

Adaptations for gas exchange in plants

The Structure of the Angiosperm Leaf

Cuticle - A waxy transparent layer. It allows light to pass through to the photosynthetic palisade mesophyll below but reduces water lost by evaporation through the top surface of the leaf.

Palisade mesophyll - main photosynthetic layer packed with chloroplasts.

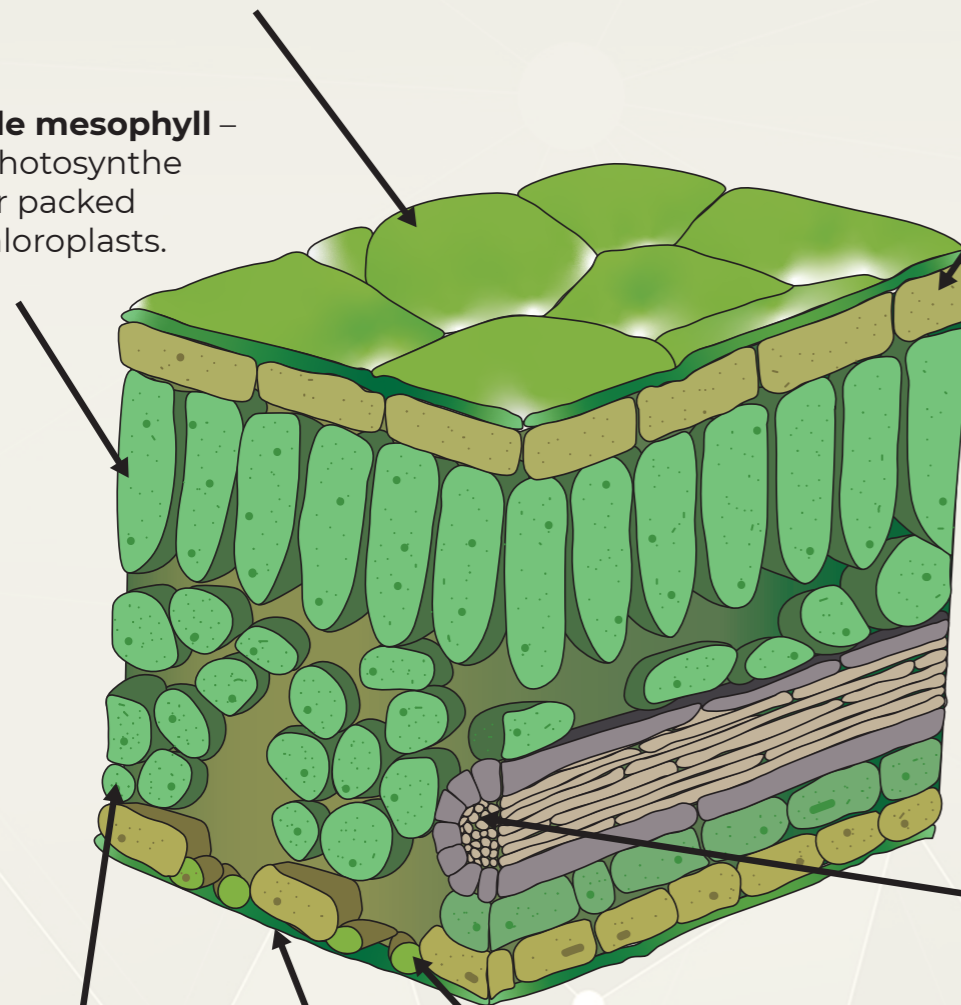
Upper epidermis - Transparent for light to easily penetrate to photosynthetic layers.

Vascular bundle containing **xylem** (carrying water from roots), **phloem** (to carry sucrose to other parts of the plant) and **bundle sheath parenchyma**.

Stomata - The stomatal pores allow the exchange of gases down a concentration gradient. The gases diffuse through intracellular spaces to and from the photosynthetic cells where they dissolve in the moist lining and diffuse into the cells. Guard cells open and close the stomata. The closing of the stomata during the night reduces water loss.

Spongy mesophyll surrounded by air spaces for easy diffusion of gases.

Lower epidermis



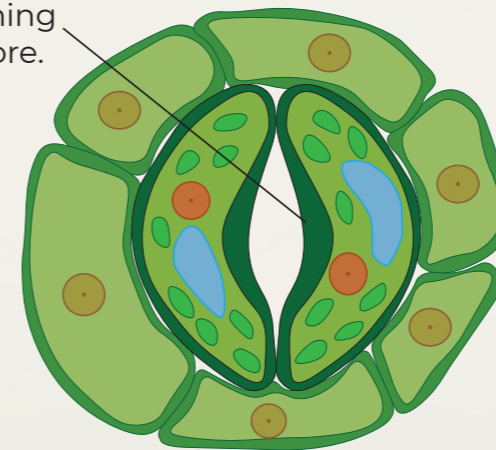
Leaves are adapted for photosynthesis by:



- **Large surface area** and orientate perpendicular to the sun for maximum light absorption.
- **Thin** with a **transparent cuticle and upper epidermis** for light to penetrate into the leaf and also for efficient diffusion of gases from the stomata, up through the gas spaces to the photosynthetic layers.
- **Palisade cells packed with chloroplasts**; cells are densely stacked with long axes perpendicular to leaf surface.

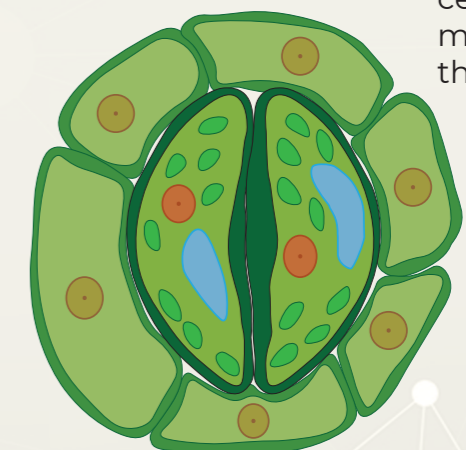
Open

Turgid guard cells bend due to thickened inner walls - opening stomatal pore.



Closed

Flaccid guard cells meet in the middle, closing the stomatal pore.



Opening and closing stomata for gas exchange

1. In light, chloroplasts in guard cells photosynthesise and produce ATP.
2. ATP used for the active transport of potassium ions into guard cells.
3. Starch is converted to malate.
4. Malate and potassium ions lower water potential of guard cells and water is drawn in by osmosis.
5. Uneven thickening of guard cell inner walls causes them to bend as they swell, opening the stomatal pore.
6. The opposite occurs when there is no light closing the pore.