Erasmus+
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ALIVE

Movement of water in plants and nutrition

World of plants

WATER FUNCTIONS AND IMPORTANCE

- The basic component of the environment
- Solvent of substances
- A source of hydrogen and oxygen for metabolic processes
- Transport of substances
- Thermoregulation (balancing the temperature of the plant and the environment)
- Participation in photosynthesis and respiration

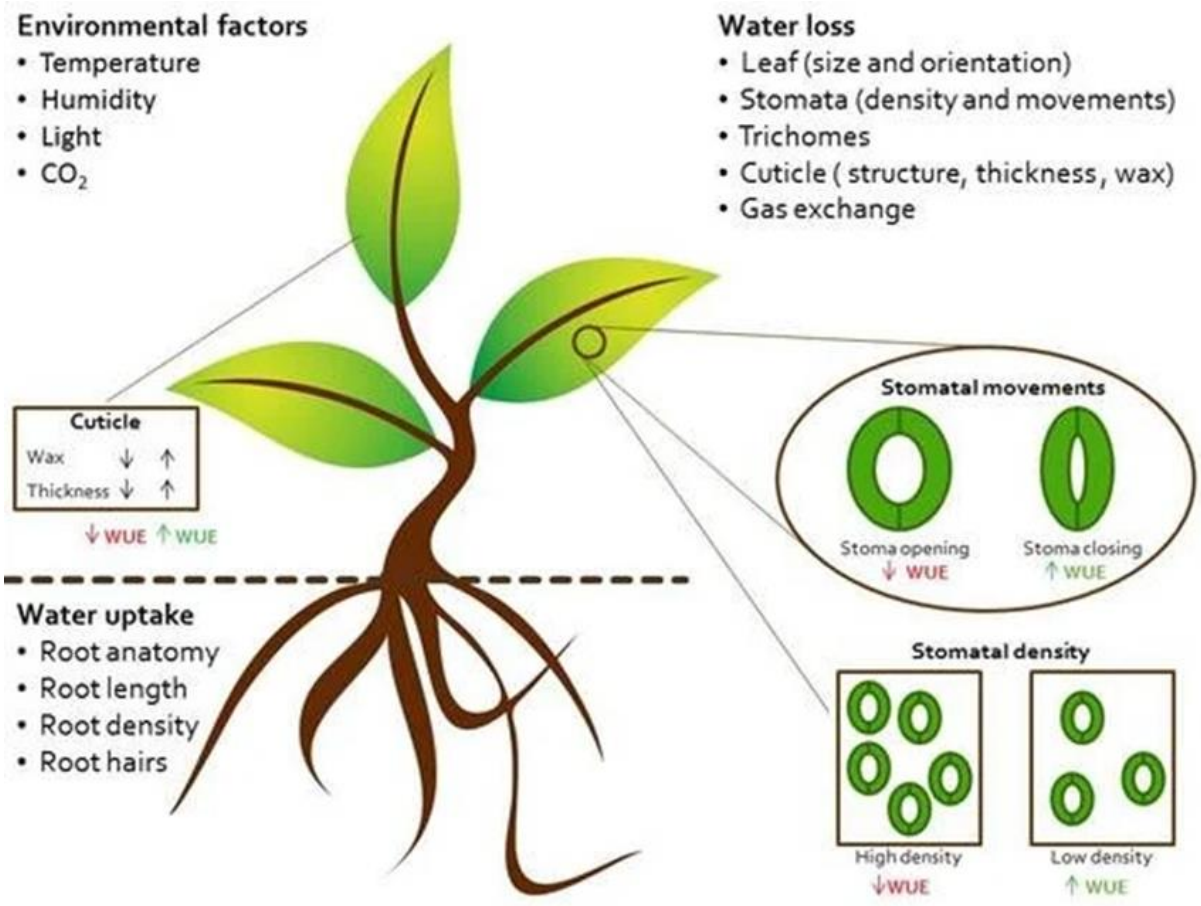
WATER FUNCTIONS AND IMPORTANCE

Impact of water shortages - drought:

- Decrease in growth intensity.
- Reduction of total intake of nutrients and their content in tissues.
- Stomata closure and decrease in photosynthesis intensity.
- Slowing down seed formation.
- Long-term lack of water can lead to plant death.

WATER REGIME OF PLANTS

Water regime of plants = intake + transport + expenditure of water



WATER INTAKE

- Lower and aquatic plants absorb water throughout the body surface by diffusion and osmosis.
- Higher plants receive water through the root system (root and root hairs). Part of the water is taken up by the extra-root system - through the leaves (rain, dew).

WATER INTAKE

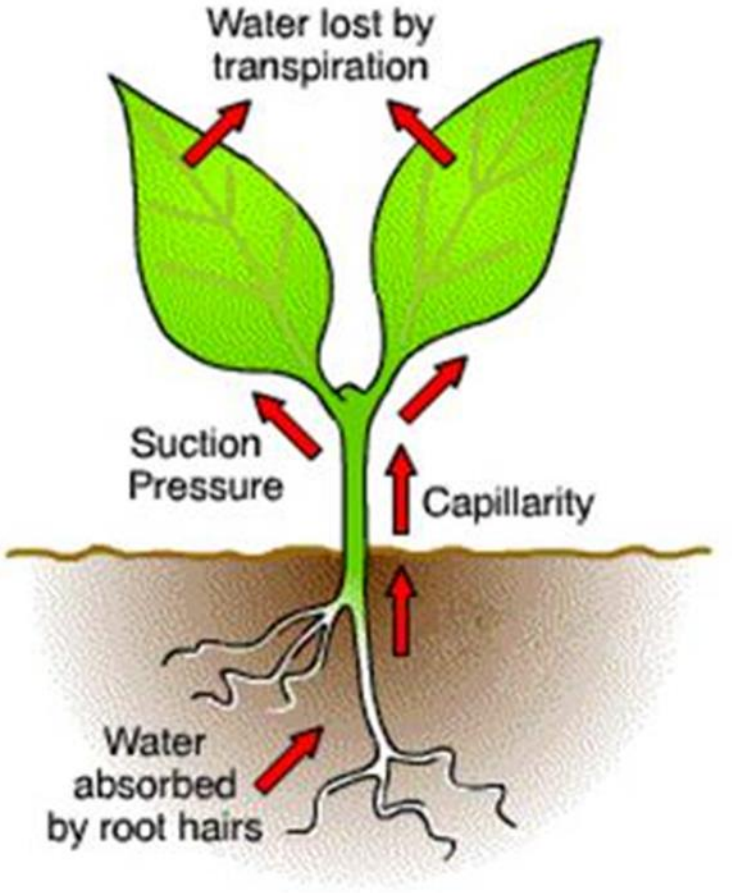
We divide water intake into:

- Passive - at a time when the plant has leaves. When the water evaporates, a negative pressure is created in the leaves and the water is passively sucked through the root hairs. In this way, the plant absorbs about 90% of the water.
- Active - at a time when the plant has no leaves. The plant absorbs water through osmosis. This method prevails in the spring.

WATER INTAKE

Water intake is affected by:

- Temperature
- Soil solution concentration
- The amount of water in the soil
- Soil particle size
- Amount of oxygen in the soil



DIFFUSION

- Movement of molecules, atoms and ions from a place of higher concentration to a place with lower concentration, i.e. in the direction of a concentration gradient.
- The rate and extent of diffusion depends on the difference in substance concentration on both sides of the biomembrane.
- The process stops when the concentration of the substance on both sides of the membrane equalizes.

DIFFUSION

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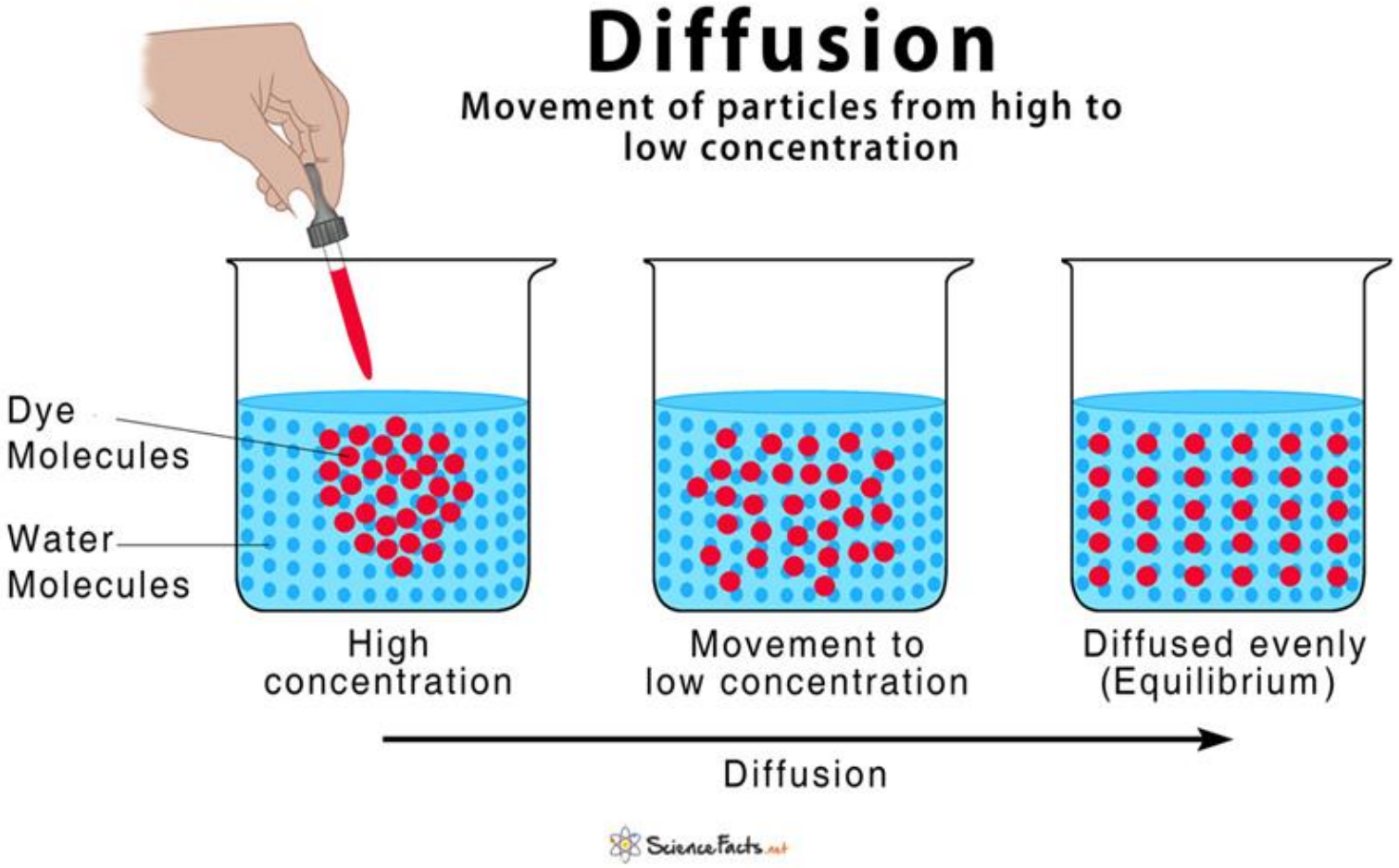


OSMOSIS

- From a physical point of view, it is a one-way passage of solvent molecules across a semipermeable membrane. In biological terms, it is a special name for the diffusion of water molecules. The driving force is the difference in the concentrations of the osmotically active particles. Osmosis depends on the concentration gradient.

OSMOSIS

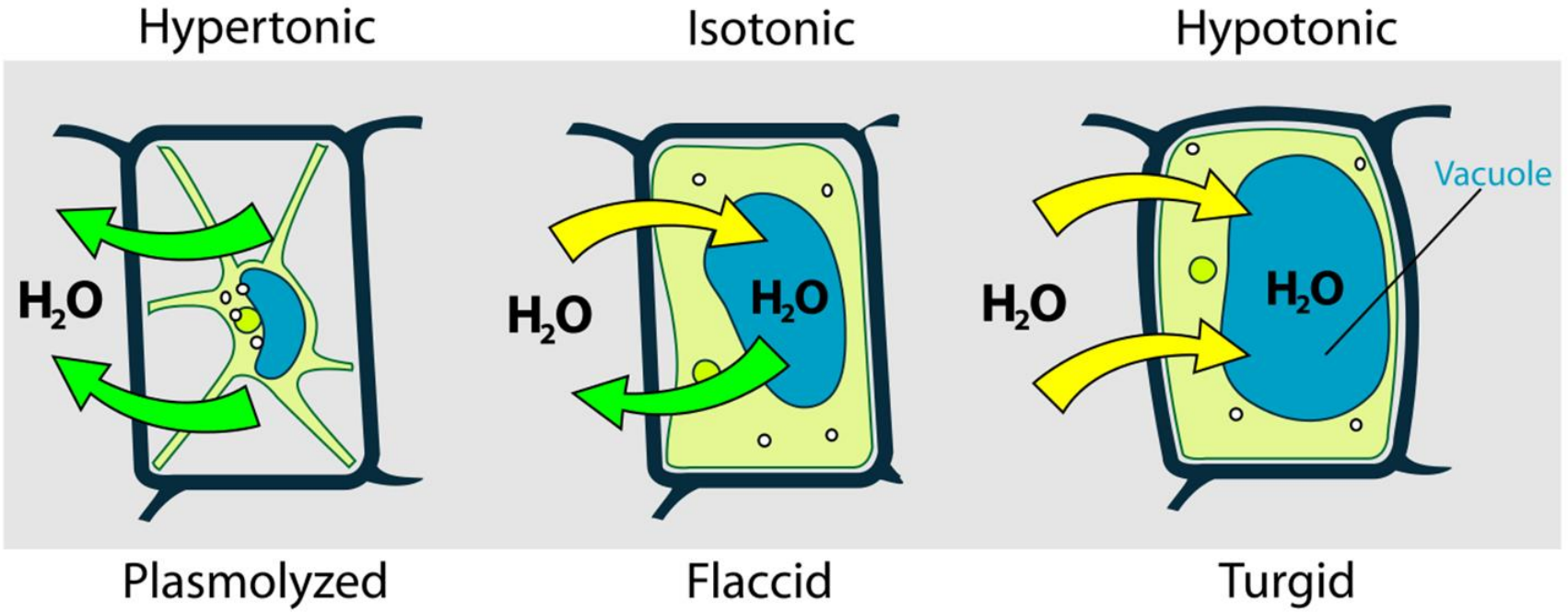
The cell can absorb or lose water osmotically depending on the concentration of osmotically active particles in the extracellular environment and inside the cell. From this point of view, we distinguish:

1. Isotonic environment - has the same osmotic value as the cell.

2. Hypertonic environment - has a higher concentration of osmotically active particles and the cell in this environment loses water, reduces its volume. Plasmolysis occurs in the plant cell.

OSMOSIS

3. Hypotonic environment - has a lower concentration of osmotically active particles than the cell. In such an environment, the cell absorbs water and increases its volume, plasmoptysis occurs and sometimes the cells rupture.



ROOT – ITS FUNCTION AND STRUCTURE

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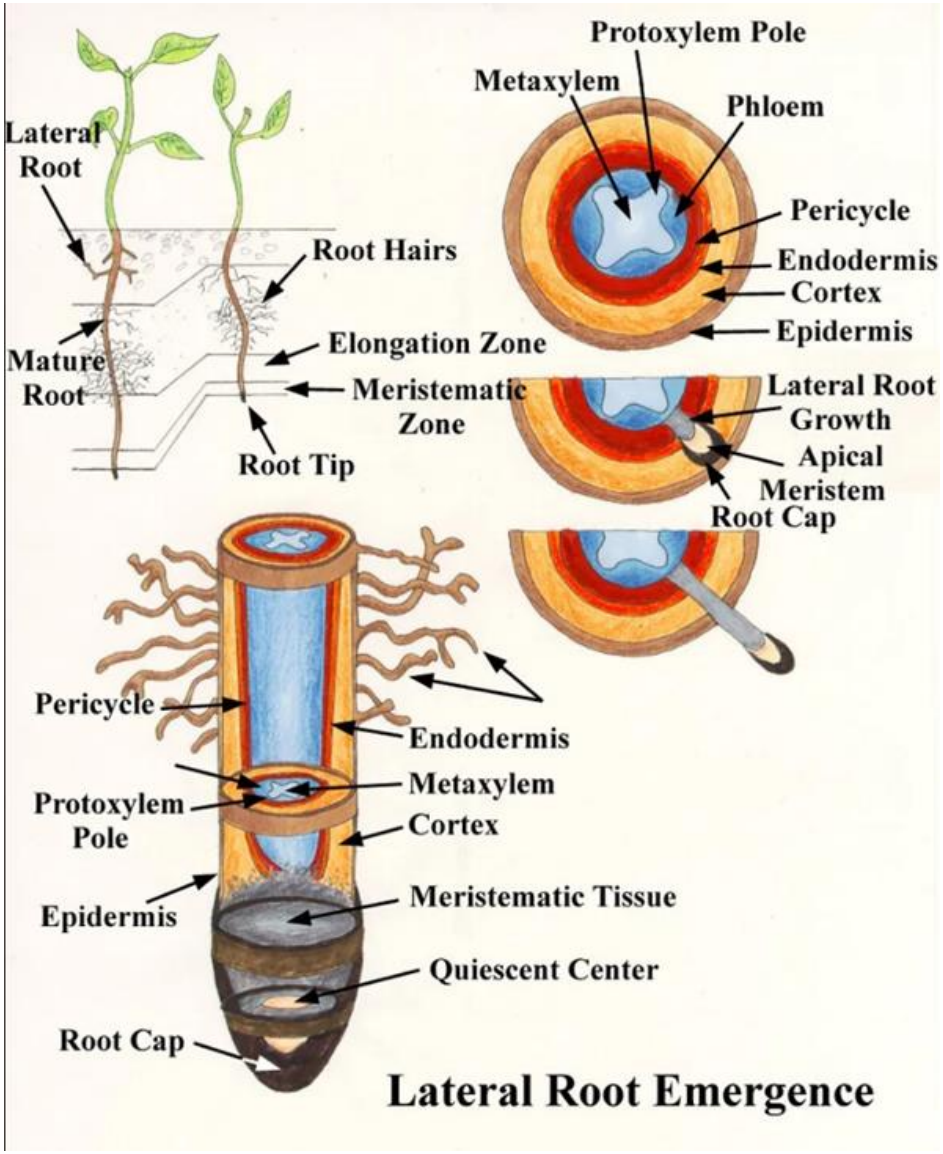
- The root is usually an underground organ.
- Its main function is to fix the plant in the soil and to absorb water and nutrients dissolved in it from the soil.

ROOT – ITS FUNCTION AND STRUCTURE



WATER TRANSPORT

- Lower plants - diffusion / osmosis.
- Higher plants - a system of conductive tissues.

Higher plants transport solutions in two directions:

- The transpiration stream conducts water with dissolved inorganic substances from the root towards the leaves. Root pressure - the ability of the root to displace water against gravity.
- The assimilation stream is directed from the leaves where organic matter (assimilates) is formed to the point of consumption or to the storage organs.

WATER TRANSPORT

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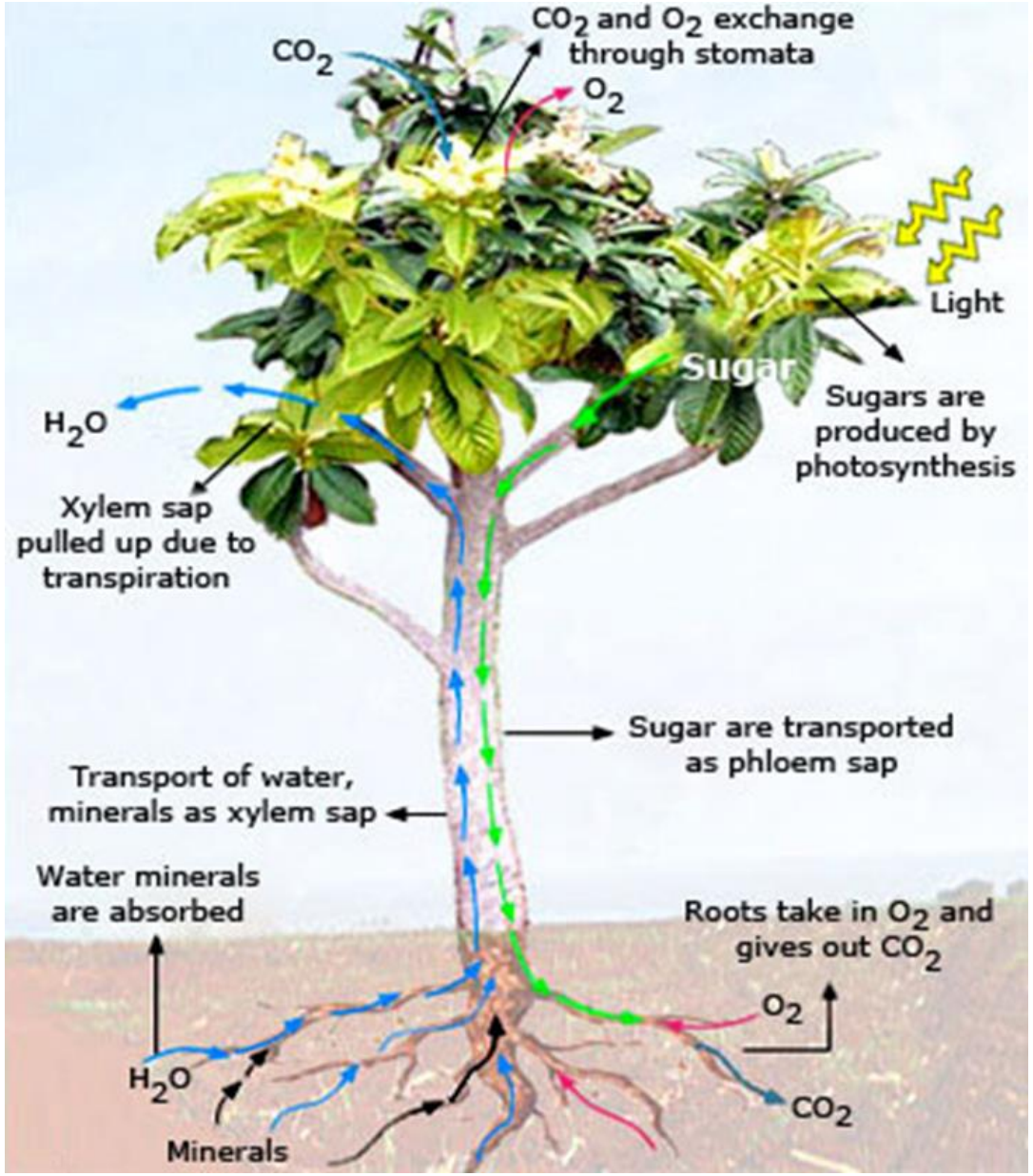


WATER TRANSPORT – VASCULAR TISSUES AND VASCULAR BUNDLES

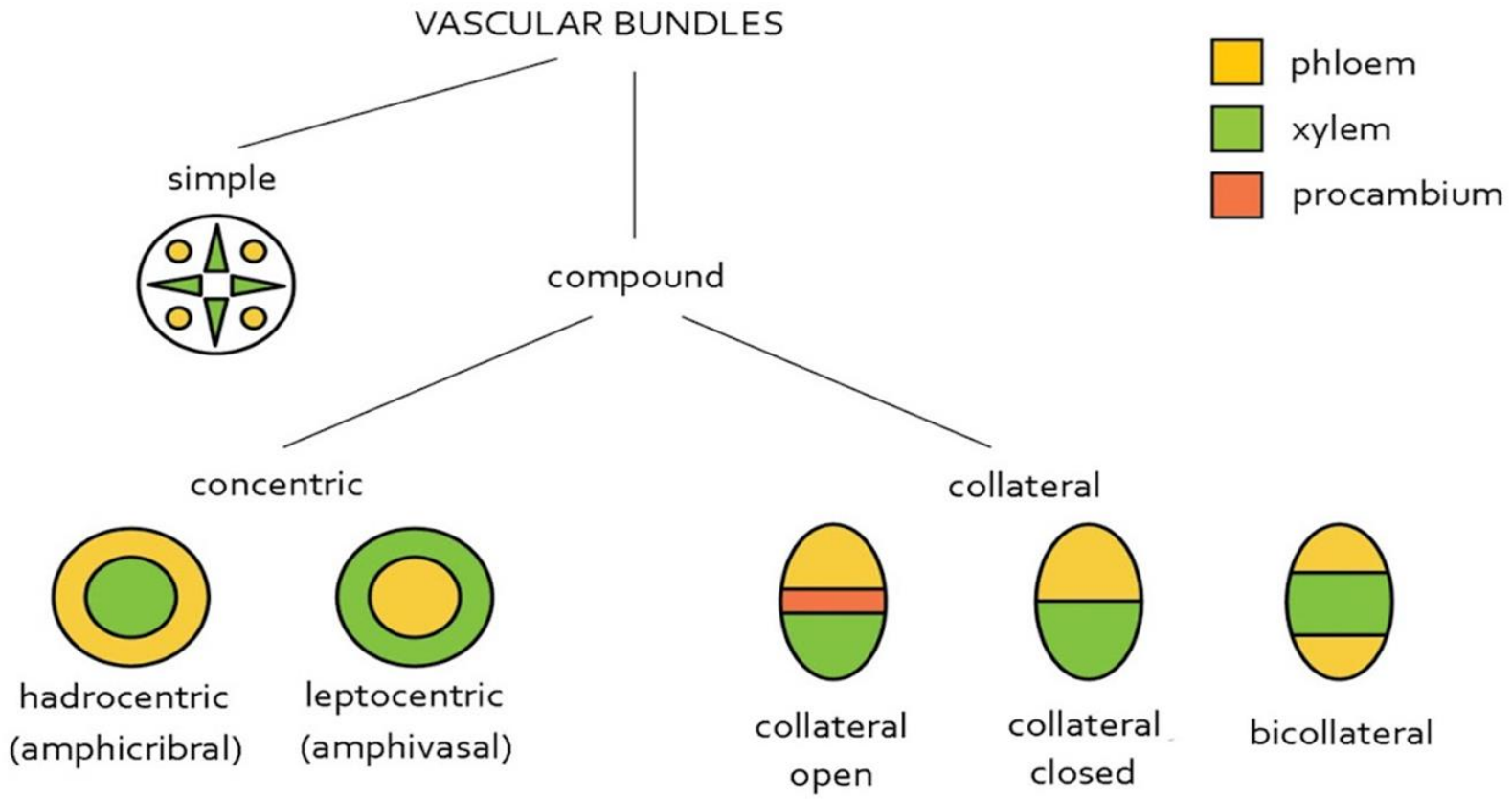
- Xylem - wooden part of vascular tissues. Transpiration stream = water and inorganic compounds conducting tissue. In addition to distributing solutions, xylem also have a mechanical function (contributing to increasing the strength of plant bodies).
- Phloem - Assimilation stream = assimilates conducting tissue.

WATER TRANSPORT – VASCULAR TISSUES AND VASCULAR BUNDLES

Xylem and phloem form a vascular bundle. According to the mutual position of the xylem and phloem part, we recognize vascular bundles:

- collateral
- bicollateral
- concentric
- radial

WATER TRANSPORT – VASCULAR TISSUES AND VASCULAR BUNDLES

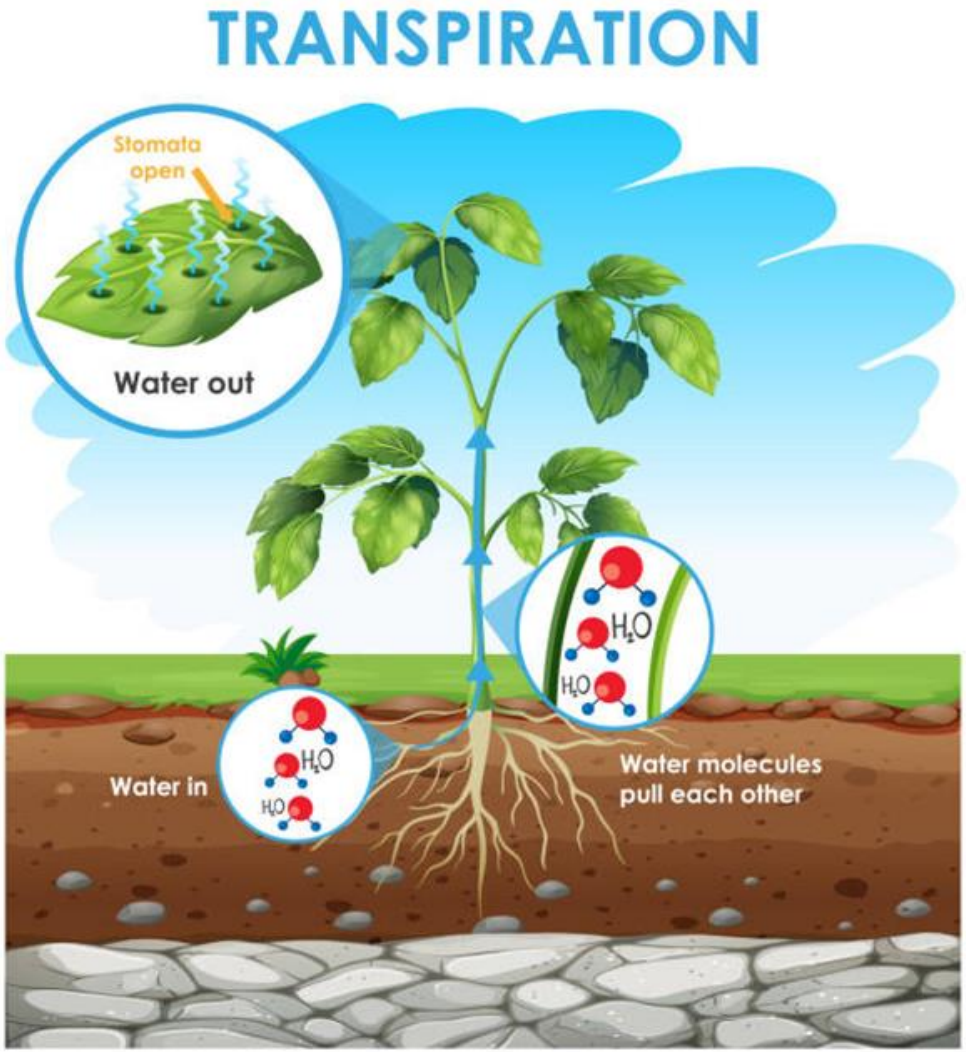


WATER EXPENDITURE

Transpiration

- Mostly through the leaves in the form of water vapour - no minerals.
- It takes place during the day.
- Via cuticle - cuticular transpiration (small part).
- Through the stomata - stomatal transpiration (mostly).
- Transpiration is affected by temperature, humidity, the amount of water available, light and some internal factors.

WATER EXPENDITURE - TRASPIRATION



WATER EXPENDITURE

Guttation

- In an environment with high humidity or in cold air (above ground).
- Uptake in the form of drops - with minerals.
- It runs through hydatodes.
- The root pressure is involved in the displacement of the water.

Plant water balance = ratio between water intake and uptake

PLANT NUTRITION

According to the method of obtaining energy, we divide organisms into:

1. Autotrophic organisms:

- They are referred to as producers. They take inorganic substances from which they are able to produce organic substances. We know:

- Photoautotrophy - obtaining energy from light energy, the main source is photosynthesis.
- Chemoautotrophy - energy is obtained by the decomposition of chemicals (e.g. bacteria).

PLANT NUTRITION

2. Heterotrophic organisms:

- They are referred to as consumers.
- They are not able to create organic substances, they have to obtain them from the external environment. These include:

- Saprophytes - nutrients are obtained by decomposing dead organisms. They are called reducers. Examples are *Monotropa hypopitys* and *Neottia nidus-avis*.

PLANT NUTRITION

- Parasites - they obtain nutrients by taking them from another organism (host), which they usually damage. They penetrate the host plant through transformed roots (haustorium). Haustoria penetrate into the phloem and xylem parts, from where the parasite draws organic and inorganic nutrients. An example is *Cuscuta europae*.
- Semi-parasites - haustoria penetrate into the vascular bundles of the host, but only into the xylem part. They contain chlorophyll and are capable of photosynthesis. An example is the *Viscum album*.

PLANT NUTRITION

3. Mixotrophic organisms:

- They are able to create organic substances (autotrophy), but they can also absorb these substances from the environment.
- These include carnivorous plants such as Drosera rotundifolia or Nepenthes.

RELATIONSHIPS AMONG ORGANISMS

1. Neutral: populations do not interact

2. Positive: there are mutually beneficial relationships between populations.

- Commensalism - population 1 benefits, population 2 is intact.
- Symbiosis (mutualism) - a mutually beneficial relationship.

RELATIONSHIPS AMONG ORGANISMS

3. Negative: relations between populations are negative unilaterally or bilaterally

- Amensalism - population 1 suffers from the influence of population 2, which is intact.
- Competition - populations compete with each other for the same food source or environment.
- Predation - population 1 (predator) feeds on population 2 (prey).
- Parasitism - population 1 (parasite) draws nutrients from population 2 (host)

PICTURES - USED SOURSES:

ALIVE

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