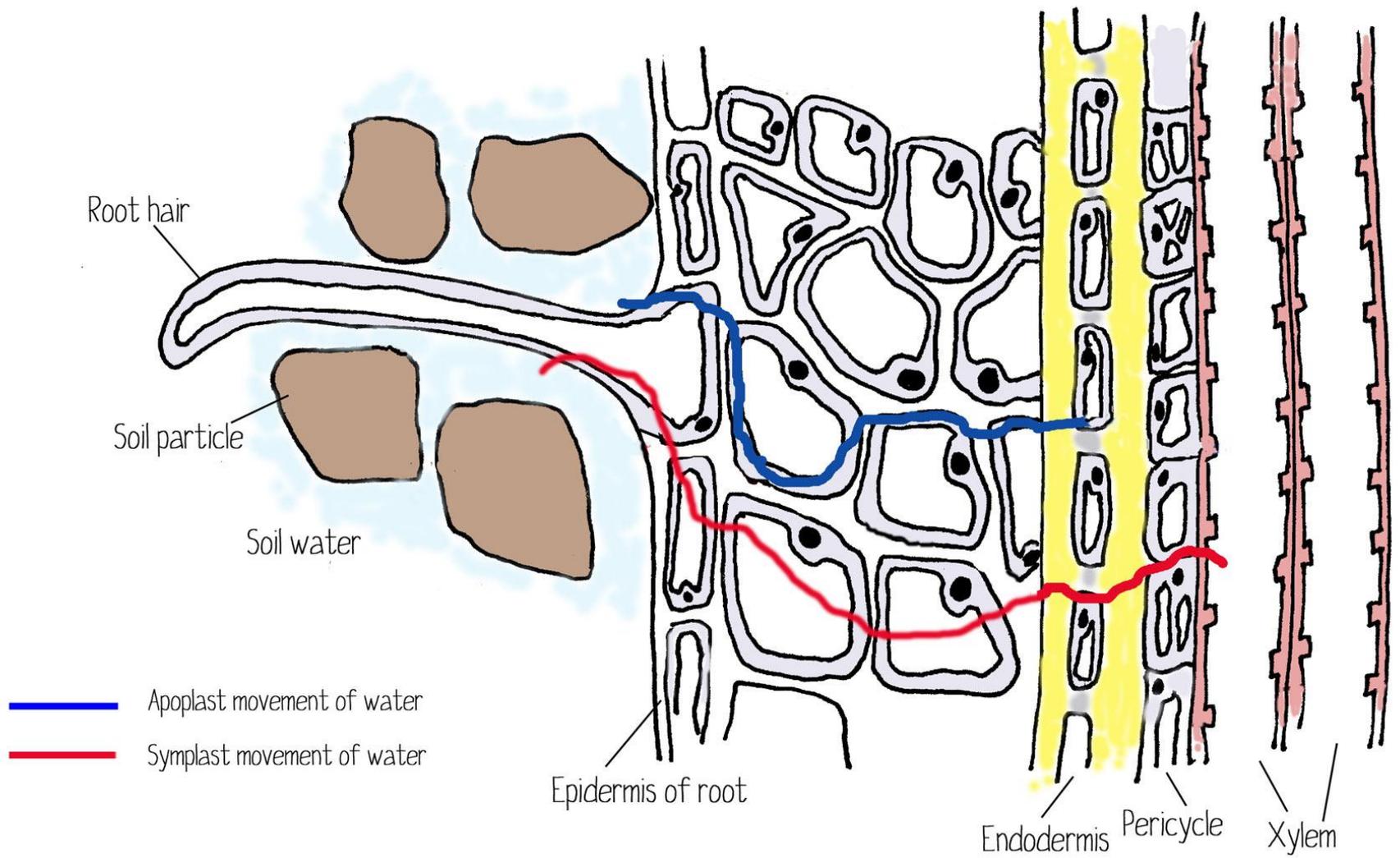
# CLASS ACTIVITY - UPTAKE OF WATER AND MINERAL SALTS

- Explain the lateral movement of water in the root using the diagram below.



# MOVEMENT OF WATER TO THE XYLEM OF THE ROOT

- The water potential in the vacuole of the root hair is higher than that of the adjacent parenchyma cells in the cortex
- Water can move via two routes down a concentration gradient:
  - The main route is from cell to cell by osmosis - resulting in slow movement
  - Water can move through cell walls and intercellular air spaces between cells by diffusion - faster movement
- When water reaches the endodermis containing the Casparian strips it cannot pass through the cell walls but moves through the passage of cells of the endodermis, through the pericycle to the root xylem



# UPWARD MOVEMENT OF WATER IN THE XYLEM FROM THE ROOTS TO THE LEAVES

- The root xylem joins the stem xylem in which the water moves upwards to the leaf
- 3 forces involved:
  - Capillarity
  - Root pressure
  - Transpiration pull

# CAPILLARITY

- The phenomenon whereby liquids will spontaneously move up tubes that have a very small bore (cross section)
- The xylem vessels and the tracheids of the stem xylem are very narrow vessels, therefore water will move upwards due to capillary action
- Capilarity is a weak force consisting of **cohesion** and forces
- Cohesion is the force of attraction between water cells
- Adhesion is the force of attraction between water molecules and the walls of the xylem vessels
- Together they make water move upward in a continuous column

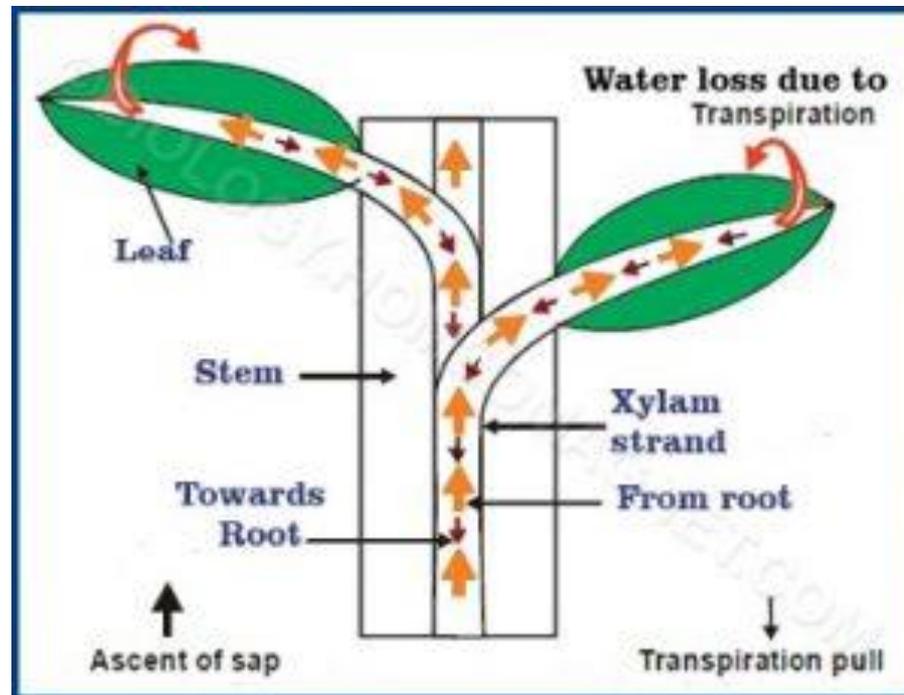
# ROOT PRESSURE

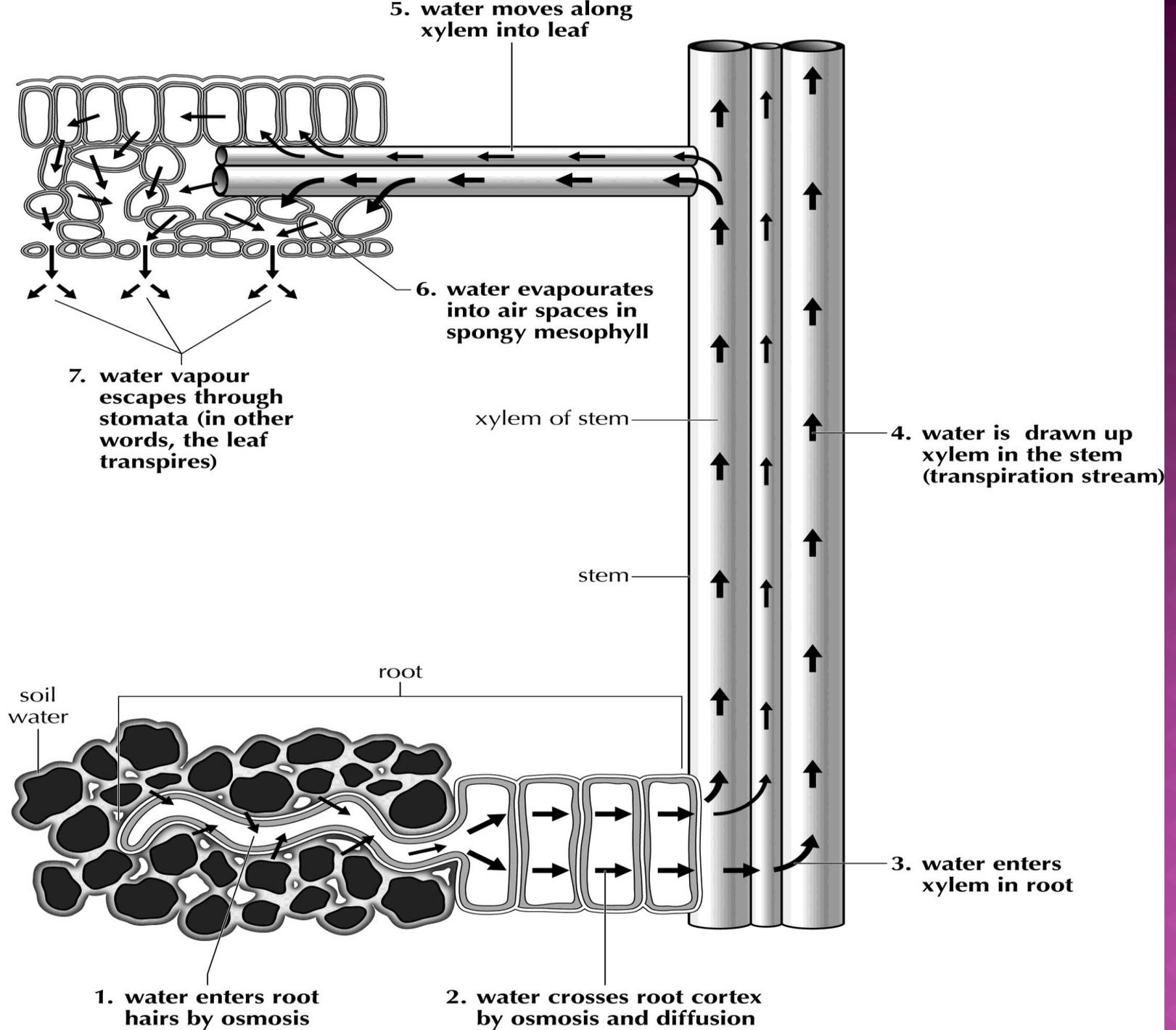
- The upward force that develops in roots due to the continuous influx of water from the soil
- Water moves by osmosis, through the root tissue to the root xylem causing pressure
- Root pressure is not strong enough to push water high up into the stem

# TRANSPIRATION PULL

- The main force drawing water upward in the plant
- Transpiration causes water to move down a series of of water potential gradients always moving from high to low
- The water potential decreases due to the loss of water through the stomata of the leaves
- Water molecules diffuse from the moist cell walls of the mesophyll cells into the air spaces
- The water potential of the mesophyll cell walls are lower than that of the cell sap in the vacuoles of mesophyll cells
- The water potential gradient extends back to the leaf xylem which joins the upper ends of the stem xylem

- Tension builds up and a suction force develops at the top of the stem xylem which pulls water up from the root xylem
- Cohesion forces causes the water molecules to be drawn upwards as a continuous column
- The water column pulled upward is called the **transpiration stream**
  
- Now the process of uptake of water into the root repeats itself

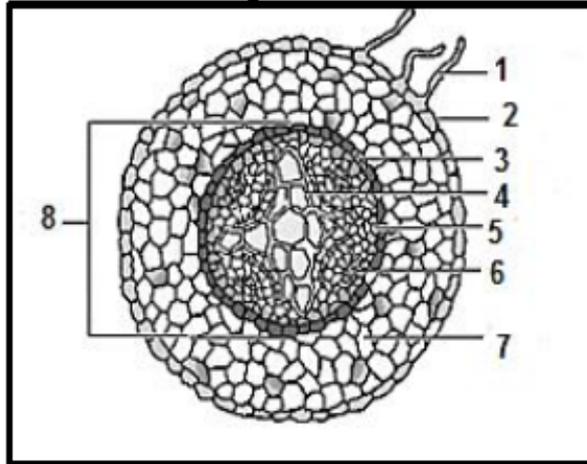




# CLASS ACTIVITY - WATER MOVEMENT IN ROOTS - LEAVES

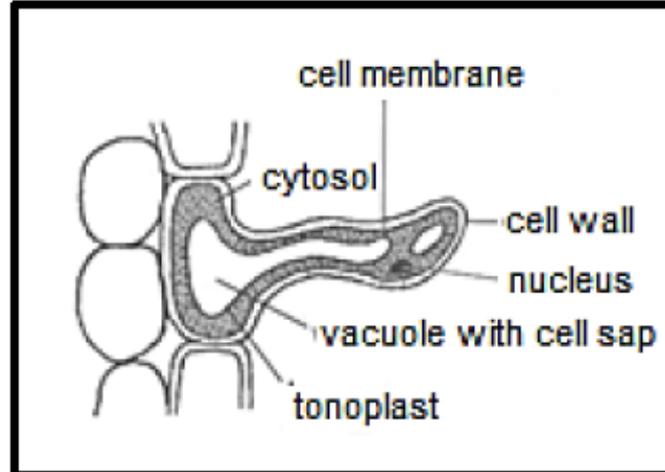
2.2 Study the diagrams below and answer the questions that follow

**T/S dicotyledonous root**



[Source: [Plant-struktur.weebly.com](http://Plant-struktur.weebly.com)]

**Root hair**



[Source: [www.sliderbase.com](http://www.sliderbase.com)]

2.2.1 Provide labels for 1 and 2. (2)

2.2.2 Give the number of the tissue that:

(a) Gives rise to side/lateral roots (1)

(b) Transports organic food in the plant (1)

(c) Stores starch in the root (1)

(d) Transports water in the plant (1)

- 2.2.3 Give ONE way in which the root hair is structurally adapted for its function. (2)
- 2.2.4 Does the root hair have a cuticle? Give a reason for this. (3)
- 2.2.5 Predict what would happen if root hairs were not there at all. (2)