PLANTS consist of

- Systems
- Organs
- **tissues**

PLANT TISSUES

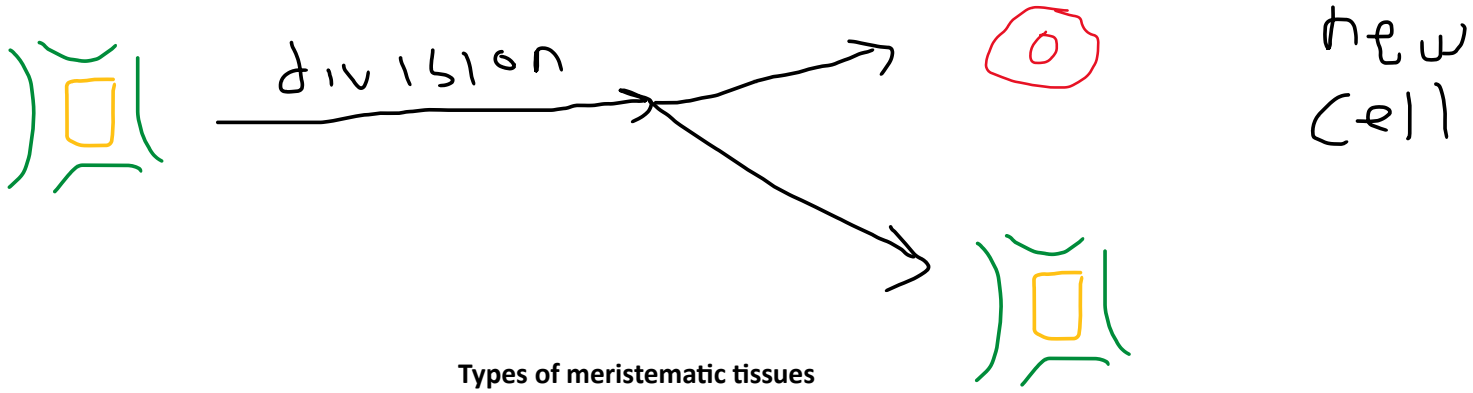
Have two types

MERISTEMATIC PLANT TISSUES

They are tissues that have **undifferentiated cells** and have the **ability to renew** again and again.

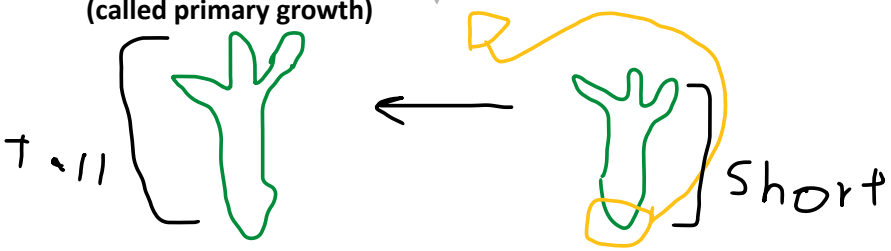
As they are the **source of any other cell in the plants**, as during cell division, one cell remains the same meristematic cell and the other becomes a different plant cell

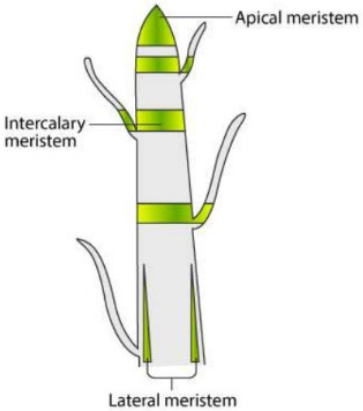
They are called **building blocks** of plants because most of the plant is built with them



Types of meristematic tissues

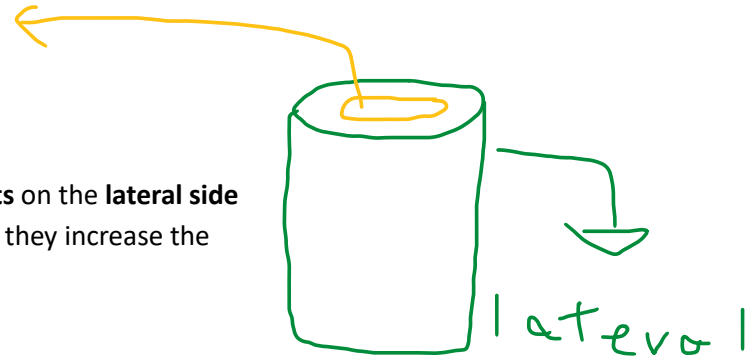
Apical => are located at the apices plants, they shoot out and divide to increase the height of the plant **(called primary growth)**





Intercalary => they lie at the internodes of plants and help to increase length of the internode, they are found in stuff like **grass, monocots, and pines**

the stem / root organs



Lateral => are located around the organs of the **stems** and **roots** on the **lateral side** such as **vascular cambium**, **cork cambium**, and **interfascicular**, they increase the thickness of the plant **(called secondary growth)**

VASCULAR & NONVASCULAR PLANTS

vascular plants => they are plants with a **vascular system (xylem & phloem)**, and are generally larger than non vascular plants, they have indeterminate growth

they have many types

- **seedless plants** are plants without seeds like **club mosses**
- **plants with seeds** differentiate into two types
  - **gymnosperms ->** plants with naked seeds that have no protective cover so they can be fertilized by just air
  - **angiosperms ->** plants with covered seeds that are fertilized by animals like **bees** and differentiate into two types

	Seed	Root	Vascular	Leaf	Flower
Monocot					
	One cotyledon	Fibrous roots	Scattered	Parallel veins	Multiples of 3
Dicot					
	Two cotyledon	Tap roots	Ringed	Net-like veins	4 or 5

Nonvascular plants => don't have a vascular system like **moss**

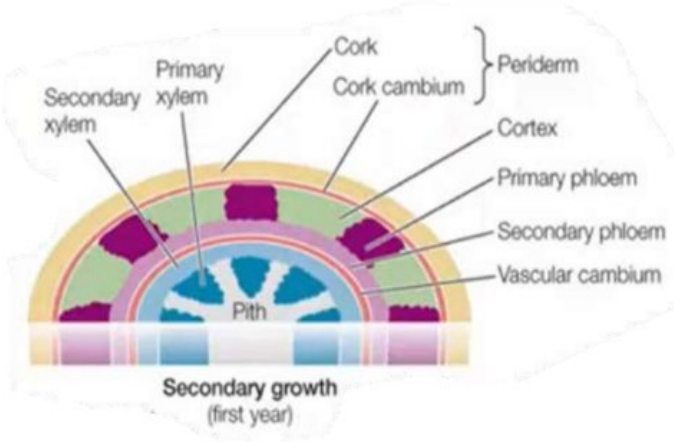
LATERAL MERISTEMS

Let's imagine a tree bark

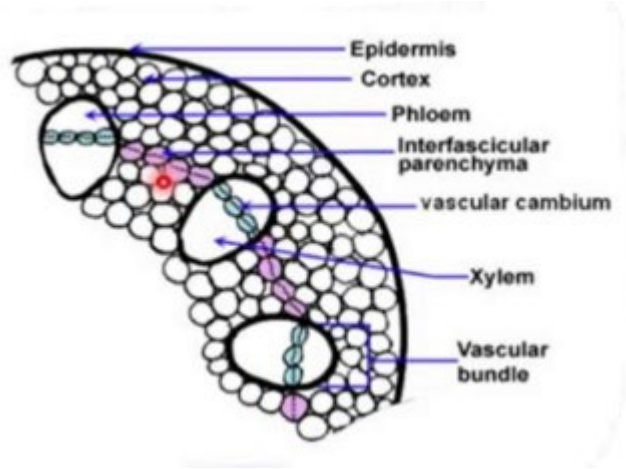
We have an **vascular area** that is made to support the plant with nutrients and water and other stuff, this has the **lateral meristems** like **(vascular cambium)**

In the vascular area, we have the **vascular cambium**, it is a slice of cells between **phloem** and **xylem**, where the area going through the **xylem and phloem** is called a **fascicular cambium**

And the area between each fascicular cambium is called an **interfascicular cambium**



There is an area around the vascular area starting with a thin layer of meristem cells called a **cork cambium** that then divides into **cork cells** on the outside and **phelloderm** on the inside



Some common properties of meristematic

1. The meristematic tissue has the quality of self-renewal. Every time the cell divides, one cell remains identical to the parent cell, and the others form specialized structures.
2. They have very small and few vacuoles.
3. The meristematic tissue is living and thin-walled.
4. The protoplasm of the cells is very dense.
5. The meristematic tissues heal the wounds of an injured plant.
6. The cells of the meristematic tissue are young and immature.
7. They do not store food.
8. They exhibit a very high metabolic activity.
9. They possess a single, large and prominent nucleus.

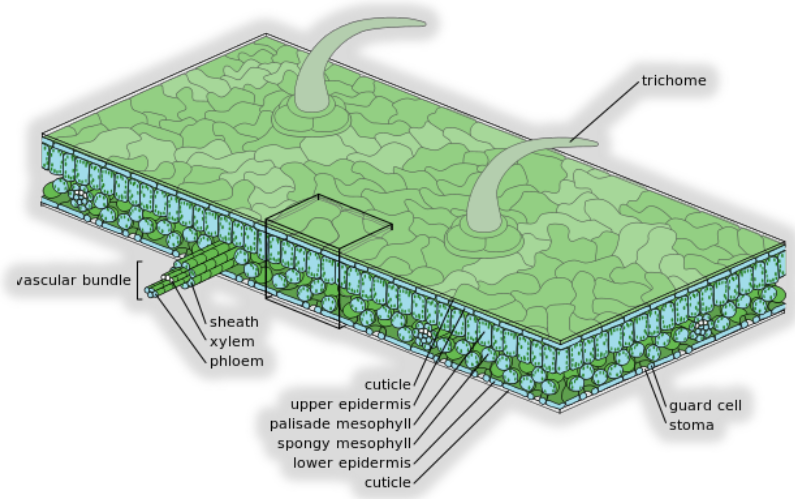
PERMANENT TISSUES

Are plant tissues with completed growth and differentiation and they are incapable of **meristematic activity**

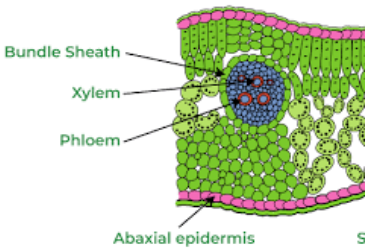
They have multiple types like

Dermal (protective) permanent tissues

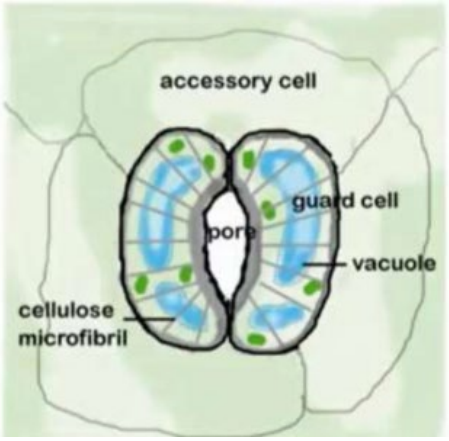
It is the system forming the outer protective covering of a plant, it consists of

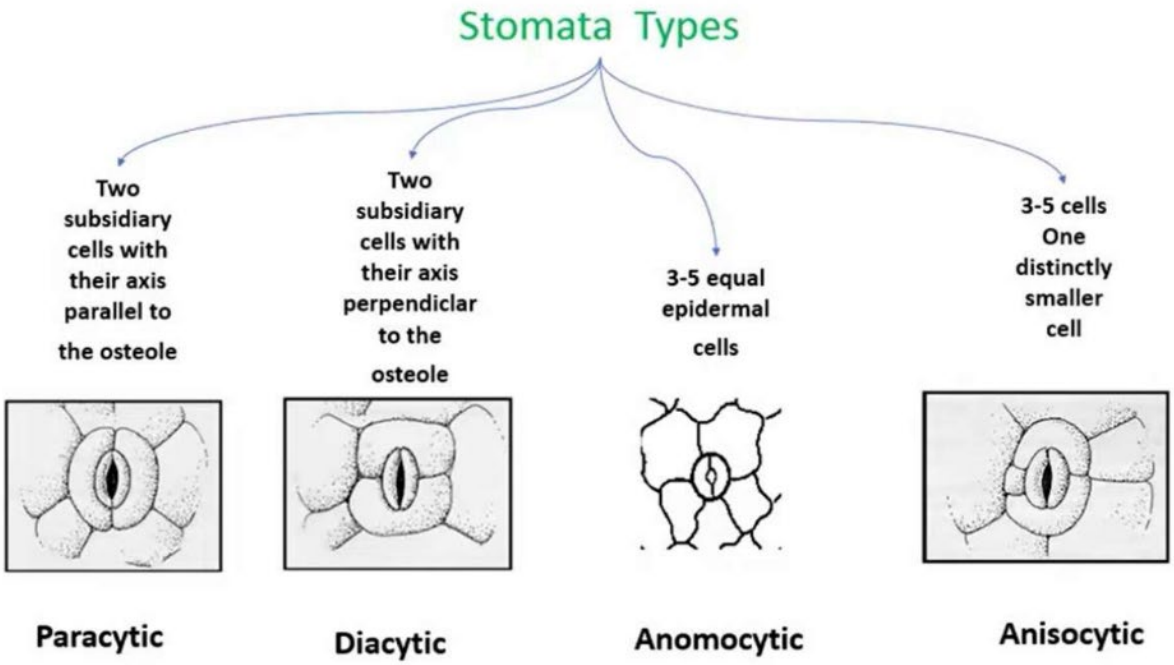


- **EPIDERMAL BODY**
  - it represents most of the outer tissue of the plant providing support and protection
  - it began with the division and differentiation of meristematic cells
  - it starts in this order
    - Cuticle => a waxy layer on the upper epidermis minimizing water loss
    - Upper epidermis => It protects the leaf from water loss and external threats
    - Mesophylls => are tissues sandwiched between the upper and lower epidermis, where **photosynthesis** takes place
      - **Palisade Mesophyll** => compactly packed cells near the upper epidermis, containing a lot of chloroplasts for efficient light capture
      - **Spongy mesophyll** => loosely arranged cells near the lower epidermis, facilitating gas exchange with air spaces for efficient CO_2 diffusion, it acts like **lungs**
    - Lower epidermis => It protects the leaf from water loss and external threats
  - **The external epidermal wall** is the thing that makes most of the dermal tissues, it can be split into 3 layers
    - **The innermost layer** is made of pure **cellulose** "starts with the inner parts of the epidermis"
    - **The middle-cutinized layer** is made of a mixture of **cellulose** and a fatty material called **cutin** "starts with the outer parts of the epidermis (abaxial epidermis)"
    - **The outermost layer** has the highest percentage of **cutin** which makes it be called **cuticle**
  - the epidermal body is smade of **Epidermal cells**
  - **Epidermal cells** have no intercellular spaces between them, so they form a continuous layer except in certain regions where **stomal pores** are found
- **VASCULAR BUNDLE**
  - It consists of **sheath** (which is a protective layer) covering **xylem & phloem**



- **STOMATA (STOMA) AND GUARD CELLS**
    - Stomata are openings in the epidermis mainly to regulate **gas exchange** in the plants, it consists of
        - **Guard cells**
        - **Subsidiary cells (2 or more cells)**





- **TRICHOMES**
    - They are epidermal modifications and appendages
    - They are commonly known as hairs or trichomes
    - Based on their function, they can be classified into
        - **Non-glandular** provide protection for the plant by trapping insects and making it difficult for herbivores to eat the plant
        - **Glandular** produce chemicals to attract polinaters

Non-glandular trichomes

- Unicellular
- Multicellular
  - Unbranched
    - Uniserriate
    - Biserriate
    - Multiserriate
  - branched
    - Stallate
    - Candelabra





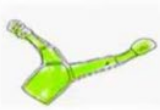
One-line	Two line	Three line	Star like	Candlestick like

Glandular trichomes

- Unicellular stalk
  - Unicellular head — Capitate
  - Bicellular head — Bi-capitate
  - Multicellular head — Clavate
- Multicellular stalk
  - Uniseriate stalk, unicellular head
  - Multicellular stalk, multicellular head
  - Branched stalk with unicellular head

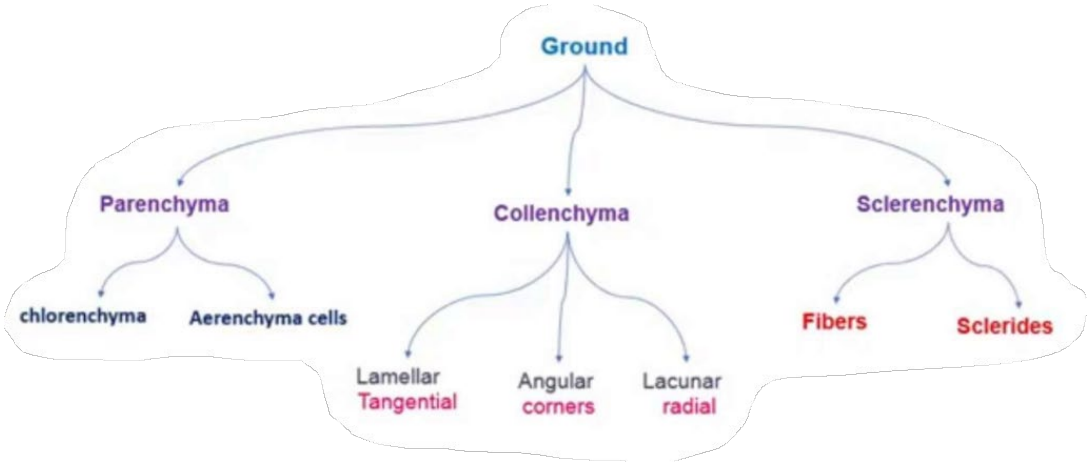




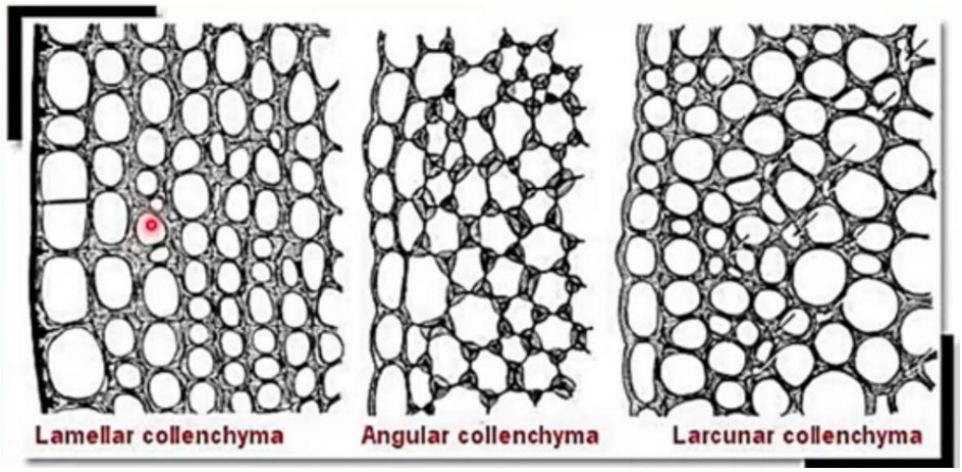
Ground (simple permanent) tissue

They make the majority of the plant and do stuff like **photosynthesis – metabolism – storage – support – cover wounds – replace lost tissue**, it is located in the roots of the plant and it also makes the majority of the embryo to provide it with food

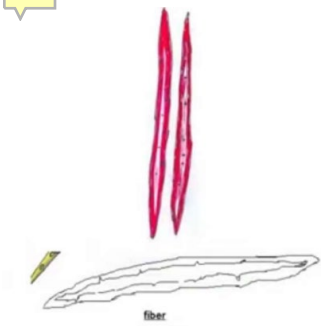


- **Parenchyma**
  - They are large living cells, having large vacuoles and thin walls consisting of cellulose
  - They have interceullular spaces between them
  - They either
    - Store water, food like starch/fat/protein
    - If chloroplasts are present, these cells can carry **photosynthesis** and usually known as **chlorenchyma**
  - ❑ parenchyma cells perform most of the metabolic functions of the plant, synthesizing and storing various organic products.
    ❑ For example, photosynthesis occurs within the chloroplasts of parenchyma cells in the leaf.
    ❑ Some parenchyma cells in stems and roots have colorless plastids called amyloplasts that store starch.
- **Aerenchyma**
  - It consists of chains of small cells enclosing **very wide intercellular spaces** it is filled with extensive connected air spaces, and it is widespread in aquatic and wet plants which must grow in hypoxic soils
  - They keep the buoyancy of the plants to them and also facilitate the diffusion of air
- **Collenchyma**
  - They are elongated living cells with non-lignified walls, they have a primnary wall of **cellulose** and a secondary wall of **hemi-cellulose / pectin**
  - They act as a **stretching power / support** for the young growing organs
  - They exist in growing stems/petioles just under their epidermis, they are absent in mature roots, mature stems, and **monocots' leaves**

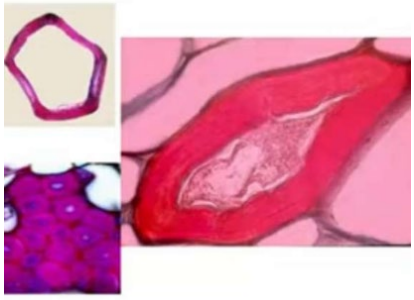
- They may be
  - **lamellar** if the thickness mainly occurring on the **tangential** walls than in the radial
  - **lacunar** if the thickness is occurring between the intercellular spaces
  - **angular** if the thickness is on the corner



- **sclerenchyma**
  - nonliving cells with thick often **lignified secondary wall**
  - they are made up of a primary **cellulose wall** and a **lignin secondary wall**
  - they are classified Into
    - **fibers =>** are long narrow spindle-shaped pitted lignin/cellulose supports such as Xylary and extraxylary they strengthen and thickens the cell, leaving small narrow lumen



    - **sclereids =>** are isodiametric elongated bone shaped stellate/filamentous supports for the plant distributed across the cortex/phloem/fruit/outer coat of seeds, they are isolated or in groups



Vascular Permanent Tissue

It is the vascular/conducting tissues in a plant, and are composed of **xylem** for water conducting and **phloem** for food conducting

Xylem is a complex tissue the characteristic components are: - **tracheary** & **atracheary** elements.

The tracheary elements **(tracheids and vessels)**

Atracheary elements **Xylem fibers and parenchyma.**

Function : -

The tracheary elements: conduction & support.

Atracheary elements : They have no role in conduction, they are specialized supporting elements.

The tracheary elements consist of

- **Tracheids** => conducting/support elements, each tracheid is a single elongated cell from one procambial cell with bluntly tapering ends, when the plant matures, the tracheids will die and become lignified, they have two types
    - Pitted -> bordered type pits
    - Non-perforated end walls
- **Vessels** => are narrow or wide water conducting tubes formed by a number of cells, by a partial or complete disintegration of their end walls

The atracheary xylem fibers consist of

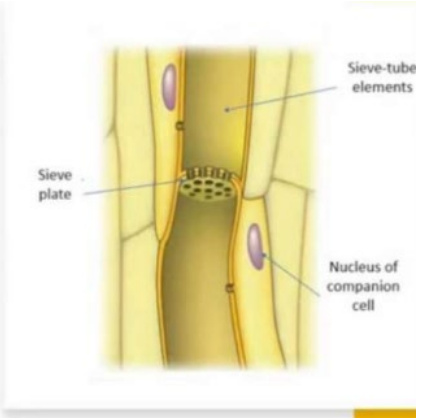
- **Xylem fibers** which are hard, thick, lignified walls which have longer and narrower ends and more tapering than tracheids
    - they have simple pits which are vessels and tracheids
- **Xylem parenchyma** are living cells scattered across tracheary elements and fibers or aggregate into rays, they have thin but often lignified walls and they
    - **Store and conduct materials across the tracheary elementsc**

The phloem is a complex tissue composed of several kinds of cells, they are sieve elements and they are food conducting tissues

Phloem

They are composed of : -
- Sieve tubes (*Angiosperms*)
- Sieve Cell (*Gymnosperms*)
- Companion cells
- Phloem parenchyma
- Phloem fiber

They may be one or several companion cells associated with the sieve tube

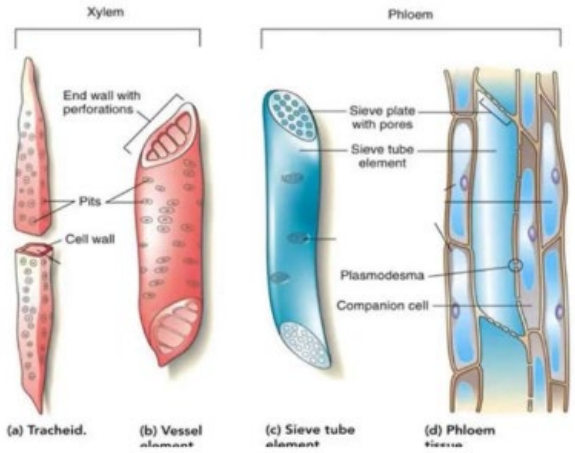


VASCULAR TISSUE COMPONENTS

In the xylem walls there are narrow holes called **pits** which can easily pass water through

Next to phloem, there are cells called **companion cells** responsible for storage through a hole called **plasmodesma** and have a mitochondria that produces ATP

Xylem itself is made of dead cells



ADAPTATION

is the adjustment or changes in an organism's behaviour/structure/physiology to become more suited for the environment

it has two types

Structural adaptations are changes to the way something is built or made

Behavioral adaptations are changes to the way something reacts or acts

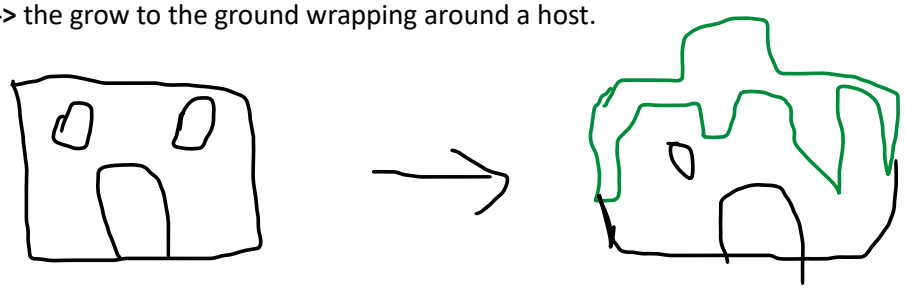
Adaptation happens in three main organs in plants like **roots – stems - leaves**

Root hairs of a radish seedling -> the hairs on the roots of a radish increase by growing rate of the radish as the roots expand the surface area where materials can get absorbed

Buttress roots -> happen because of the moist conditions in their environment as their roots look like buttresses giving architectural support to the trunk of the tree because of its size

Pneumatophores -> known as air roots, they are produced by trees like mangrove so they can obtation oxygen because it is little in mud

Strangling aerial roots -> the grow to the ground wrapping around a host.

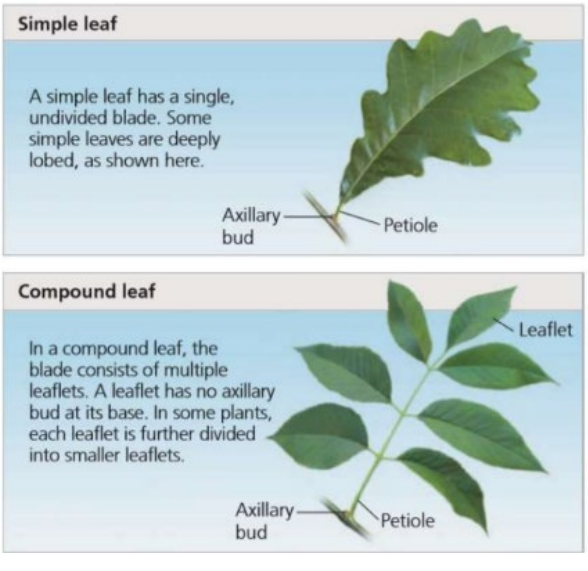


Tendrils the tendrils which this pea plant clings to a support, like how grapevines cling onto stuff

Spines are spines that are leaves, like how they are in cacti

Storage leaves are bulbs of stored materials layered ontop of another like onions

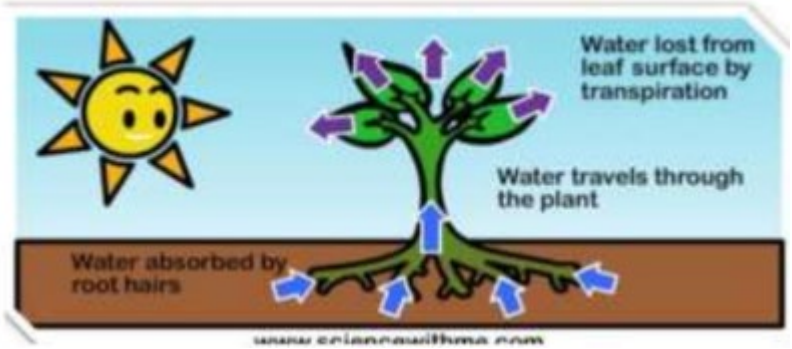
Reproductive leaves are leaves that produce plantlets which fall off the leaf and starts new roots

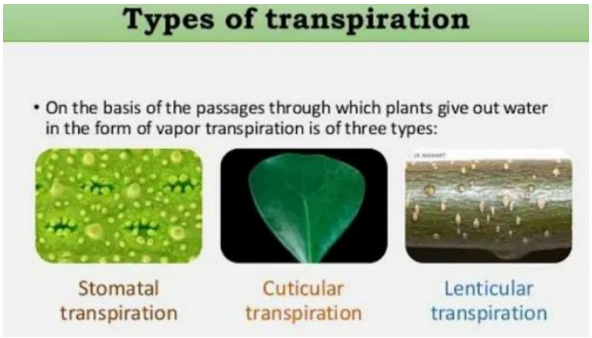


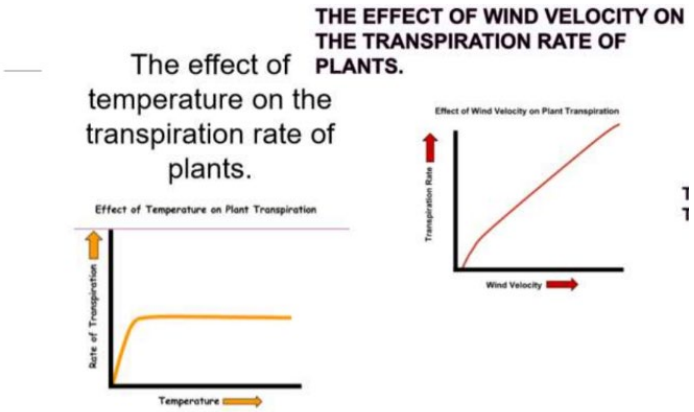
TRANSPIRATION

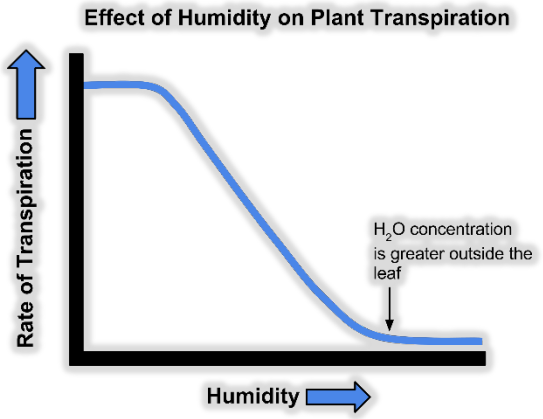
Is the process of moving water through the plant, it starts with roots down the soil to draw water into them, the water carries the **nutrients** some water is already returned to the air with evaporation (evapotranspiration"

But because of the sun's heat, water moves from the soil into plant's roots, up through the sapwood into the leaves, so the water will go until it reaches the stomata on the leaves with most of the nutrients absorbed by the plant









CAPILLARY ACTION (WICKING)

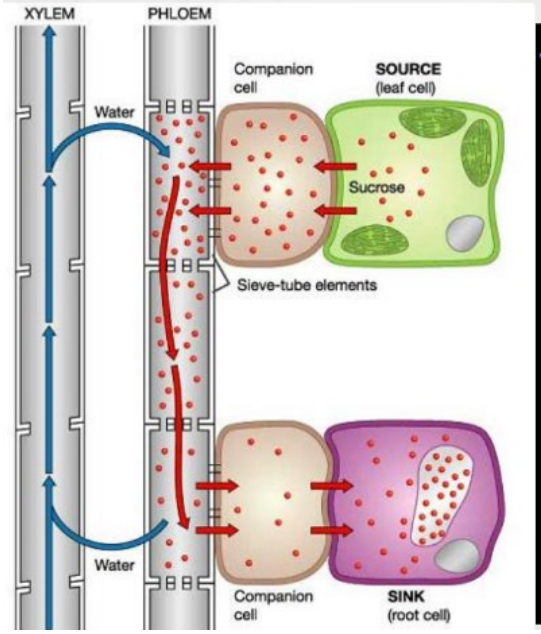
Is the ability of a substance to draw another substance into it

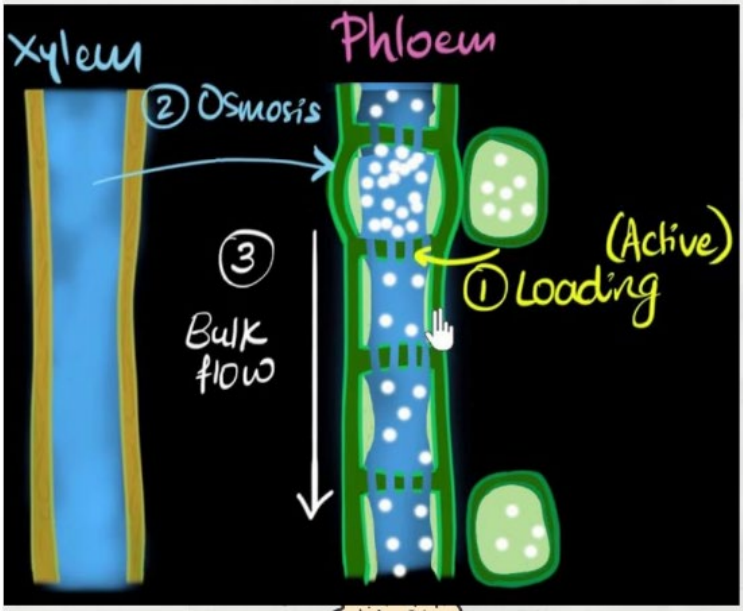
Adhesion is when water molecules are pulled by different molecules, so any higher molecules will pull the water molecules upwards

Cohesion is when water molecules are held tightly together because of hydrogen bonds, the water on top will begin to pull the lower ones upward

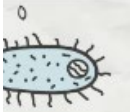
Water moves from down to up in the plant using **adhesion and cohesion**

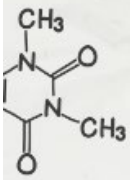
Moving food in plants

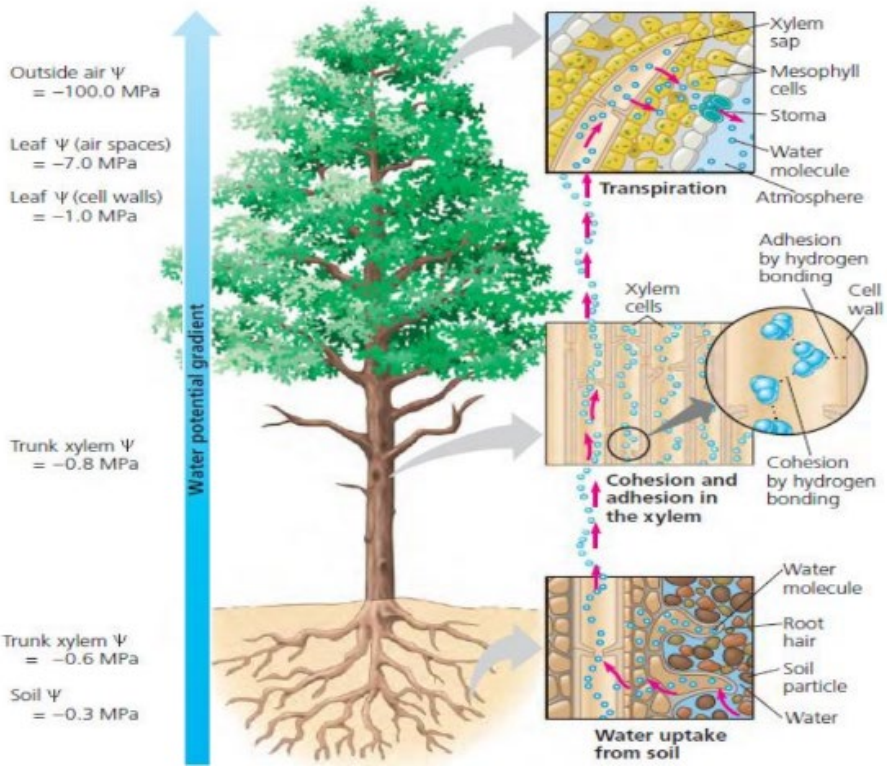




Moving water in plants







IMAGES FOR PRACTICAL EXAM

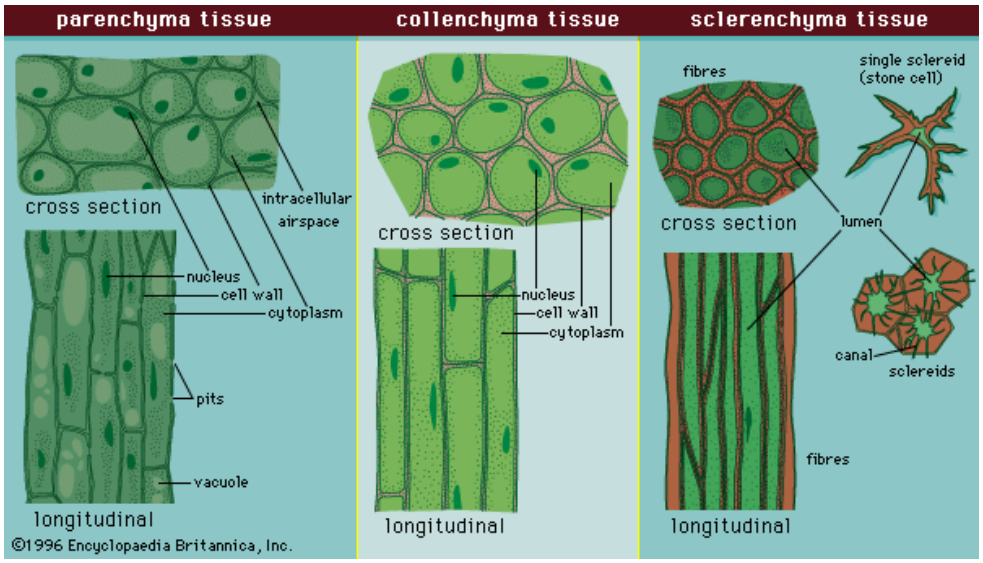
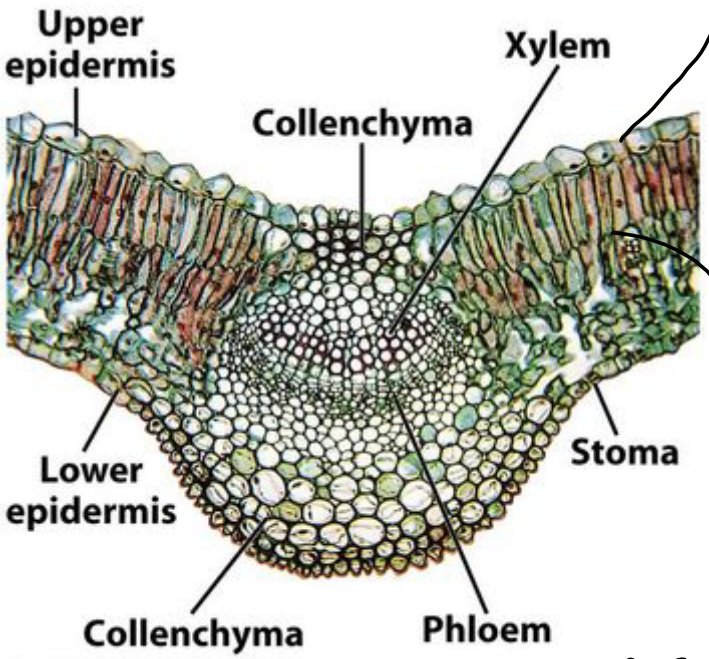


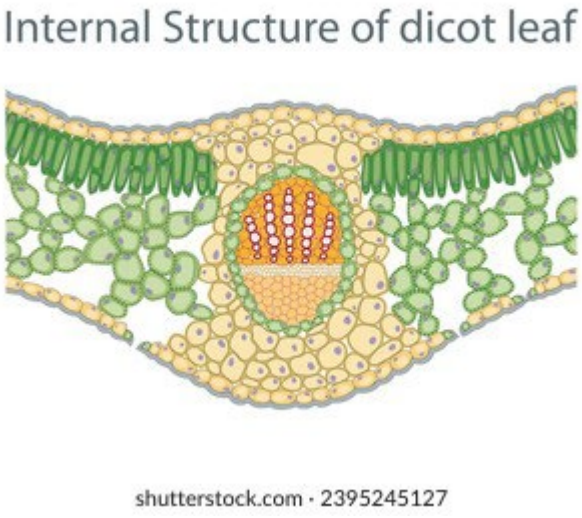
IMAGE OF A LEAF UNDER THE MICROSCOPE

palisade tissue

TO DRAW THEM, DO IT LIKE THIS



mesophyll



subscribe to sir Devenilla aka: Omar Tarek