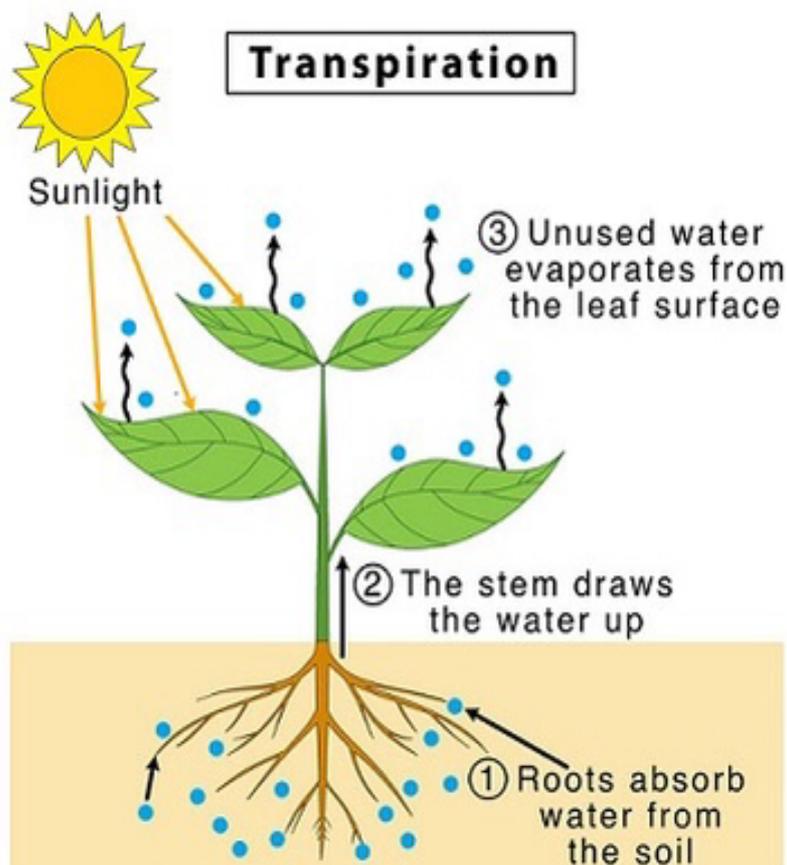


Transpiration

- ▶ Transpiration is the loss of water from the plant
- ▶ It caused by evaporation and diffusion of the plant surface especially leaves surface
- ▶ Evaporation creates slightly shortage of water from plant but this shortage recover by a xylem tube (take water upward).
- ▶ Transpiration stream occur when water shortage occur in plant.



Rate of Transpiration:

- ▶ Rate of transpiration is affected by Four main factors
 1. **Light intensity** - increase in increases the transpiration rate. This is because evaporation from leaves increases.
 2. **Temperature** - increase in temperature increases the transpiration rate. This is because evaporation from leaves increases.
 3. **Air flow** - increase in air flow increases the transpiration rate. If there is a poor air flow, the water in the air surround the leaf and water won't diffuse out of the leaf. However, if there is a good air flow, the water outside of the

leaf is constantly being taken away, so water keep moving out of the leaf to replace it. A good air flow maintains a high concentration gradient for the water.

4. **Humidity** - increase in humidity decreases the transpiration rate. If the air around the leaves is really dry, then the concentration of water is highest in the leaves. The water will move out of the leaves, down the concentration gradient. If the air is very humid, then there is not much difference in the concentration gradient and water will not leave the plant (or will move out at a very slow rate)

Factors affecting transpiration rate

Factor	Explanation
↑ temperature	↑ the kinetic (movement) energy of water molecules → they diffuse faster.
↑ air movement (wind...)	Removes water molecules as they pass out of the leaf → maintaining a steep concentration gradient for diffusion .
↓ humidity	↓ the concentration of water molecules outside the leaf → steeper concentration gradient for diffusion .
↑ light intensity	Stomata open to allow gas exchange for photosynthesis → water vapour can diffuse out of the leaf.

► Measuring Transpiration and stomata

Using a Potometer to Investigate Transpiration

A **potometer** is a piece of equipment that can help you measure the rate of transpiration (assuming that the water taken up by the plant is related to that which evaporates from the plant).

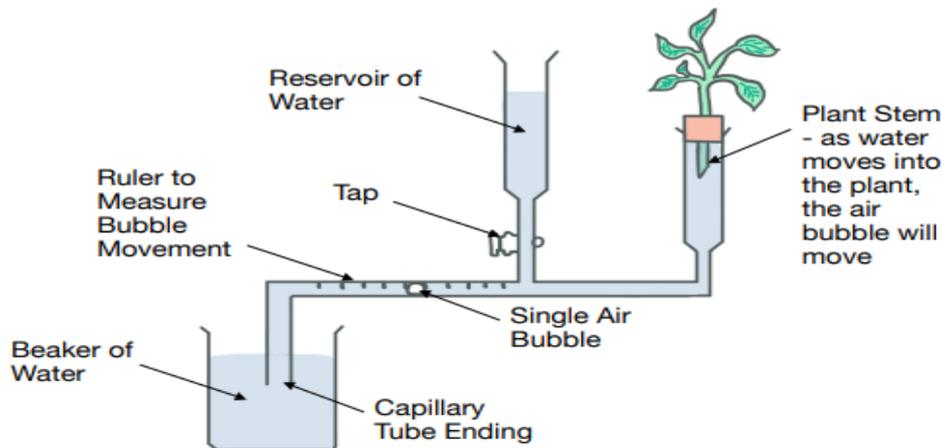


Fig 1. Potometer equipment set up to measure the rate of transpiration.

Experiment :

1. Set up the potometer in water as shown in the diagram above leaving the tap for the reservoir of water open. Make sure the equipment is set up in water to prevent any air bubbles entering the equipment.
2. Make sure to cut the stem of the plant at a slant under water. This will prevent air from entering the xylem and the slant will increase the surface area over which water is absorbed.
3. Lift the potometer out of the water but leave the opening end of the capillary tube submerged in the water. This is the water that will supply the plant.
4. Double check that the entire equipment is airtight and watertight. You don't want any air bubbles or extra water interfering with your experiment.
5. Give time for the plant to acclimatise to this new setting and pat dry its leaves.
6. Close the tap for the reservoir of water.
7. Remove the capillary tube end from the water until one air bubble enters and then immediately place the capillary tube end back in the water.
8. Measure and record the starting position of the air bubble and start the stopwatch.
9. Time how long it takes the bubble to move a certain distance and calculate the rate of transpiration.

► **Calculating Rate of Transpiration**

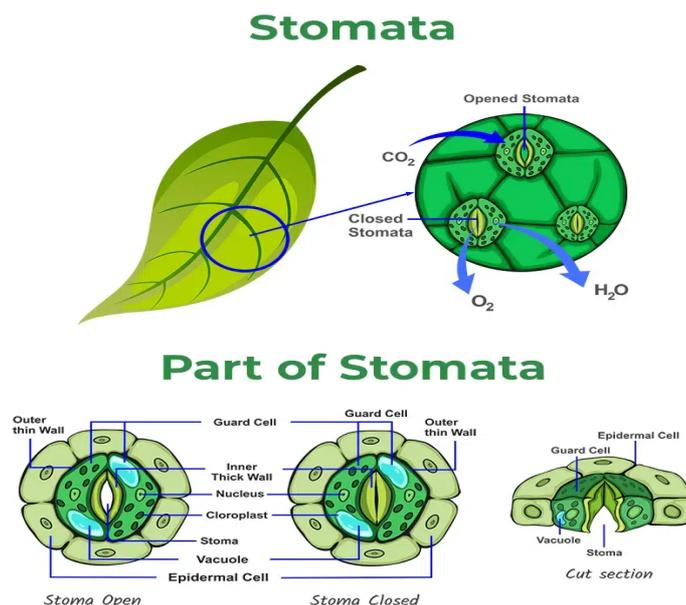
Using this formula:

$$\frac{\text{Transpiration}}{\text{Unit Time}}$$

► **Guard cells are adapted to open and close stomata**

Structure of Stomata

- a) The structure of the stomata comprises a kidney-shaped epidermal cell along with an opening in the center called a pore.
- b) The stomata are bordered by a pair of specialized parenchyma cells which are the guard cells.
- c) These are responsible for regulating the size of its opening, thereby saving the plant from water loss.
- d) The four vital parts of a stoma are:
 - Pore
 - Guard cells
 - Subsidiary cells
 - Epidermal cell



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Opening and Closing of Stomata

- when the plant is short of water, guard cell lose water and become flaccid.
- Thick inner wall and thin outer wall help in the opening and closing work
- They are very sensitive to light and close at night to save the water.

Functions of Stomata

Stomata has the following functions –

- Facilitate Exchange of Gases:** This important function of Stomata involves the absorption of **carbon dioxide**, which the plants break into carbon and oxygen. The carbon is essential for its growth, while oxygen combines with **hydrogen** and forms the water required.
- Adequate Transpiration Rate:** The stomatal pore openings help in the **evaporation** of excess water present in the plant. This maintains a healthy water level within the plant.
- Healthy Water Ratio:** The stomata close during the night which reduces the loss of water through evaporation and hence keeps the plants from drying up.
- Assisting Photosynthesis:** The exchange of gases and facilitation of water evaporation greatly facilitates the process of photosynthesis where the plant makes food with the help of sunlight.

