

## EXPERIMENT: 03

### STUDY OF STRUCTURE AND DISTRIBUTION OF STOMATA

#### PRINCIPLE

Stomata is a pore, found in the epidermis of leaves, stems, and other organs, that facilitates gas exchange. The pore is bordered by a pair of specialized parenchyma cells known as guard cells that are responsible for regulating the size of the stomatal opening.

The term is usually used collectively to refer to the entire stomatal complex, consisting of the paired guard cells and the pore itself, which is referred to as the stomatal aperture. Air enters the plant through these openings by gaseous diffusion, and contains carbon dioxide and oxygen, which are used in photosynthesis and respiration, respectively. Oxygen produced as a by-product of photosynthesis diffuses out to the atmosphere through these same openings. Also, water vapor diffuses through the stomata into the atmosphere in a process called transpiration.

Stomata are present in the sporophyte generation of all land plant groups except liverworts. In vascular plants the number, size and distribution of stomata varies widely. Dicotyledons usually have more stomata on the lower surface of the leaves than the upper surface. Monocotyledons such as onion, oat and maize may have about the same number of stomata on both leaf surfaces. In plants with floating leaves, stomata may be found only on the upper epidermis and submerged leaves may lack stomata entirely. Most tree species have stomata only on the lower leaf surface. Leaves with stomata on both the upper and lower leaf are called amphistomatous leaves; leaves with stomata only on the lower surface are hypostomatous, and leaves with stomata only on the upper surface are epistomatous or hypostomatous. Size varies across species, with end-to-end lengths ranging from 10 to 80  $\mu\text{m}$  and width ranging from a few to 50  $\mu\text{m}$ . Depending upon the distribution and arrangement of stomata in the leaves five categories of stomatal distribution have been recognized in plants.

1. **Apple or mulberry (hypostomatic) type:** Stomata are found distributed only on the lower surface of leaves, e.g. Apple, Peach, Mulberry, Walnut, etc.
2. **Potato type:** Stomata are found distributed more on the lower surface and less on its upper surface, e.g. Potato, Cabbage, Bean, Tomato, Pea, etc.

3. **Oat (amphistomatic) type:** Stomata are found distributed equally upon the two surfaces, e.g. Maize, Oats, Grasses, etc.
4. **Water lily (epistomatic) type:** Stomata are found distributed only on the upper surface of leaf, e.g. Water lily, Nymphaea and many aquatic plants.
5. **Potamogeton (astomatic) type:** Stomata are altogether absent or if present they are vestigial. e.g. Potamogeton and submerged aquatics

Loftfield (1921) classified the stomata into four types, depending upon the periods of opening and closing.

- 1) **Alfalfa type:** The stomata remain open throughout the day but close during night, e.g. Pea, Bean, Mustard, Cucumber, Sunflower, Radish, Turnip, Apple, Grape.
- 2) **Potato type:** The stomata close only for a few hours in the evening, otherwise they remain open throughout the day and night e.g. Allium, Cabbage, Tulip, Banana.
- 3) **Barley type:** The stomata open only for a few hours in day time, otherwise they remain close throughout the day and night e.g. Cereals
- 4) **Equisetum type:** The stomata remain always open throughout the day and night e.g. Amphibious plant or emergent hydrophytes.

## **MATERIALS REQUIRED**

A potted Tradescantia or Bryophyllum plant, forceps, needles, watch glasses, glass slides, a dropper, cover slips, a brush, blotting paper, safranin, glycerin and a compound microscope

## **PROCEDURE**

1. Remove a healthy leaf from the potted plant.
2. Remove a part of the peel from the lower surface of the leaf. You can do this by folding the leaf over and gently pulling the peel apart using forceps. Keep the peel in a watch glass containing water.
3. Put a few drops of safranin stain in a watch glass.
4. After 2-3 minutes take out the peel and place it on a clean glass slide.
5. Put a drop of glycerin over the peel and place a clean coverslip gently over it with the help of a needle.

6. Remove the excess stain and glycerin with the help of blotting paper.
7. Observe the slide under the low-power and high-power magnifications of the compound microscope.

### **OBSERVATION**

1. The epidermal cells are visible. These are irregular in outline and have no intercellular spaces.
2. Many small pores (stomata) are seen scattered among the epidermal cells.
3. Each pore is guarded by two bean-shaped guard cells, each containing chloroplasts and a nucleus.
4. The inner concave boundary of each guard cell is thick, whereas its outer boundary is thin.
5. The stomata may be open or closed. The guard cells regulate the opening and closing of the stomata.

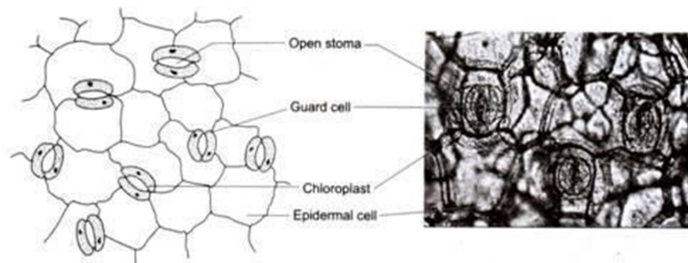
### **RESULT**

Stomata are present in the epidermal cells of the lower surface of the leaf.

### **CONCLUSION**

## PRECAUTIONS

1. Cut the peel to a proper size and avoid folding it.
2. Always place the peel at the centre of the slide and hold the slide at the edges.
3. Do not overstrain or under strain the peel.
4. Always handle the peel with a brush as a needle may damage the cells.
5. Take care to prevent the peel from drying by using glycerin.
6. Place the coverslip gently, avoiding any air bubbles.
7. Remove excess stain and glycerin with a blotting paper.



(b) (c)  
(a) Mounting a leaf peel (b) Epidermal layer in the peel taken from a dicot leaf showing open stomata (c) High-power magnification of stomata