Transpiration

Transpiration is a process during which water is lost in the form of water vapour through the aerial parts of the plant.

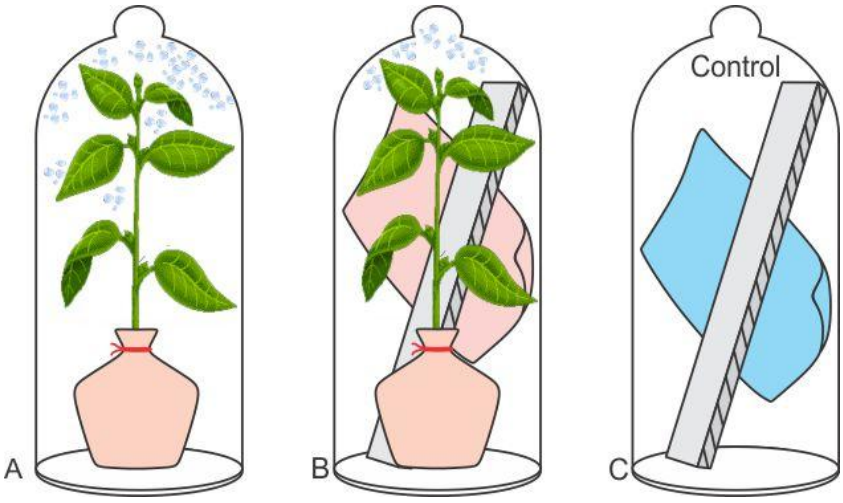
Demonstration of Transpiration

Experiment 1

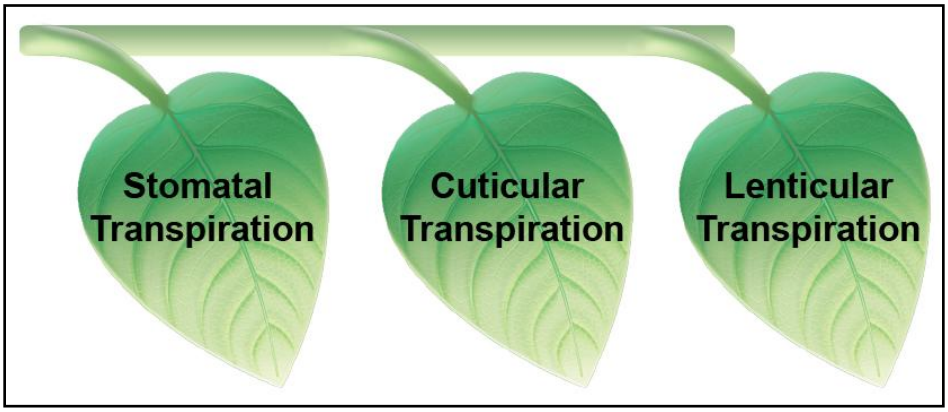
- Drops of water appear on the inner side of the polythene bag.
- No such drops appear in the empty polythene bag.
- The plant gives off water vapour which saturates and condenses on the inner surface of the polythene bag.

Experiment 2

- Setup A: Water vapour condenses on the inner wall of the bell jar.
- Setup B: The bell jar also shows similar condensation of water vapour, and at the same time, the cobalt chloride paper which is initially blue turns pink.
- Setup C: In this bell jar, neither water droplets are found nor does the cobalt chloride paper turn pink.
- Condensation of water vapour occurs on the inner walls of the bell jar in setups A and B.
- Change in the colour of cobalt chloride paper proves that plants give off water vapour during transpiration.



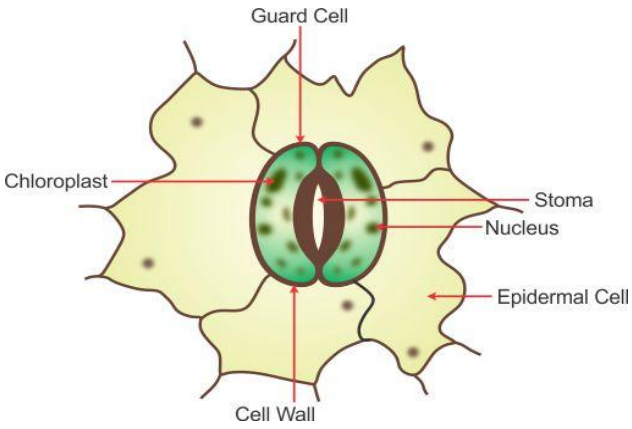
Kinds of Transpiration



Stomatal Transpiration	Cuticular Transpiration	Lenticular Transpiration
• Water vapour escapes through the stomata of the leaf.	• Transpiration occurs directly from the surface of the leaves and stems.	• Transpiration occurs through lenticels present on old stems.

Stoma

A **stoma** is surrounded by two bean-shaped **guard cells**. The **number of stomata** may range from **1,000 to 10,000 per cm^2**.

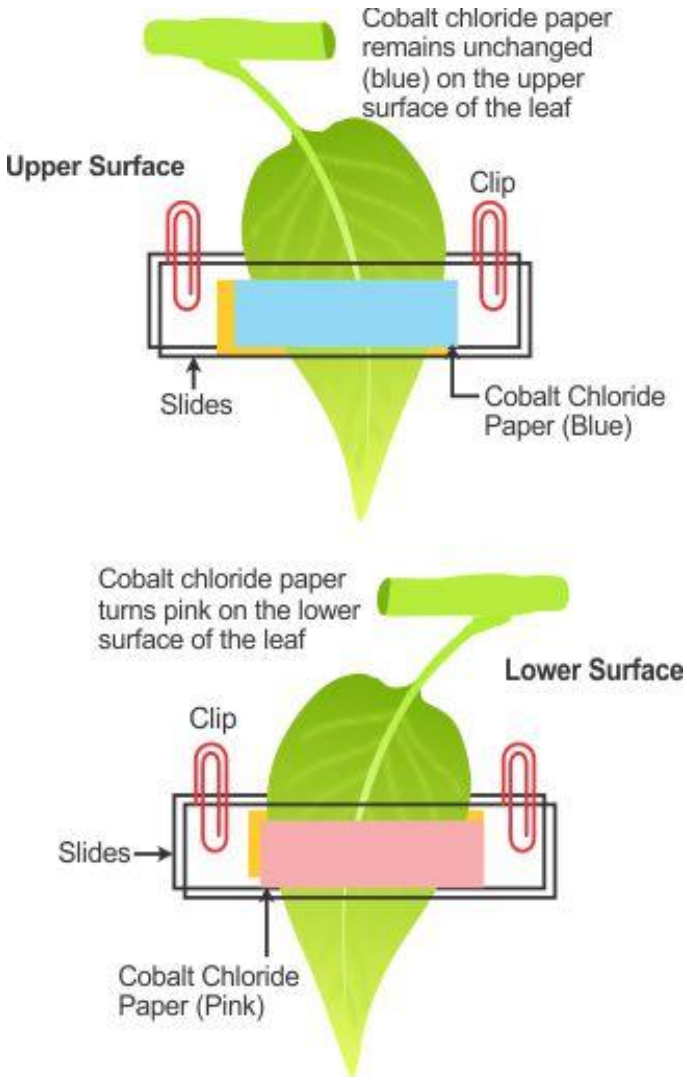


Mechanism of Stomatal Transpiration

- The surfaces of spongy mesophyll cells in a leaf are exposed to intercellular spaces.
- Water vapour formed saturates the air in the intercellular spaces, diffuses into connecting intercellular spaces and reaches the sub-stomatal space. Finally, it escapes in the atmosphere through air.
- The turgor pressure in cells forces some water out of the cell wall into the intercellular space.
- Here, the water evaporates, and the water vapour from the intercellular spaces diffuses into the sub-stomatal space from where it finally diffuses through stomata.
- The opening and closing of stomata is regulated by the guard cells.

Experiment

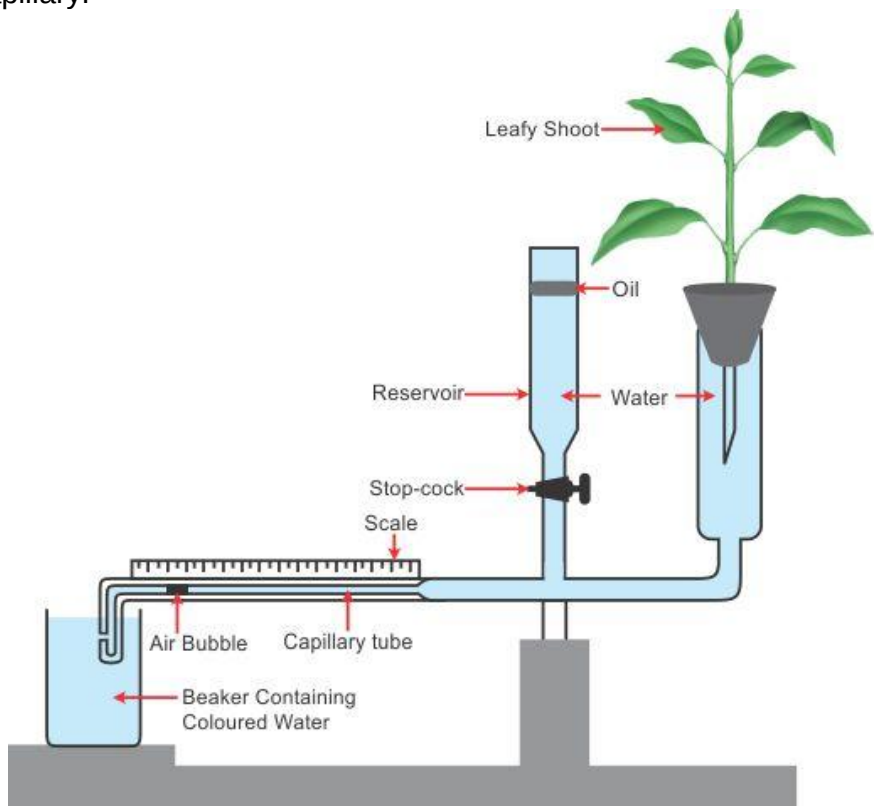
- The cobalt paper on the lower side turns pink in much lesser time than the one on the upper surface.
- This shows that more transpiration occurs from the lower surface of the leaf which is due to more number of stomata on the lower surface.



Rate of Transpiration

Experiment: Potometer Method

A potometer is a device which measures the rate of water intake by a plant which is almost equal to the water lost through transpiration.
Air bubbles move through the horizontal arm.
Water loss during transpiration sets up a suction force which pulls the water from the beaker, and bubbles move along in the capillary.



Factors Affecting the Rate of Transpiration

• **Intensity of sunlight**	With increase in the intensity of sunlight, the rate of transpiration increases.
• **Temperature**	Increase in the temperature of the air increases the rate of transpiration.
• **Velocity of wind**	Transpiration increases with rapid or active air movement.
• **Humidity**	If the air is humid, then the rate of transpiration is reduced.
• **Carbon dioxide**	Increase in the CO_2 level in the atmosphere over normal 0.03% causes stomatal closure. Hence, it decreases the rate of transpiration.
• **Atmospheric pressure**	With decrease in atmospheric pressure, the rate of transpiration increases.

Adaptation in Plants to Control Excessive Transpiration

Plants which grow in dry climate have evolved a variety of adaptations to curtail transpiration.

- Leaves may be modified into spines as in cactus or into needles as in pines.
- Leaves may be folded or rolled up.
- The number of stomata is reduced, and they may be sunken in pits.
- A thick waxy cuticle develops on the leaves. Examples: Banyan tree, evergreen trees

Significance of Transpiration

- Evaporation reduces the temperature of leaf surfaces.
- It draws more water up through the stem which causes roots to absorb more water from the soil.
- Higher the rate of transpiration, greater the rate of absorption of water and solutes from the soil.

Differences between Transpiration and Evaporation

Transpiration	Evaporation
Loss of water in the form of water vapour from aerial parts of the plant.	Loss of water from the surface of water bodies.
It is a slow process.	It is a fast process.

Guttation and Bleeding

Guttation

The water appears as tiny drops along the margins or tips of leaves. This loss of excessive water is called **guttation**.

Guttation occurs through hydathodes.

Bleeding

Loss of water, i.e. cell sap, through a cut stem is called **bleeding**.

Differences between Transpiration and Guttation

Transpiration	Guttation
Water is lost in the form of vapour.	Water is lost in the form of water droplets.
Water vapour is lost through stomata, lenticels and cuticle.	Water is lost through hydathodes.