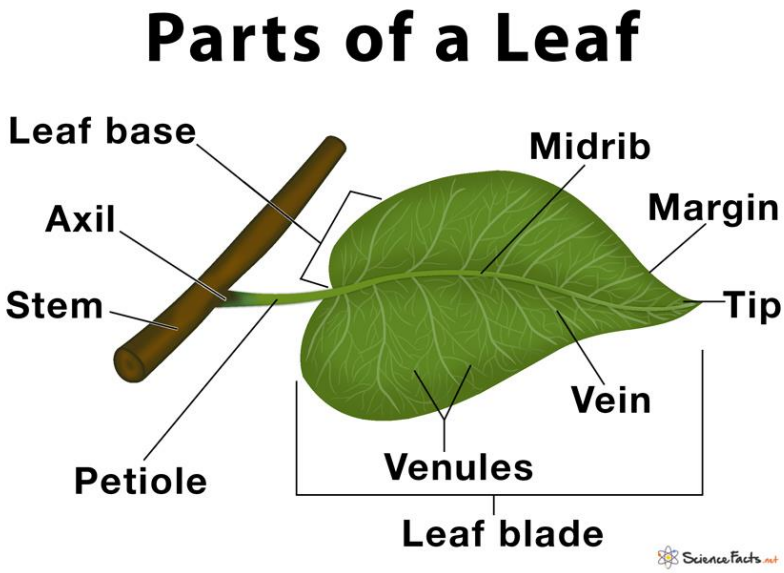
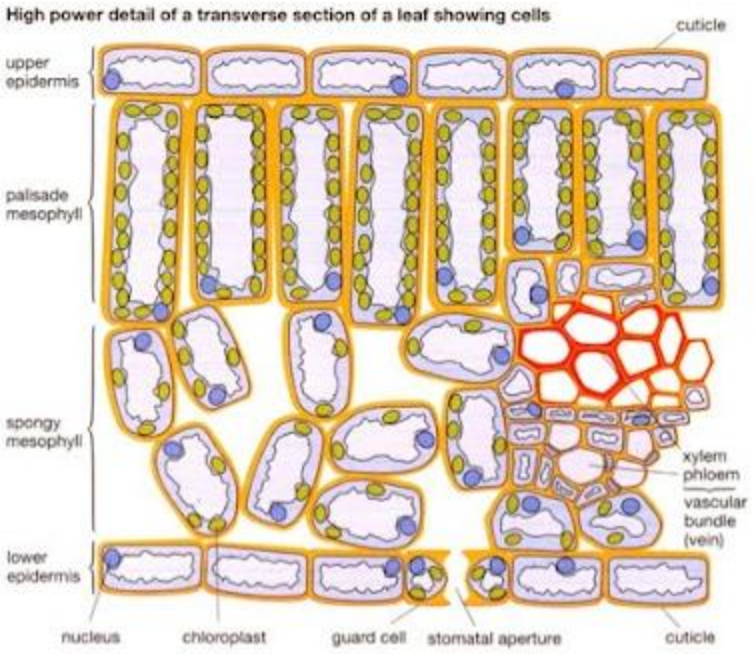
NUTRITION IN PLANTS

Transverse section of dicotyledonous leaf



1. Lamina
- Large surface area allows maximum light absorption
- Thin surface provides short diffusion distance for gases
2. Midrib
- Provides strength
- Contains the largest area of vascular bundle
3. Veins and venules
- Made up of small vascular bundles
4. Petiole
- Connects the leaf to the stem
- Holds leaf in position to absorb maximum light

Parts of leaf



Layer	Structure	Function
Upper epidermis	Uppermost *single layer* of transparent, closely-packed cells Covered by a layer of waxy, transparent *cuticle*	Protects inner layers of the cells; allows light to enter inner layers of leaf Reduces water loss through evaporation; allows light to enter inner layers of leaf
Palisade mesophyll cell	Closely-packed, long and cylindrical cells Contains highest distribution of chloroplast	Highest rate of photosynthesis takes place here
Spongy mesophyll cell	Irregular shape Numerous intercellular air spaces among cells Contains fewer chloroplasts than palisade mesophyll cell Cells are covered with a thin film of moisture Contains xylem and phloem	Allow high rate of diffusion of gases into and out of mesophyll cells Photosynthesis takes place here Allows carbon dioxide to dissolve Xylem transports water and mineral salts to cells Phloem transports sucrose and amino acids
Lower epidermis	Lowermost single layer of closely-packed cells	Guard cells control the opening and closing of the stomata and thus regulate

	Covered by a layer of waxy, transparent cuticle Two guard cells surround stoma and are the only epidermal cells containing chloroplasts	the rate of diffusion of gases into and out of the leaf Photosynthesis takes place in guard cells Stomata are open during the day and close at night Stomata may be closed even in bright sunlight under *dry, hot conditions*

Photosynthesis

1. Definition

- Process by which light energy is absorbed by chlorophyll and transformed into chemical energy. The chemical energy is then used to synthesize glucose from carbon dioxide and water (raw materials)
- Oxygen is released during the process (can be used in investigation on the effects of carbon dioxide concentration on rate of photosynthesis)

2. Word equation

Carbon dioxide + Water → light energy + chlorophyll → Glucose + Oxygen + Water

3. Chemical equation

$6CO_2 + 12H_2O \rightarrow$ light energy + chlorophyll $\rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

Fate of glucose

- Broken down during **respiration** to **release energy for vital activities** of the plant
- Converted into **amino acids** (when nitrates are available from the soil), **oils** (olive oil) and **fats** (cocoa butter in seeds)
- Used to **synthesize cellulose cell wall**
- Excess is stored temporarily as **starch**
- Converted to **sucrose and transported to other parts via phloem**

Movement of carbon dioxide into the leaf

- Carbon dioxide diffuses down a concentration gradient through the stomata into the intercellular air spaces of the leaf
- Carbon dioxide dissolves in thin film of moisture on the surface of mesophyll cells
- Dissolved carbon dioxide diffuses into the cell and **enters the chloroplasts**

Limiting factors: Directly affects a process if its quantity is changed

a) Light intensity: Vary distance of light source from the experimental set-up

b) CO_2 concentration: Adding equal amounts but different concentrations of sodium hydrogen carbonate

- Beyond a particular concentration, rate of photosynthesis doesn't increase. To make use of surplus CO2 in the water, light intensity has to be increased.

c) Temperature: Vary the temperature by using water at different temperatures

Investigations

1. Investigate the effects of carbon dioxide concentration on the rate of photosynthesis using aquatic plant

- Amount of oxygen released increases with an increase in the concentration of NaHCO3 dissolved in water in the beaker

2. Investigate the effects of light intensity on the rate of photosynthesis using an aquatic plant: The rate of photosynthesis increases with increasing light intensity.