

B3.1.7 — Gas exchange in leaves

↳ Gas exchange occurs through leaf

- It contains the following tissues:

1. **Epidermal tissue** → forms leaf's outer boundary

- **Epidermis** → single layer of tightly packed cells

- ↳ Lower portion contains **stomata**

- **Stomata (stoma - singular)** — openings for gas exchange & water loss (site of gas exchange)

- ↳ Each stoma is surrounded by 2 **guard cells**

- **Guard cells** → control the opening & closure of the stomata

- **waxy cuticle** → waxy layer surrounding epidermis to make it impermeable (minimizes water loss)



2. **Mesophyll tissue** → makes up the bulk of leaf's internal structure

- **parenchyma cells** → make up the mesophyll tissue & contain chloroplasts (where photosynthesis occurs)

- Two types of mesophyll tissue:

- i) **Palisade mesophyll** → site of photosynthesis cells w/ lots of chloroplasts

- ii) **Spongy mesophyll** → contains large air spaces between cells for **gas exchange** to occur

3. **Vascular tissue** → transports substances between leaf & rest of the plant

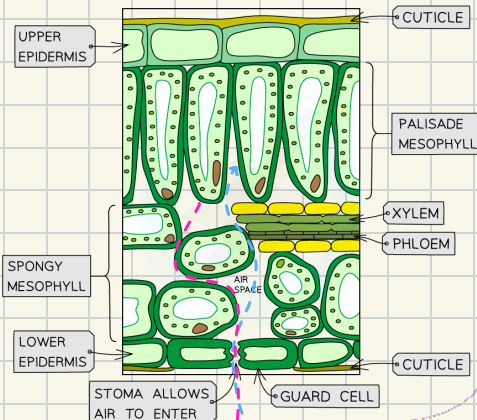
- Arranged in **vascular bundles**

- ↳ These vascular bundles form the leaf's **veins**

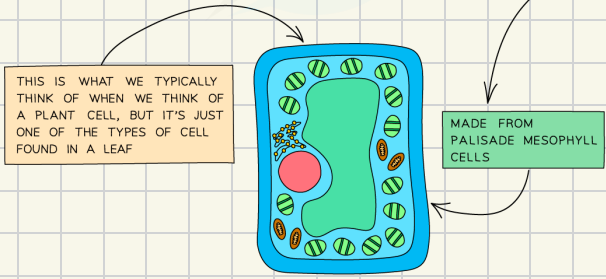
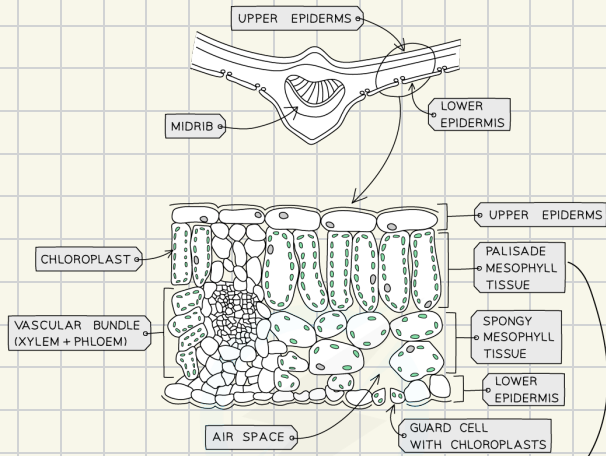
- Ex. → **Xylem** transports water to leaves

- Ex. → **phloem** transports $C_6H_{12}O_6$ & O_2 from leaves to other plant parts

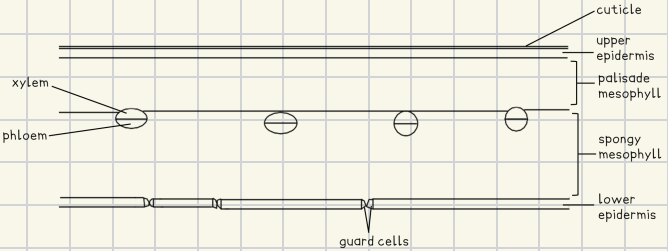
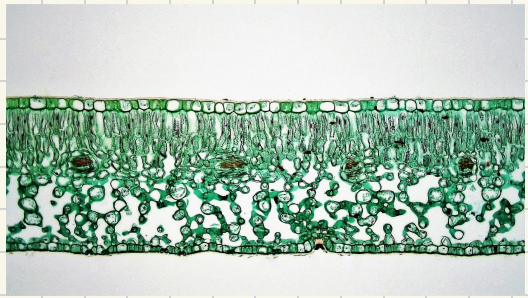
B3.1.8 — leaf tissues



Adaptation	Function
Waxy cuticle	Prevents gases and water vapour from leaving through the epidermis so that gas exchange must occur through stomata. This allows gas exchange and water loss to be controlled
Epidermis	Contain stomata for gas exchange. Most stomata are found in the lower epidermis where the temperature is lower. This reduces water loss
Air spaces	Maintains a concentration gradient of gases between the air and spongy mesophyll cells by allowing movement of gases
Spongy mesophyll	Increases the surface area for gas exchange
Guard cells	Control gas exchange and water loss by opening or closing stomata
Veins	Xylem vessels bring water to the leaf which is required for photosynthesis and transpiration. Photosynthesis requires carbon dioxide to diffuse into the leaf while transpiration involves the loss of water vapour



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B3.1.9 — Transpiration in plants

↳ For the plant to perform photosynthesis, the stomata must be open (gas exchange)

- This causes water to be lost in the form of water vapour
 - Water moves from high to low water content (moist → dry)

Transpiration → loss of water vapor from the leaves

↳ Factors affecting transpiration:

a) Air movement

- More air movement leads to increased rates of transpiration
 - i) When air is still, water accumulates just outside inhibiting further diffusion
 - ii) When air shifts, water is carried away so more water must diffuse

Transpiration is the inevitable consequence of gas exchange in the leaf

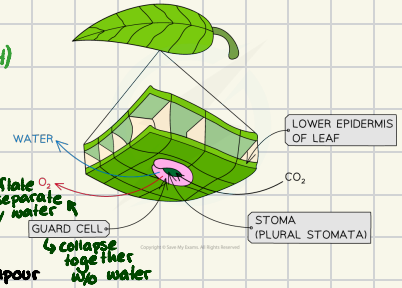
This considers air in leaf's external vicinity to be less humid than its internal environment

b) Temperature

- Higher temps lead to higher rates of transpiration (up to a point)
 - i) High temp → KE of H_2O ↑, they evaporate @ faster rate
 - ii) Too high temp → stomata close to prevent water loss

c) Humidity

- Higher humidity levels reduce the rate of transpiration
 - i) High humidity = air surrounding leaf is saturated w/ water vapour
 - This decreases transpiration, as there is not enough dif. (or none at all) between $[H_2O]$ levels outside vs inside cell



↳ Plants choose at which times their stomata

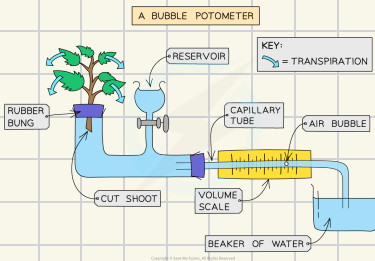
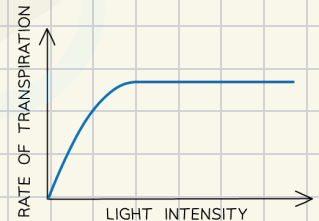
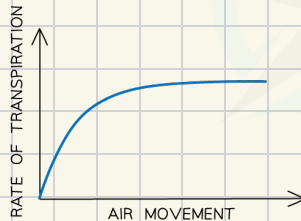
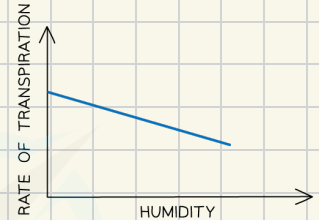
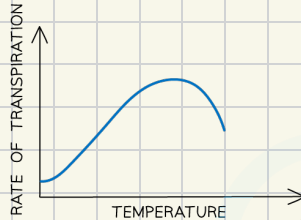
would open/close, usually:

a) opening @ daytime

- Allows for photosynthesis

b) closing @ night-time

- Allows for water loss minimization



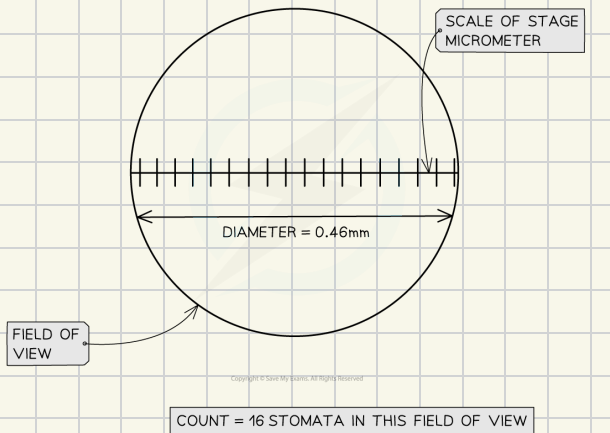
used to measure transpiration!
Water would move the air bubble left as the plant transpires. One can measure the distance it travelled ∴ transpiration

B3.1.10 — Stomatal density

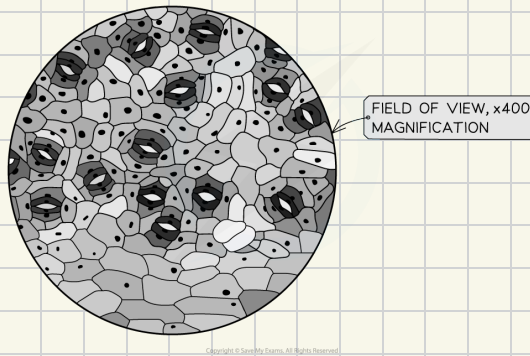
Stomatal density \Rightarrow # of stomata in a given area $\left(\frac{\# \text{ stomata}}{\text{cm}^2} \right)$

\hookrightarrow Two methods to investigate this:

1. Peel off epidermis \ddagger mount on slide
2. Paint, dry, peel \checkmark clear nail polish to make a cast \ddagger study it under a microscope



COUNT = 16 STOMATA IN THIS FIELD OF VIEW



$$d = 0.46 \text{ mm}$$

$$r = 0.23 \text{ mm}$$

$$A = \pi r^2 \Rightarrow A = \pi (0.23)^2 \text{ mm}^2$$

$$A = 0.1662 \text{ mm}^2$$

$$\text{density} = \frac{16 \text{ stomata}}{0.1662 \text{ mm}^2}$$

$$\text{density} = 96.27 \text{ st/mm}^2$$

$$\text{density} = 96 \text{ st/mm}^2$$