Respiration:

- Process of transferring energy from glucose. Happens in every cell in the body.
- Energy transferred by respiration cannot be directly used by cells - used to make a substance/ energy compound called ATP (adenosine triphosphate)
- Cellular respiration breaks bonds within molecules releasing energy to make ATP.
- When a cell needs energy, ATP molecules are broken down and energy is released.
- This energy originates in the sun, and is passed along a food chain as part of organisms.
- Chemical reactions (metabolism) divided into either releasing energy or using energy.

Aerobic Respiration:

- Glucose is broken down to CO2 and water. Oxygen helps the reaction release lots of energy.
- Happens when lots of oxygen is available/abundant.
- The most efficient way to transfer energy from glucose (32 molecules of ATP per glucose)
- The type of respiration being used most of the time (by humans and animals

Anaerobic Respiration:

- Glucose is partially broken down without use of oxygen. Little energy is released from glucose.
- Often short-term. Some organisms (like bacteria) can only respire anaerobically.
- Happens when aerobic respiration does not provide enough oxygen to muscles (in animals)
- NOT the best way to transfer energy from glucose - releases less energy per glucose molecule compared to aerobic respiration (2 molecules of ATP)

- **Anaerobic Respiration in Animals** (lactic acid as waste):
  - Lactic acid builds up in muscle - causes pain and cramp.

- **Anaerobic Respiration in plants and fungi** (ethanol and carbon dioxide as waste):
  Also known as fermentation

No.

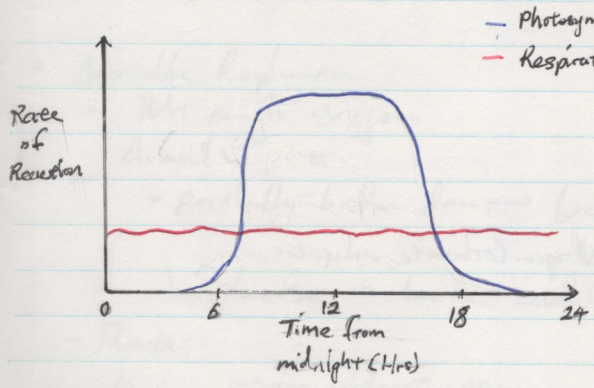
Date

Gas Exchange

Photosynthesis: Use Carbon Dioxide (CO_2)
Produce Oxygen (O_2) (waste product)

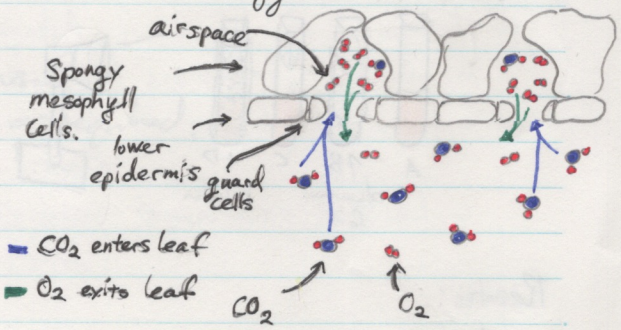
Respiration: Use Oxygen (O_2)
Produce Carbon Dioxide (CO_2) (waste product)

These gases move in and out of plants through small holes under the leaf called Stomata (stoma - singular)
Move by Diffusion (from higher conc. to lower conc.)



In respiration:
- Uses Oxygen in leaf
  ↳ Concentration of Oxygen is lower in leaf.
  ↳ Oxygen diffuses into leaf.

In Photosynthesis:
- Uses CO_2 in the leaf
  ↳ Concentration of CO_2 is lower in the leaf.
  ↳ CO_2 diffuses into leaf.
- Produces Oxygen
  ↳ Concentration of Oxygen is higher in leaf
  ↳ Oxygen diffuses out of leaf.



* Photosynthesis can only happen during the day (with enough light)
- Respiration happens both day & night
- Plants make more oxygen in day than they use in respiration → (Net exchange) Release oxygen, use CO_2.
- At night (or low light intensity) plants only respire, so the Net exchange of gas is use Oxygen and release CO_2.

"Adapted for gas exchange"

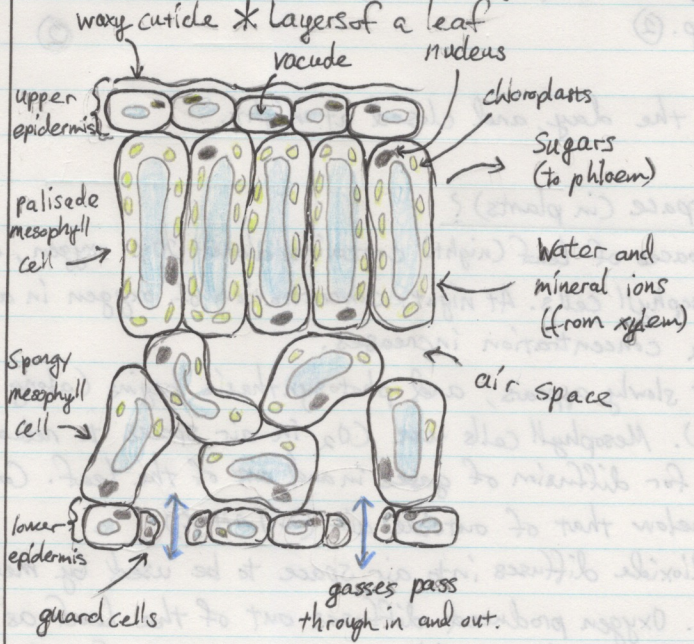
- Large surface area for diffusion.
- Thin - gases have to only travel short distances
- Airspaces in leaf allow easy movement of gas, and increases surface area.
- Lots of Stomata (stoma) under the leaf enables diffusion of gases (CO_2 & O_2) in and out of Leaf.
  ↳ useful for transpiration (H_2O) (leaf)
- Stomata close at night to keep water from escaping, and prevent it from drying out.
  ↳ they also close when lacking water supply from roots, but therefore cannot photosynthesize.
  ↳ Guard cells increase volume to open stomata (decrease to close stomata)
- Cells are in close contact to air spaces for easy exchange of gases.

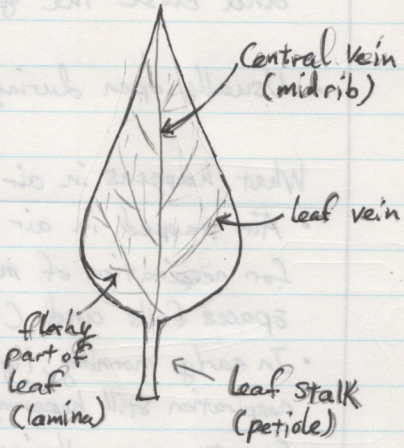
KW's

3.1 Gas exchange in flowering plants (pg 86 ~ 90)

Introduction:

- Two processes in plants use and produce gasses.
  - Respiration uses oxygen and releases CO_2.
  - Photosynthesis uses CO_2 and releases oxygen, given that light and chloroplasts are present.
- If a leaf is dipped into hot water, air expands inside the air spaces that escape through stomatal pores.





A leaf has features adapted for gas exchange:

- Large flat surface exposed to air provides a large surface area in relation to volume.
- Lots of stomata (most under the leaf) allows for movement of gases in and out of the leaf.
- Distance of diffusion of gases is short as the leaf is thin.

Stomata

- Lots of stomata open in sunlight.
- Air spaces inside the leaf allow for gas diffusion in and out of the cell.
- Palisade mesophyll cells (with most chloroplasts) are close to air spaces enabling easy gas exchange from photosynthesis.
- Spongy and palisade mesophyll layers are thin for gases to pass through membranes.
- Moisture in air spaces and surfaces help gases dissolve and diffuse.
- Cells in close contact with air spaces for easy exchange of gases from respiration.
- Net diffusion from stomata: balance of gas diffusion depending on rate of photosynthesis and respiration (and light intensity)
- Stomata must be open for gas exchange.

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Date .

KW's

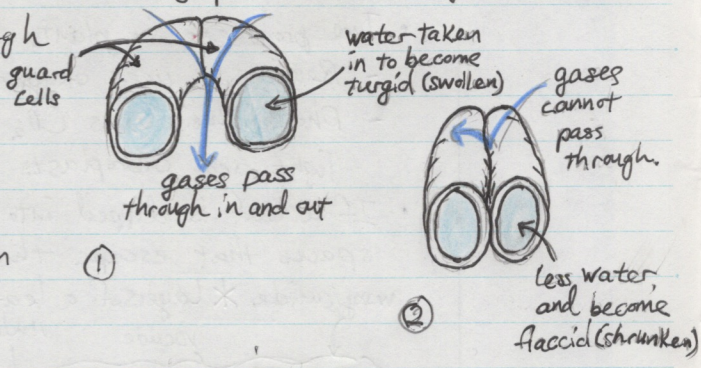
Guard cells

turgid

flaccid

Stomata and Guard Cells:

- Each stoma (stomata, plural) made of two guard cells with a small gap between.
- Guard cells contain chloroplasts, different from other cells on epidermis.
- Guard cells can change shape to increase size of gap, or close the gap.
- Guard cells take in water through osmosis, becoming turgid and curved to open a gap. ①



- Guard cells get rid of water, becoming flaccid to straighten and close the gap. ②
- Usually open during the day, and closed at night.

What happens in air space (in plants)?

- Air trapped in air spaces of leaf (night) contains about 20% oxygen, enough for respiration of mesophyll cells. At night, concentration of oxygen in air spaces falls and CO_2 concentration increases.
- In early morning, light slowly appears, and photosynthesis begins (along with respiration still happening). Mesophyll cells use CO_2 in air spaces to release oxygen. Stomata open, allowing for diffusion of gases in and out of the leaf. Concentration of CO_2 decreases below that of outside air (~0.04%)
- Net effect: Carbon dioxide diffuses into air space to be used by mesophyll cells for photosynthesis. Oxygen produced diffuses out of the leaf as concentration is higher inside (continues as long as light is bright enough for photosynthesis)

Other places gas exchange happen in flowering plants:

- All living cells in plants carry out respiration, and require oxygen and also get rid of CO_2 waste.
- Cells with chloroplasts carry out photosynthesis when there is enough light, and are linked to gas exchange.
- For example, gas exchange in roots take place through root hairs. Thin walls allow for diffusion of oxygen (from soil air spaces) and release of Carbon dioxide. If the soil is flooded with water, air spaces are filled, and less oxygen is available.