

Tender Heart High School

Class - 9

Date - 13.01.2025

Subject - Biology

Teacher - Nidhi Rana

Chapter 5

Transpiration (contd.)

Kinds of Transpiration

- (1) Stomatal Transpiration - occurs through stomata
- (2) Cuticular Transpiration - occurs directly from the surface of leaves and stems.
- (3) Lenticular Transpiration - occurs from the lenticels which are minute openings on the surface of old stems

Major part of transpiration occurs through the stomata and least transpiration occurs through cuticle.

Mechanism of stomatal Transpiration

Stomata (singular stoma) (Please practice the diagrams in

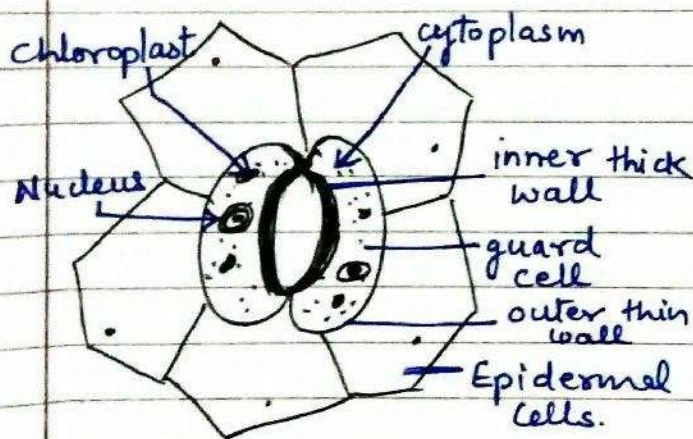


Fig 1 Stomatal Apparatus

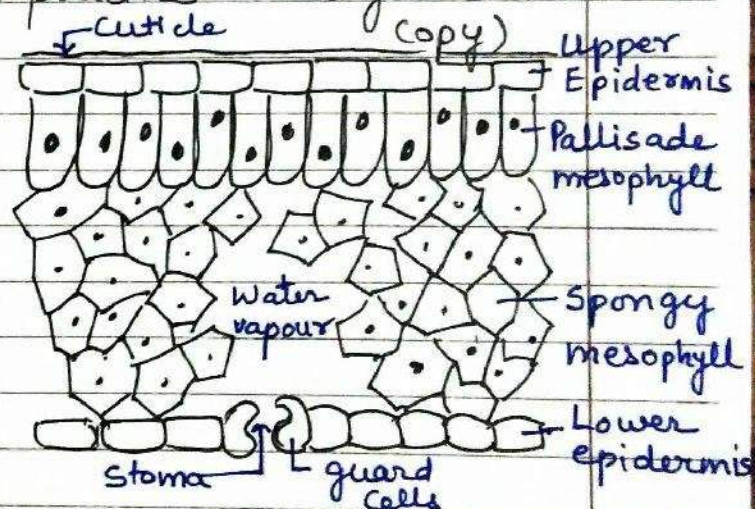


Fig 2. Vertical section of Leaf.

Sequence of movement of water from xylem of leaves to the outside atmosphere through stomata is as follows.

Xylem (leaves) → Palisade mesophyll → Spongy mesophyll → intercellular spaces → substomatal space → stomata → outside atmosphere

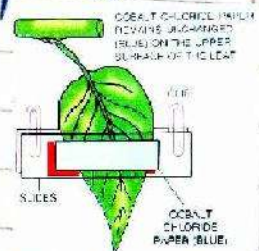
Subject - Biology

Mesophyll cells are specialised cells present in the leaves which contain chloroplast and are present in the leaves. One the upper side of leaf 'pallisade mesophyll' are present. Pallisade mesophyll are elongated cells without intercellular spaces. They are present on upper side of leaf which receives maximum sunlight. Hence they are helpful in doing photosynthesis. Below the 'pallisade mesophyll' are 'spongy mesophyll' which are loosely packed (have intercellular spaces) between them.

Movement of water from xylem to mesophyll cells (and further) occurs due to diffusion (i.e. along the concentration gradient from higher concentration to the lower concentration).

The cells that lose water in this way replace it by drawing more of it from the nearest vein. Thousands of cells evaporate water in this way causing more water to be pulled from below via xylem vessels. Thus a kind of transpiration pull is created that can draw water up to about 50m or more in tall trees.

Experiment 6.



Attach pieces of dry cobalt chloride paper on the two surfaces of leaf and held in position by two glass slides on either side tied together by clips. Leaf should remain attached to its own plant. Piece of paper tied on upper surface of leaf turns pink in longer time than the one on lower side.

Assignment 1.

Based on the experiment answer the following questions-

- Q-1) What is the aim of the experiment?
Q-2) Name the phenomenon observed in the experiment. Define it.
Q-3) What is the purpose of cobalt chloride paper in the experiment?
Q-4) What is the purpose of paper clips and glass slides?
Q-5) What is the observation / result and why?
(Students are required to answer these questions in copy.)
More transpiration occurs from lower surface of leaf because more numerous stomata are found on lower surface of leaf.

STOMATAL REGULATION OF TRANSPIRATION:

Transpiration occurs when stomata are open. Opening and closing of stomata is regulated by the amount of water and solutes present in guard cells. As stomata open during daytime, along with diffusion of gases for photosynthesis, transpiration also occurs. If for any reason water content of leaf is falling short, the guard cells fail to remain turgid, rather they turn flaccid thereby closing stomata and transpiration stops.

Leaves of some plant wilt during midday and recover in the evening. Reason - This is because rate of transpiration during midday exceeds the rate of absorption of water by the roots. Thus cells lose turgidity. In evening temperature is not high so transpiration rate is not high and the turgidity of water is restored and they stand erect.

Stomatal transpiration can be controlled by the plant by adjusting the size of the stomata, whereas this does not happen in case of cuticular and lenticular transpiration.

Cuticular transpiration

Cuticle is a waxy layer secreted by epidermis on the two surfaces of leaf. It serves to prevent transpiration. Desert plants have thicker cuticle to cut down transpiration.

Lenticular Transpiration

Lenticels are special openings that develop on the barks of older stem. These allow diffusion of gases for respiration and photosynthesis. Lenticels never close. They remain open all the time.

FACTORS AFFECTING TRANSPIRATION

EXTERNAL FACTORS

- (1) Intensity of sunlight - During day stomata are open and at night they are closed. Hence more transpiration occurs during sunny day. Cloudy day reduces transpiration.
- (2) Temperature - Higher the temperature, more is the evaporation from leaves, more the transpiration.
- (3) Velocity of wind - Transpiration increases with the velocity of wind. If the wind blows faster the vapours released during transpiration will be removed faster and the area around the leaf does not get saturated with water. Hence more vapours can be released.
- (4) Humidity - If humidity is high then the outside air gets saturated with water vapours hence it reduces the rate of outward diffusion of internal water vapours across stomata, thereby reducing rate of transpiration.
- (5) Carbondioxide - Increase in CO_2 (over normal 0.03%) causes stomatal closure. Hence reduces transpiration.
- (6) Atmospheric Pressure - Less the atmospheric pressure more the transpiration as it enhances diffusion of water vapours.

Internal factors (within the leaf)

If the water content of leaves decreases due to insufficient absorption of water by roots, the leaf wilts, stomata closes; hence transpiration is reduced. It is natural mechanism of conserving water within plant.

ADAPTATIONS IN PLANTS TO REDUCE TRANSPIRATION:-

- (1) Sunken stomata i.e. stomata are present deep within the leaf (are not superficial). Stomata may be covered with hair (Eg Nerium)
- (2) Fewer stomata - Number of stomata may be less/reduced
- (3) Narrow leaves - Narrow leaves reduce the surface area, hence reduce the transpiration rate.
- (4) Reduced exposed surface - In some cases, leaves may get wavy, rolled, folded to reduce the surface area exposed to sun. Hence reduce transpiration.
- (5) Loss of leaves - Trees/plants may shed their leaves. Leaves may be absent or reduced to spines. Eg Cactus.
- (6) Thick cuticle - Leaves may be covered by thick cuticle. Eg Banyan. Thicker the cuticle, lesser the transpiration.

Significance of Transpiration (Advantages)

- (1) Cooling effect - Evaporation reduces temperature of leaf surface in hot sunny days.
- (2) Suction force - Transpiration helps in ascent of sap by producing suction force acting from top of plant. As water evaporates through transpiration from leaves, a suction force is produced at the top of plant, drawing more water up through the stem and making the roots absorb more of it from the soil.
- (3) Distribution of water and minerals - As the transpiration continues, more and more water is absorbed by the plant. Along with water, minerals also get distributed in plant.

- (4) Transpiration increase the moisture/water vapours in atmosphere, which further brings rainfall. Hence forests contributes in bringing rain and thus affects climate.

DIRECT LOSS OF WATER BY PLANTS -

- (1) Guttation is the loss of water as droplets from the margins of the leaves (at the tips of leaf veins) through special pores called hydathodes. Examples of such plants - Banana, nasturtium and strawberry. Exudation/Guttation is seen in early morning. This particularly happens in plants found in warm humid climate/conditions. A humid environment hampers transpiration while the roots continue to absorb water. This builds up big hydrostatic pressure in plants which forces water to come out of leaves by guttation.
- (2) Bleeding - Loss of water through a cut/injury in the plant. The plant sap escapes from the ruptured surface of plant. The root pressure generated by plant assists in bleeding.

Note for students

Please go through the chapter 5 as discussed in the book carefully with understanding. It may require multiple readings to grasp the topics completely.

Home assignment

1. Please answer 'Assignment 1' Questions in notebook.
2. After going through the chapter carefully please try to answer 'Progress check' questions and 'Review questions' given at the back of book - Chapter 5. Objective type questions can be done in the book itself. Other answers are to be written in notebook.