Structure and working of stomata

In plants most photosynthesis takes place in the leaf. let us observe a leaf section to understand the location of stomata.

The outermost layer is the waxy cuticle, under the upper epidermal layer is a layer of palisade cells containing the chloroplasts.

Beneath the palisade cells is the spongy tissue with air spaces, the stomata are located mainly in the lower epidermis.

Stomata are nothing but minute pores in the lower epidermis of a leaf.

let us now observe a single stoma closely. The two bean shaped cells enclosing the stoma are the specialized guard cells. The guard cells have a number of chloroplasts present in them.

Observe that guard cells have a thin outer wall and a thick inner wall. The guard cells play a vital role by regulating the opening and closing of stoma.

They control the exchange of gases between the leaf and the atmosphere.

Air containing carbon dioxide and oxygen enters the plant through these openings where it gets used in photosynthesis and respiration respectively.

During the day, the stomata pores are open and gaseous carbon dioxide enters the leaves.

Waste oxygen produced by photosynthesis in the cells of the leaf interior exits through these same openings.

Also water vapor is released into the atmosphere through these pores in a process called transpiration.

What regulates the opening and closing of the stomata-

During the day the guard cells gain water and become turgid that is they become swollen or puffed out.

During the night the guard cells become flaccid that is wrinkled and less rigid making the stomata closed. Thus the guard cells play an important role in photosynthesis.

The factors that regulate the opening and closing of a stoma are listed here **biological rhythm:**

Stomata continue to open and close on an approximately 24-hour clock even when switched to continuous light.

**intensity of light**

light causes stomata to open. The minimum light level for opening of stomata in most plants is 1 by 1,000 to 1 by 30 or full sunlight just enough to cause some net photosynthesis.

**concentration of carbon dioxide**

low concentrations of carbon dioxide cause stomata to open.

High carbon dioxide content causes stomata to close.

if carbon dioxide free air is blown across in darkness stomata open

**water balance or humidity**

Wilting plants close their stomata

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once the carbon dioxide has diffused through these little holes it moves up the leaf and enters the spongy mesophyll tissue which has lots of air gaps between the cells so that the gas can easily diffuse through to the next layer which we call the palisade mesophyll layer. This is where most of the photosynthesis happens and so the palisade cells are packed full of chloroplasts.

Above this with the upper epidermis which is another layer of epidermal tissue. These cells are almost transparent though as the sunlight needs to be able to pass through them to get the chloroplasts in their palisade cells beneath and once photosynthesis has finally produced the sugar molecules they're carried to the rest of the plant by these green tubes here which we call the phloem.

Now the main problem that leaves face is water loss. The xylem which runs next to the phloem here continually brings water up from the roots for the palisade cells used in photosynthesis. but that water can be lost from both the top and bottom of the leaf

To reduce this water loss the leaf has a waxy cuticle on top which is basically a thin waterproof layer of lipids that the water can't get through

When it comes to the bottom of the leaf the main problem is the stomata as the water will diffuse out of any gaps really easily

the leaves need these holes though so they can get the carbon dioxide that they need

as a compromise the leaves keep their stomata open for as short a time as possible so they can maximize carbon dioxide absorption but minimize water loss

Stomata in order to achieve this delicate balance each stoma which is what we call a single stomata is formed from the gap between two guard cells

when the plant has lots of water so it doesn't need to worry so much about conserving it the guard cells will be well hydrated which we call turgid and this makes a gap between them larger allowing more carbon hydroxide to diffuse through.

on the other hand when the plant is short of water the guard cells will lose water due to osmosis and they'll become flaccid.

this in effect closes the stomata meaning the plant no longer takes in carbon dioxide but more importantly it will conserve its water vapor.

Another adaptation is that the guard cells are sensitive to light so they close at night time when photosynthesis isn't taking place and they don't need carbon dioxide and the reason that most of the stomata are on the underside of the leaves rather than the top is that the lower surface is more shaded which makes it cooler and so it means that less water will evaporate.

when seen from above the guard cells are usually kidney-shaped.

Between the guard cells is a pore which connects the internal atmosphere of the leaf with the surrounding air.

Unlike other epidermal cells guard cells contain chloroplasts. The stomata complex also includes accessory cells.

The walls of the guard cells which enclose the pore are strengthened by cellulose microfibrils which radiate from the pore gas exchange between the internal atmosphere of the plant organs and the surrounding air takes place through the stomata carbon dioxide enters the substr mottle cavities in the mesophyll while water vapor and oxygen which is a product of photosynthesis escape to the outside.

Types of stomata

Depending upon the types of the guard cells and arrangement of sunsidiary cells, stomata are divided into 4 types:

* Moss type
* Gymnospermous type
* Gramineous type
* Dicotyledonous type

Functions of the stomata: