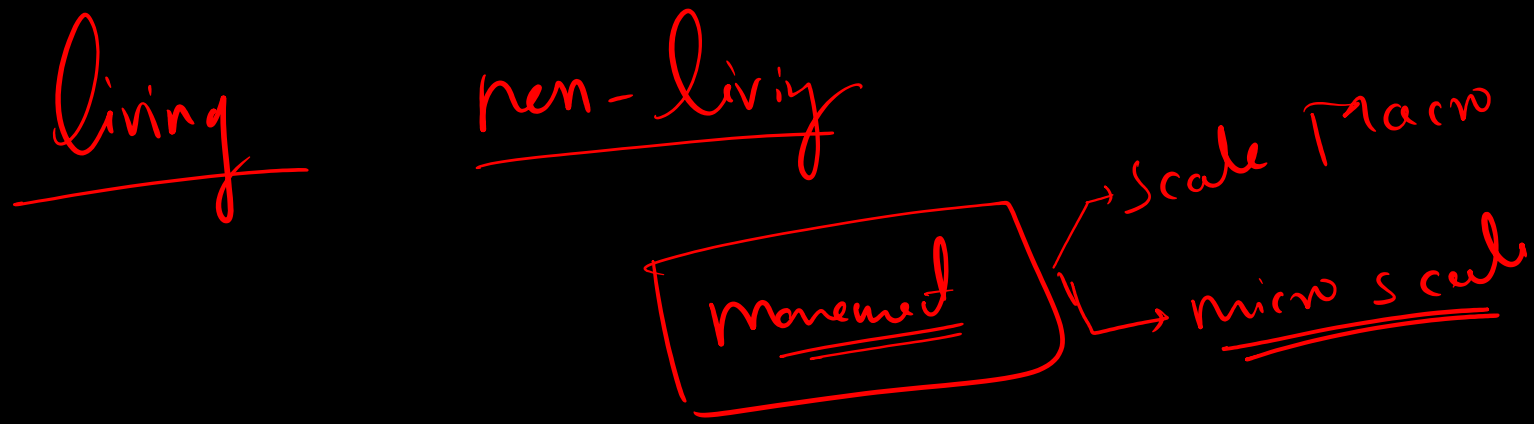
Life processes



Life sustain

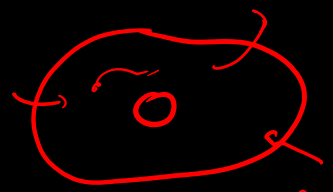
→ Respiratory System

movements

O_2

Glucose → CO_2 + H_2O + Energy

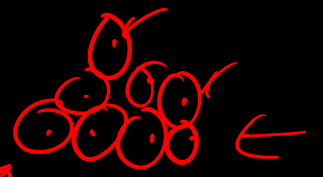
Excretory System



Single cell.

Nutrition

food → Energy



Transportation system

Unicellular Organism

Surrounding environment

Diffusion

Organelles.

organism

Nutrition

Respiration

Transp. Ex.

Coord. Rep.

Multicellular Organism

Diffusion ✗

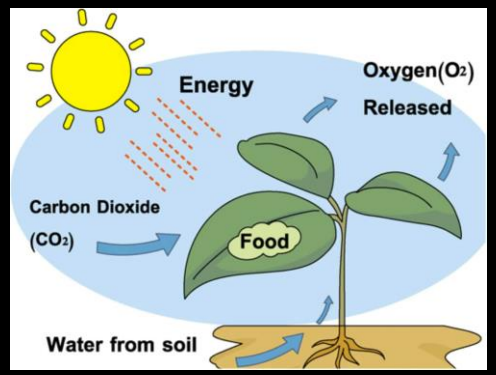
→ Specialised organ system

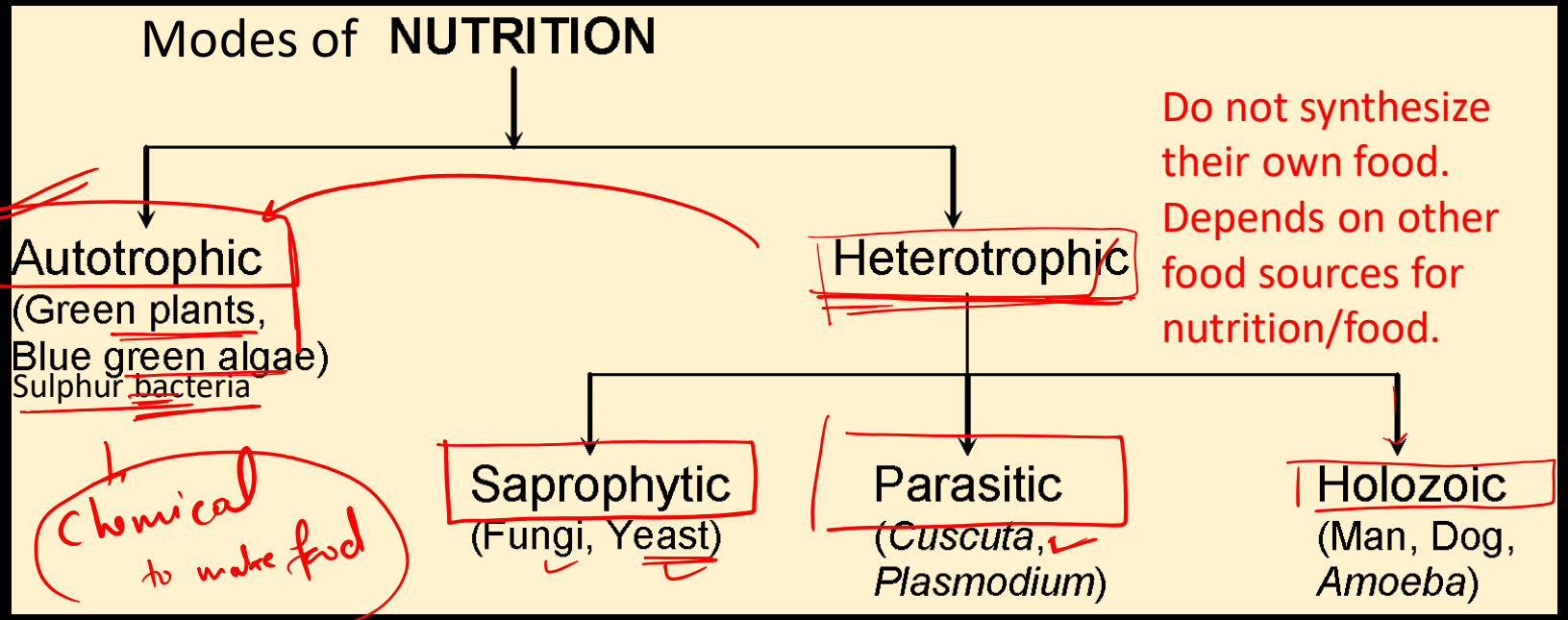
Life Processes

- All the processes which are necessary to maintain life in an organism are called life processes.
  - Nutrition
  - Respiration
  - Transportation
  - Excretion
  - Etc.
- All the biological process taking taking place in our body which are essential for our survival.

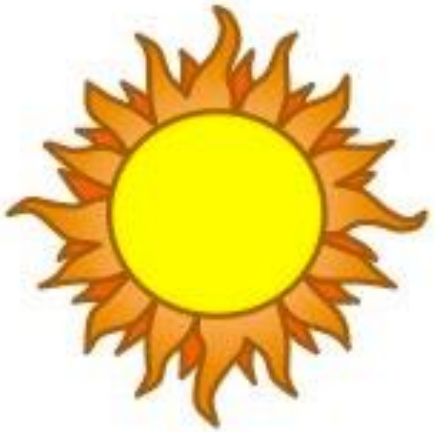
Nutrition

- We derive nutrition from from the food which we eat.
- Food is required for growth and maintenance of body of an organism.
- Mode of intake of food may also be considered as nutrition.



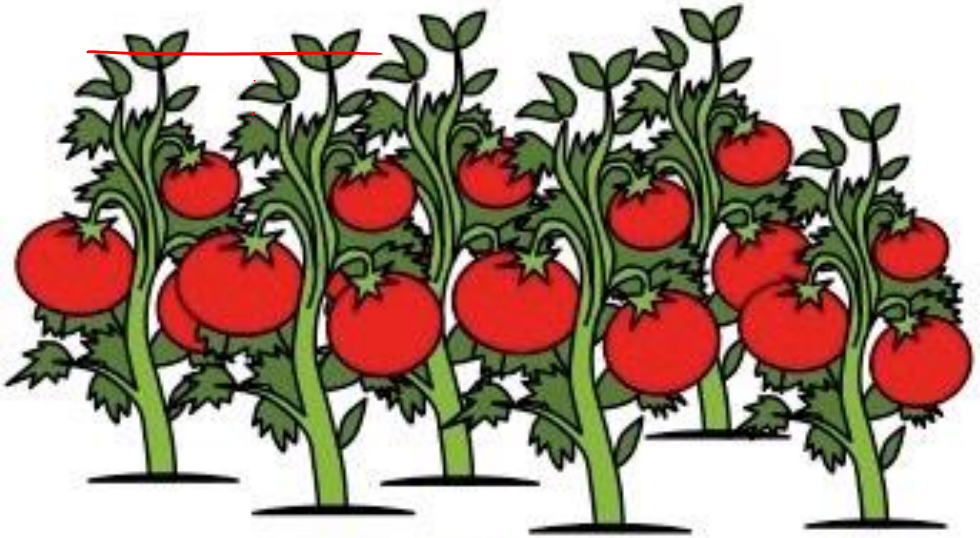


Prepare their own food from inorganic substances



Sun:
Light is the initial energy source for most communities

Photosynthesis



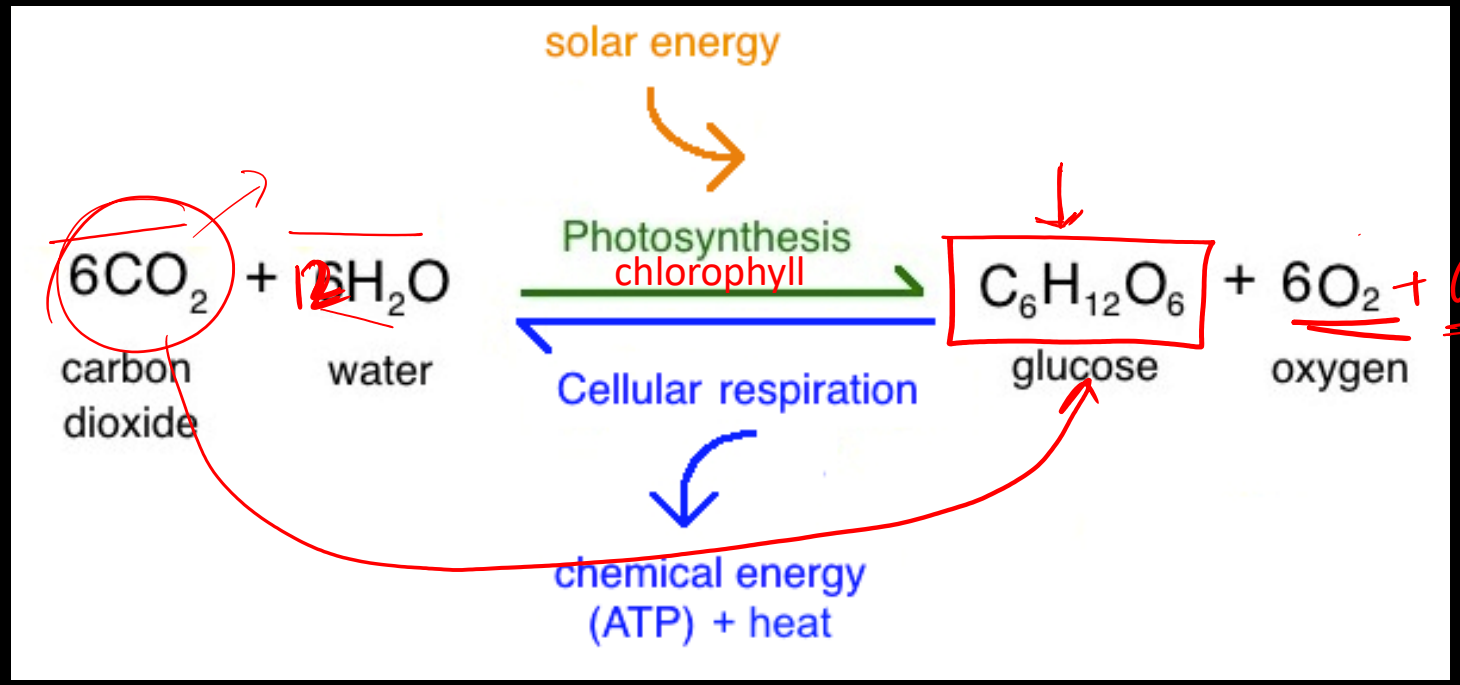
Feeding

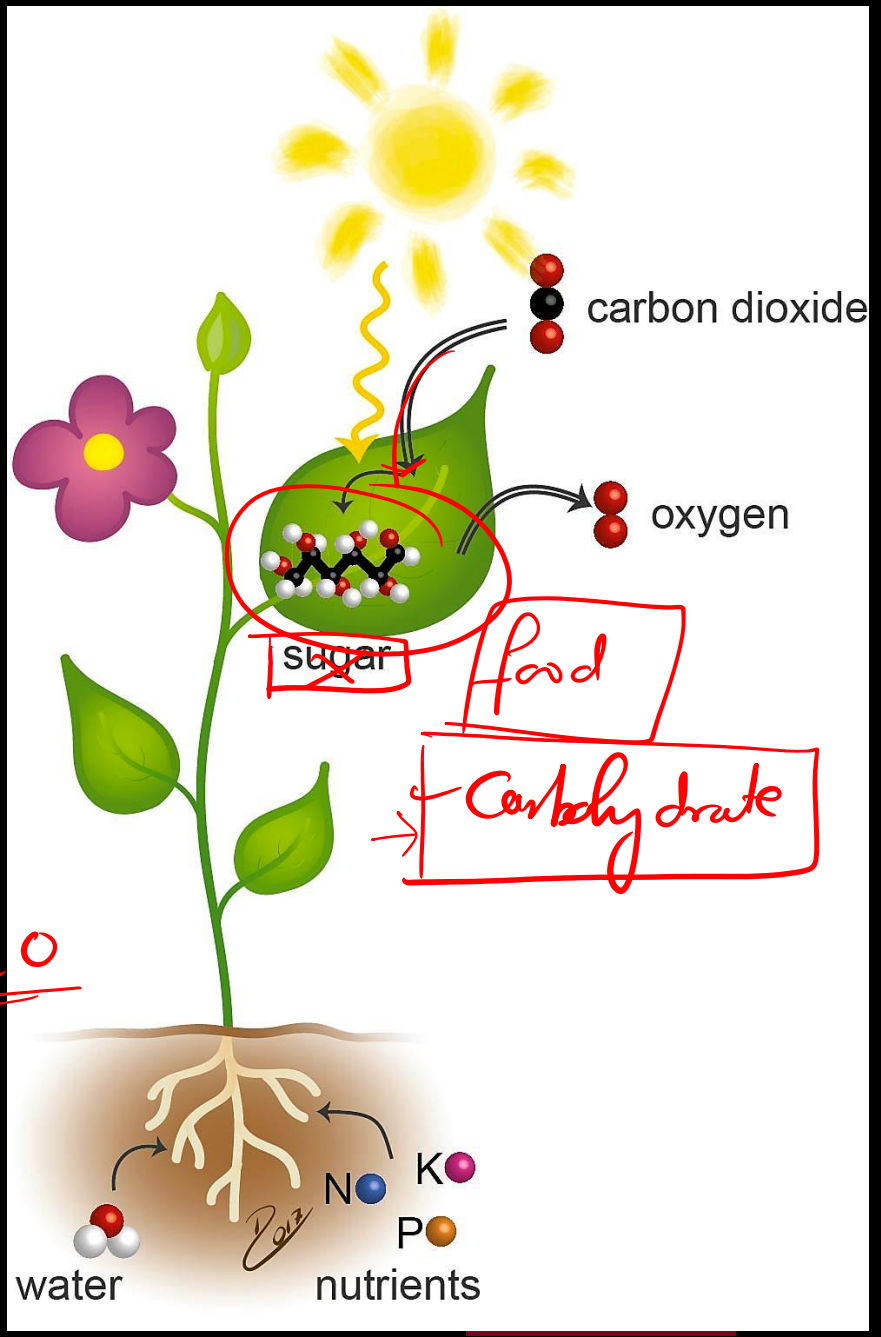
Autotrophs:
Synthesizes own organic molecules

Heterotrophs:
Ingests organic molecules

Autotrophic mode of Nutrition

- Photosynthesis: the processes by which green plants synthesize nutrients (carbohydrate) from carbon dioxide and water in presence of sunlight and chlorophyll is called photosynthesis.





What happens to extra carbohydrate

- Carbohydrates synthesized during photosynthesis is used to provide energy to the plants.
- Extra carbohydrates are stored in the form of starch.
  - It acts as an internal energy reserve to be used as and when required by the plants.
  - In animals excess carbohydrate is stored in the body in the form of glycogen.
- Plants also require other raw materials to build their body.
  - Nitrogen, Phosphorus, Potassium, Magnesium, Iron, etc. taken directly from soil.
  - N is essential element (for protein synthesis) taken up in the form of **inorganic nitrates** or **nitrites**. They may also be taken up as organic compounds prepared by some bacteria from atmospheric nitrogen.

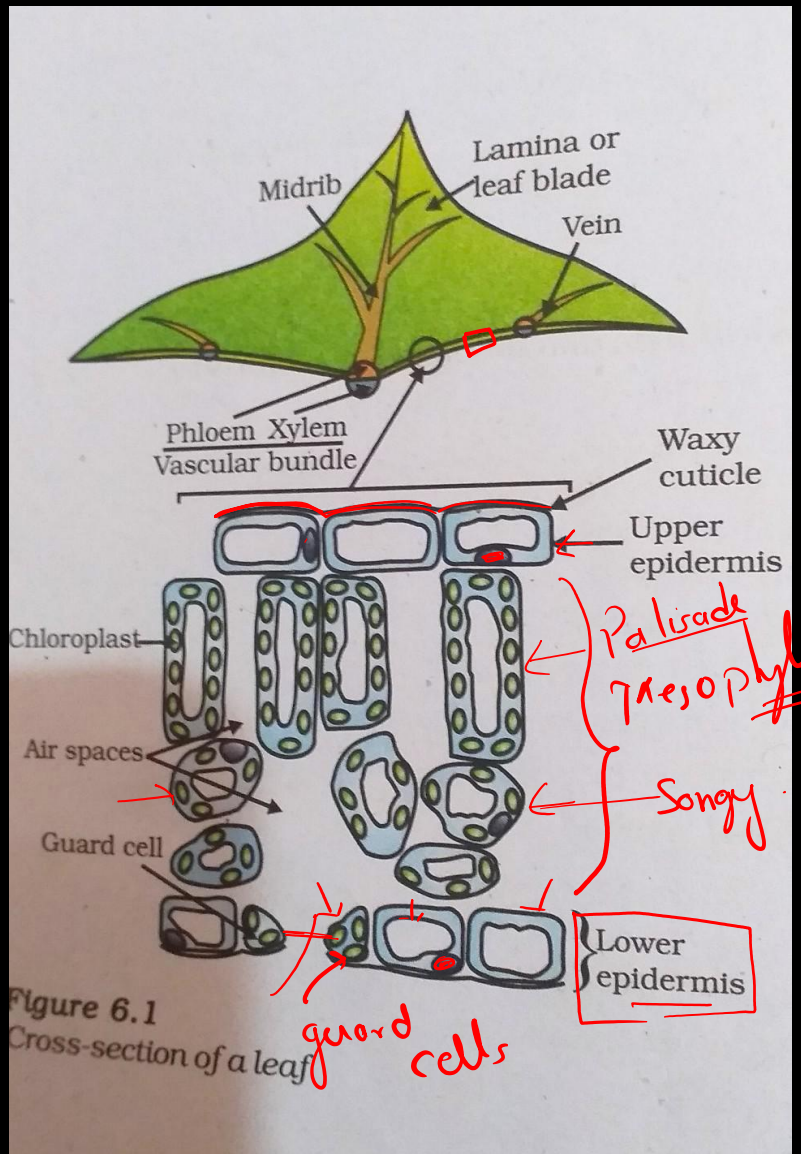
Events occurring during Photosynthesis

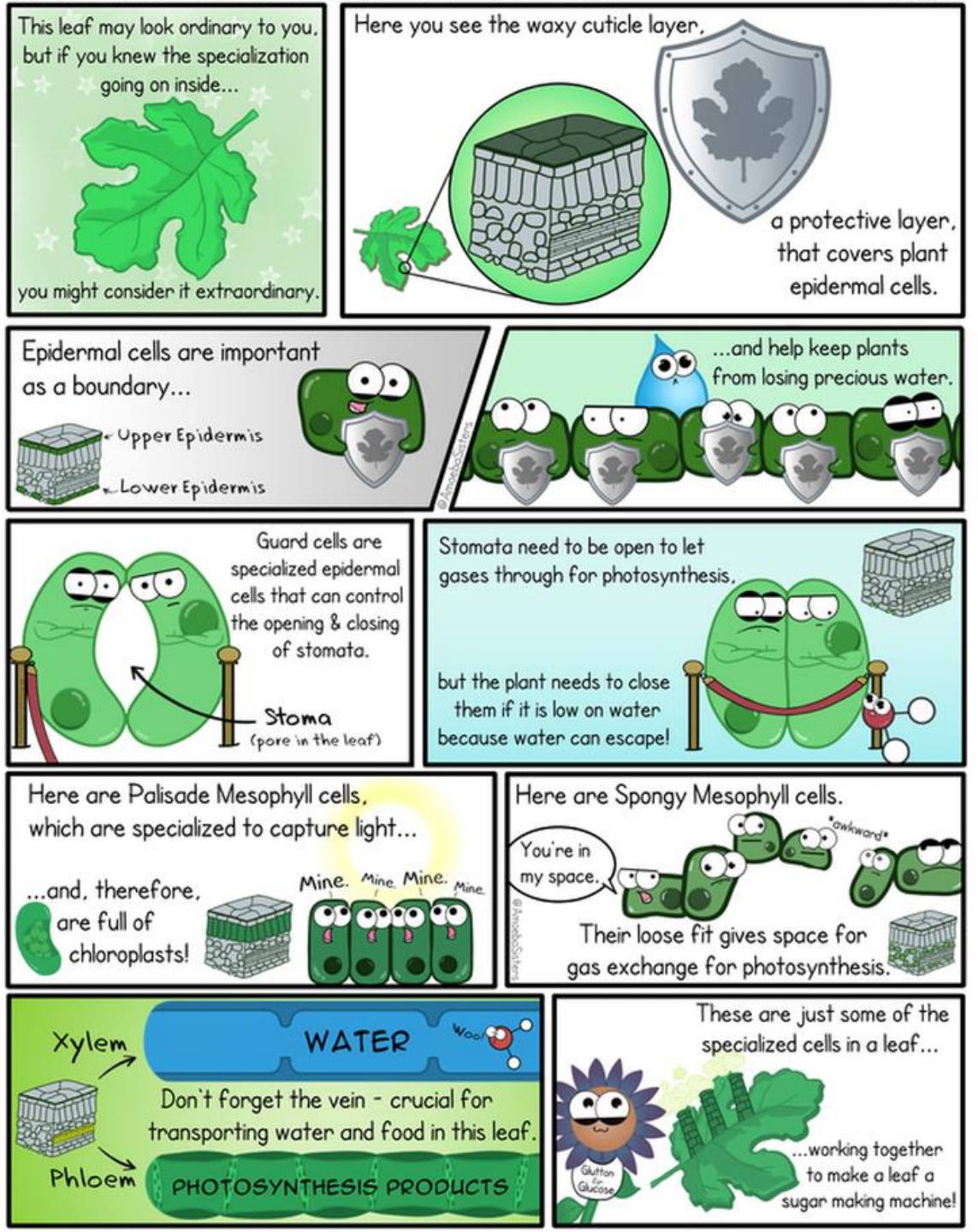
- Absorption of light energy by chlorophyll.
- Conversion of light energy to chemical energy and splitting water molecule into Hydrogen and Oxygen.
- Reduction of carbon dioxide to carbohydrates.

These events do not necessarily takes place in steps.

Dessert plants (Xerophytes/Succulents) take carbon dioxide at night (as they keeps stomata closed to minimize the loss of water from the plant) and converts it into an intermediate compound (Maleic acid C4) . This intermediate is acted upon by the the energy absorbed by the chlorophyll during day.

Cross-section of leaf

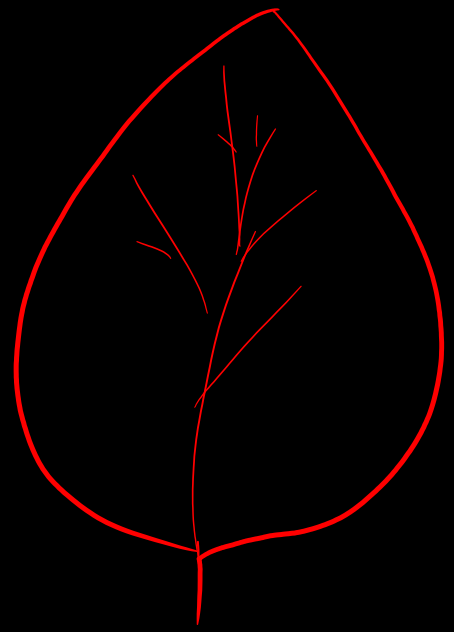




Activity 5.1

Testing the presence of starch in leaf

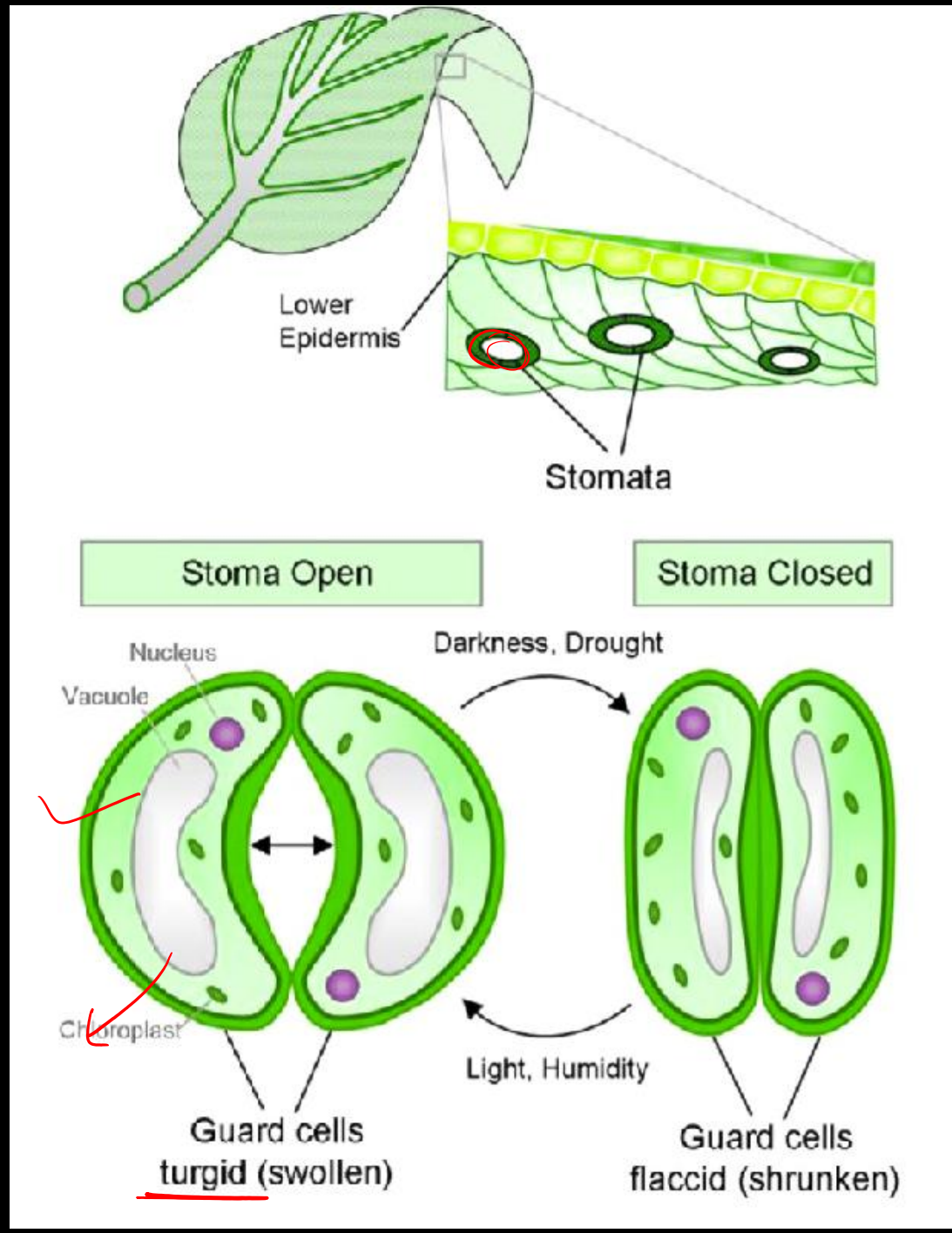
- Starch gives blue-black color with iodine solution.



Blue colour

How plants obtain CO_2.

- Mechanism of exchange of gases through stomata.
  - Stomata are tiny pore present mostly on the undersurface of the leaves.
  - Massive amount of gaseous exchange takes place in the leaves through these pores.
  - Exchange of gases also occurs through stems and roots.
  - Plants close these pores when they do not need CO_2, as water is lost through these openings.
  - Opening and closing of Stomata is function of guard cells.
  - When water flows into the guard cells, pore opens.
  - When water flows out of guard cells, pore closes.



CO_2

↓

5.2

KOH → CO_2 absorb

↓

Heterotrophic Nutrition

HETEROTROPHIC

Holozoic Nutrition

- The organism feed by ingesting solid organic matter which is then digested and absorbed into their bodies.
- Eg. human, animals and insectivorous plants

Saprophytism

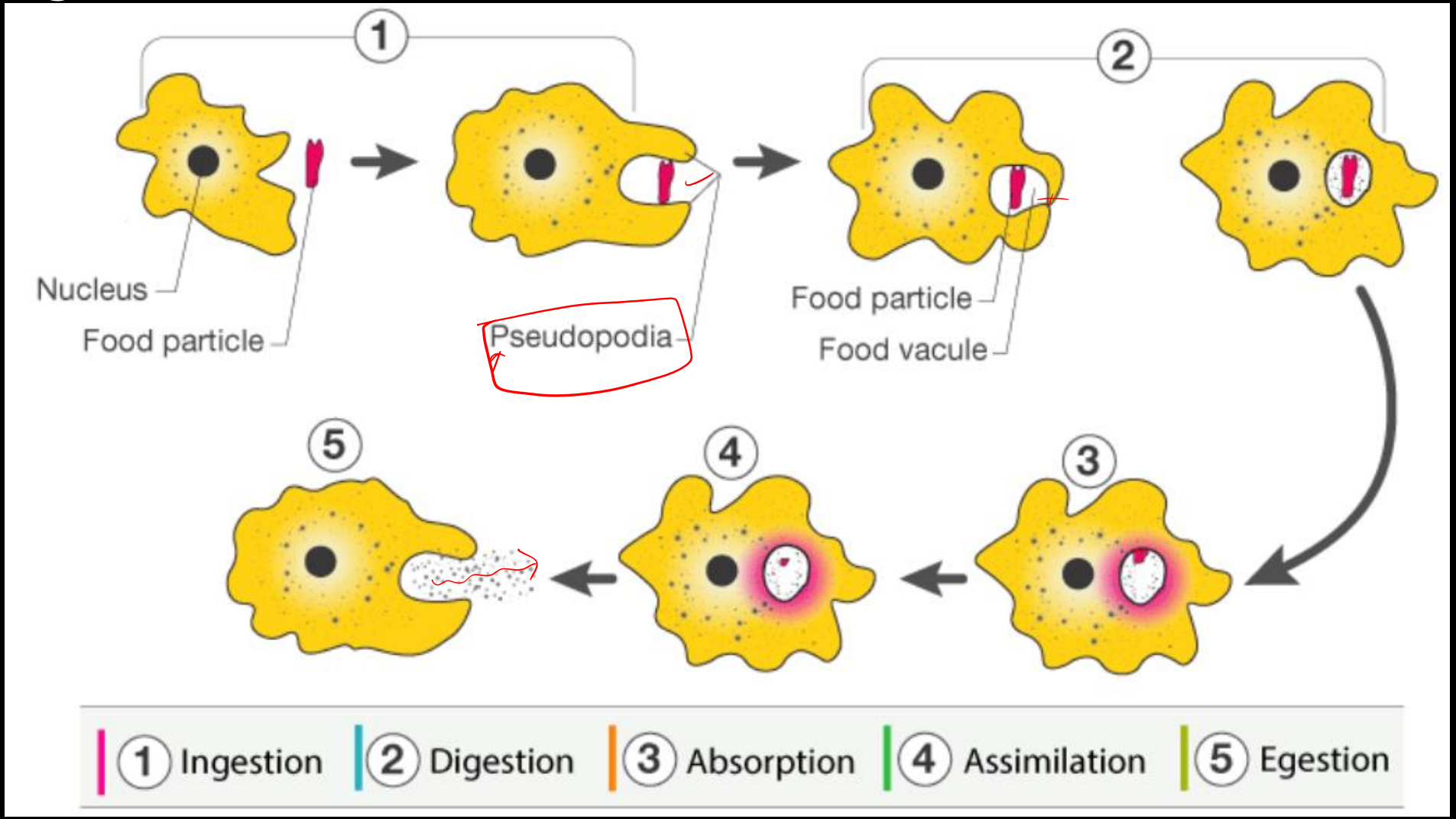
- Saprophytes.
- Feed on dead and decaying matter.
- Include bacteria and fungi which digest the food externally before the nutrients are absorbed.

Parasitism

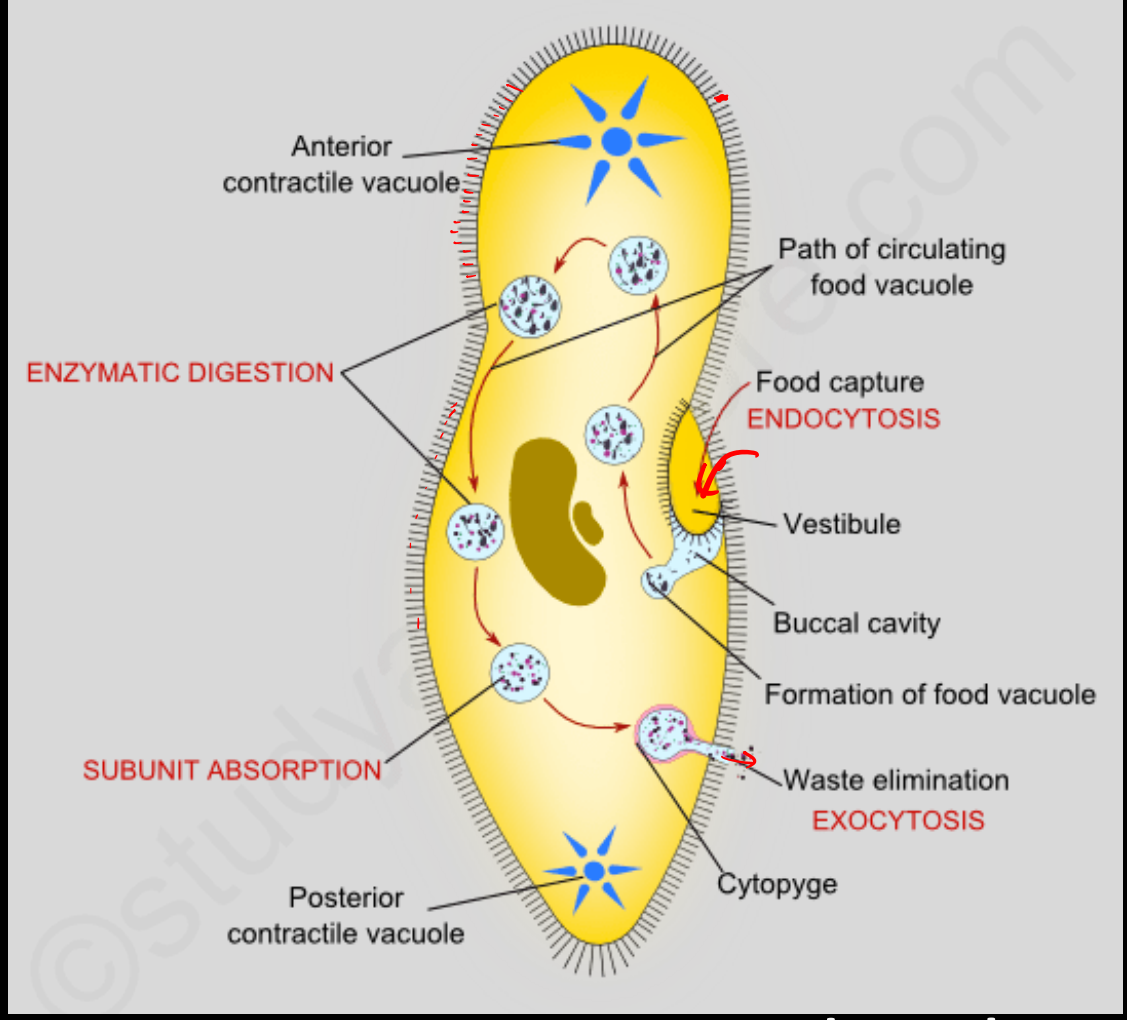
- Obtains nutrients from living organisms
- The parasite obtains nutrients by living on or in the body of the host.
- Eg. fleas, lice and tapeworms

How do organism obtain nutrition?

Feeding by Amoeba



How do organism obtain nutrition?

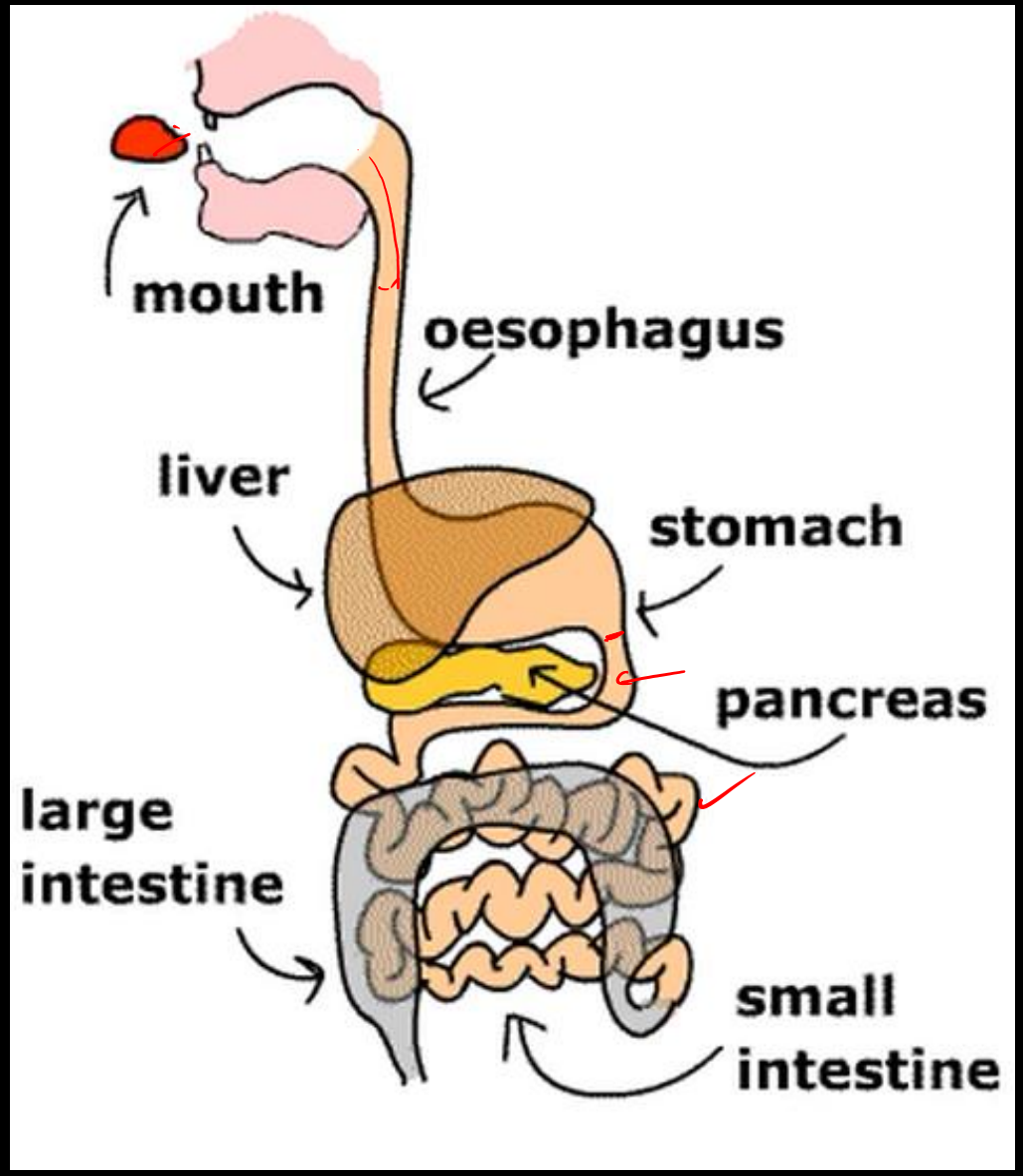


Feeding by paramecium

Nutrition in Human Beings

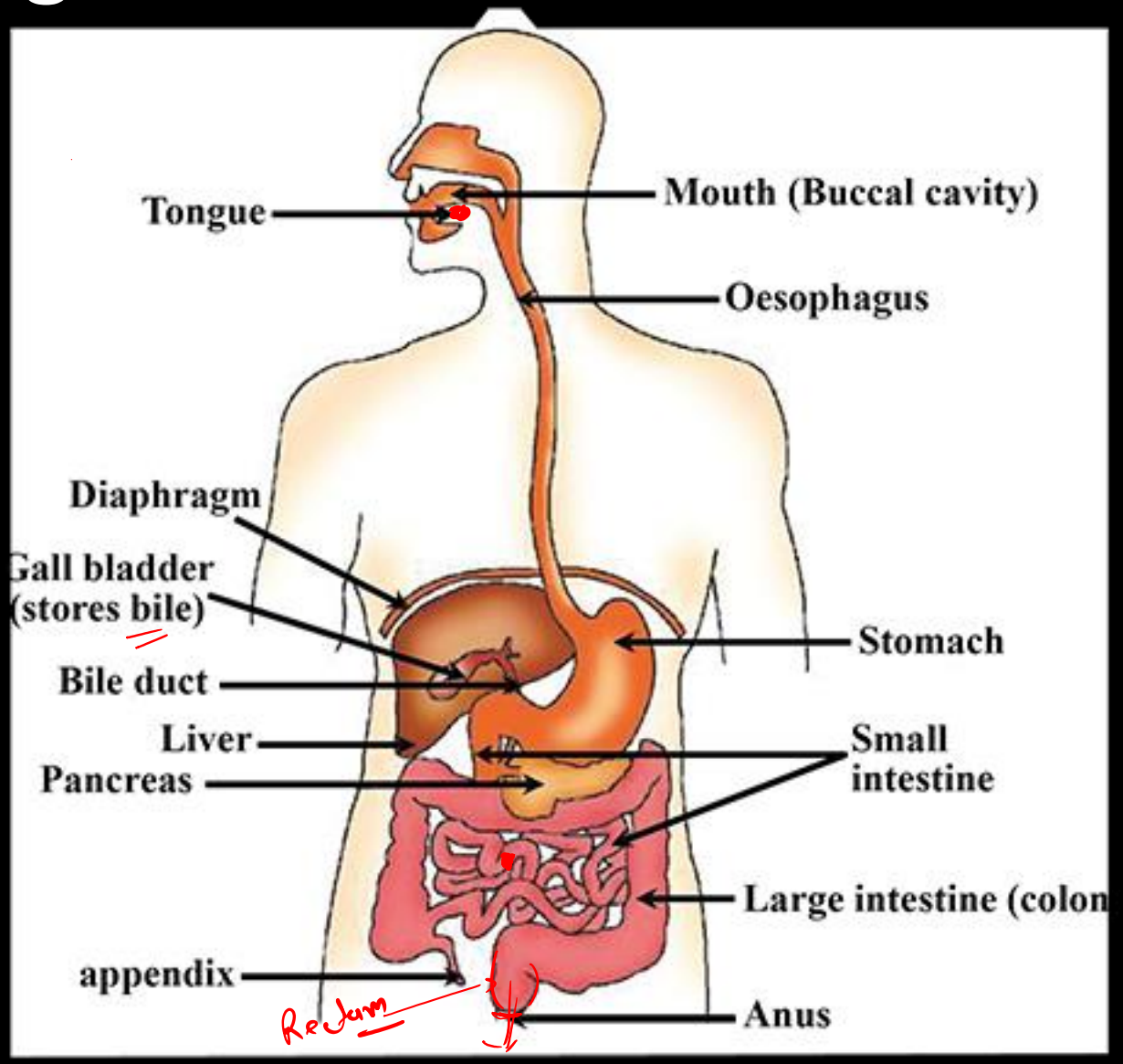
- Alimentary canal is a long muscular tube extending from mouth to anus.

  Various regions of this canal are specialized to perform different function.

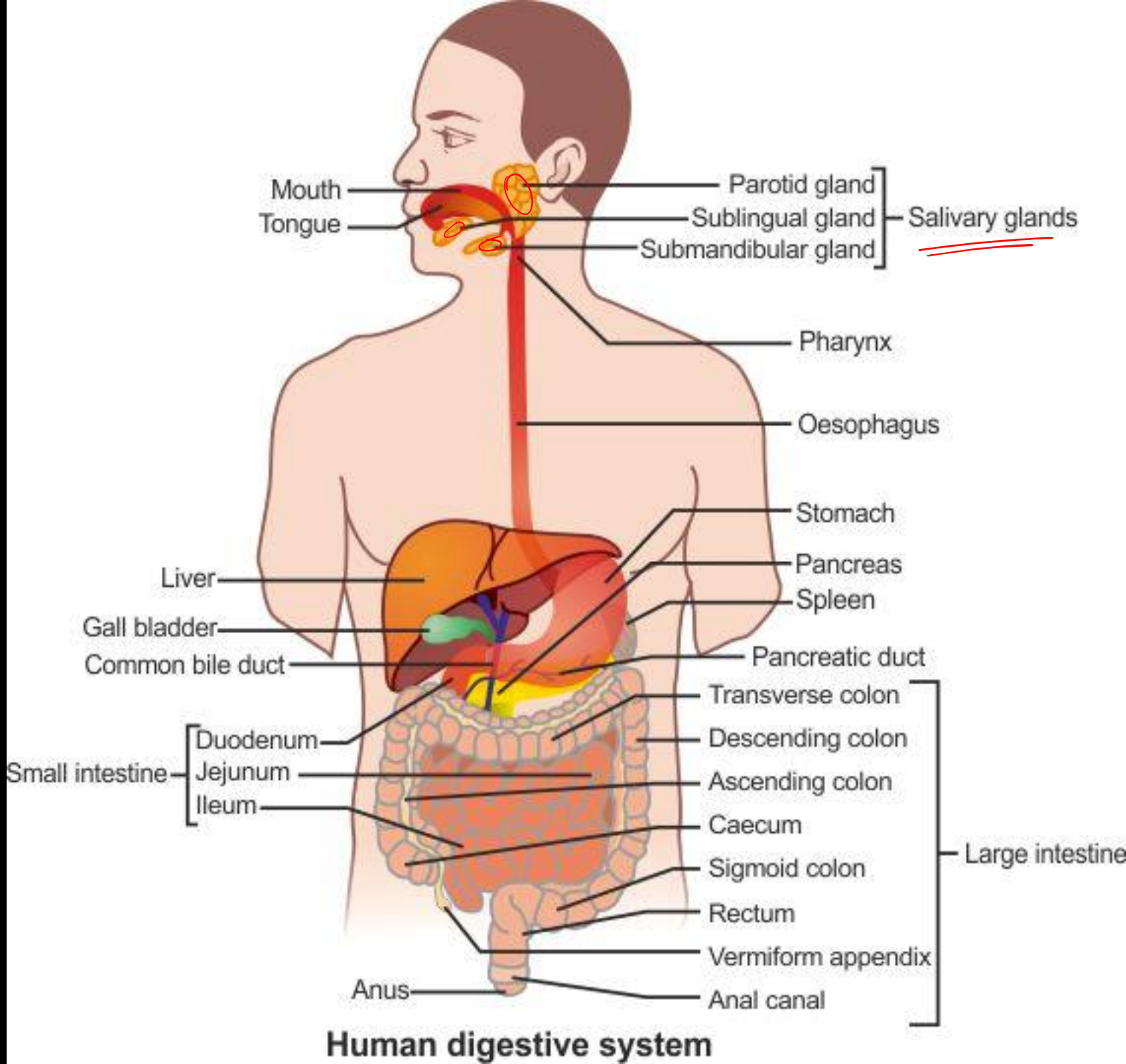


Nutrition in Human Beings

- Mouth
- Salivary glands
- Oesophagus
- Stomach
- Small Intestine
- Large Intestine
- Liver → Bile
- Gall bladder
- Pancreas → Pancreatic
- Appendix
- Anus



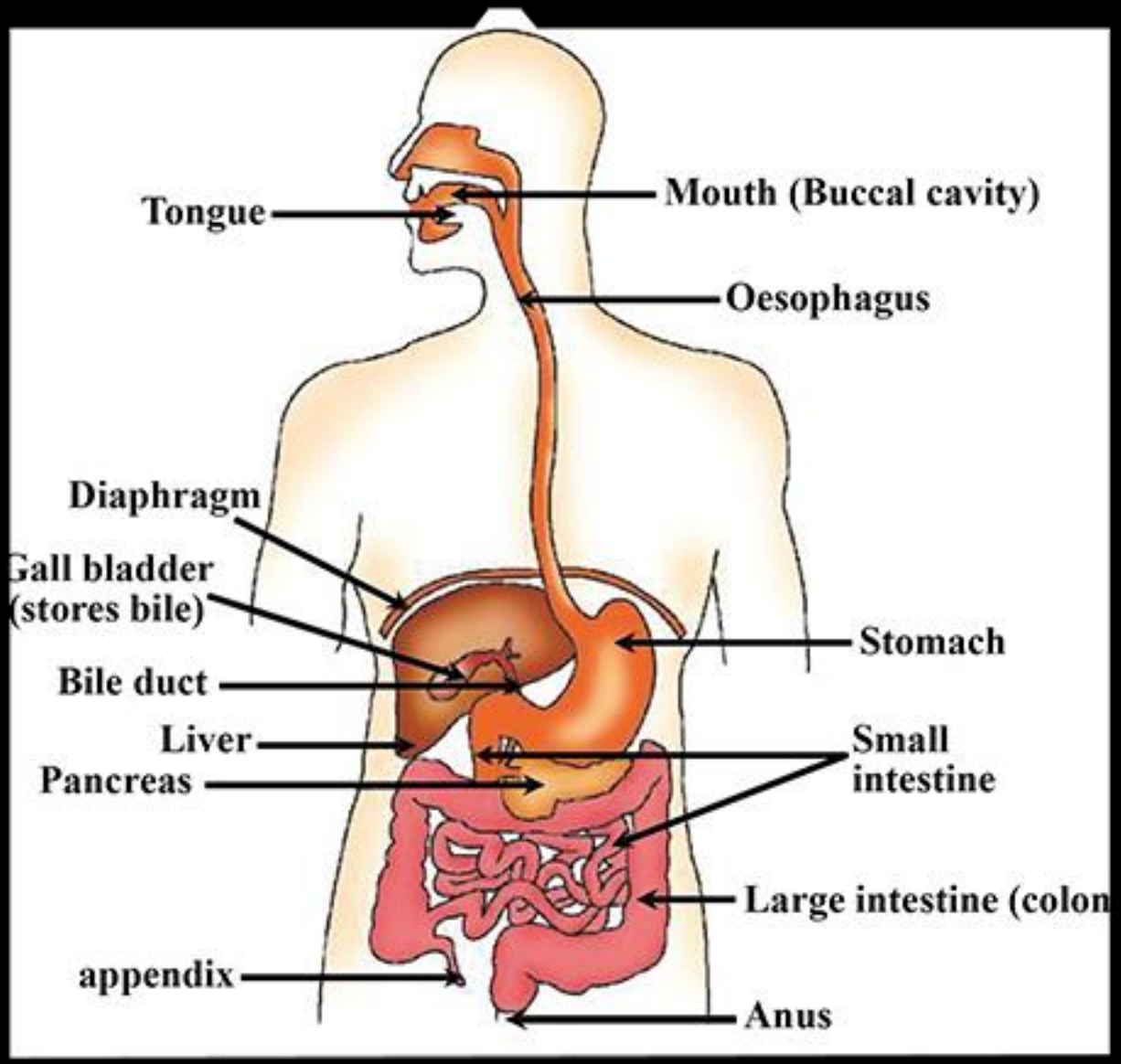
Nutrition in Human Beings



Human digestive system

Mouth

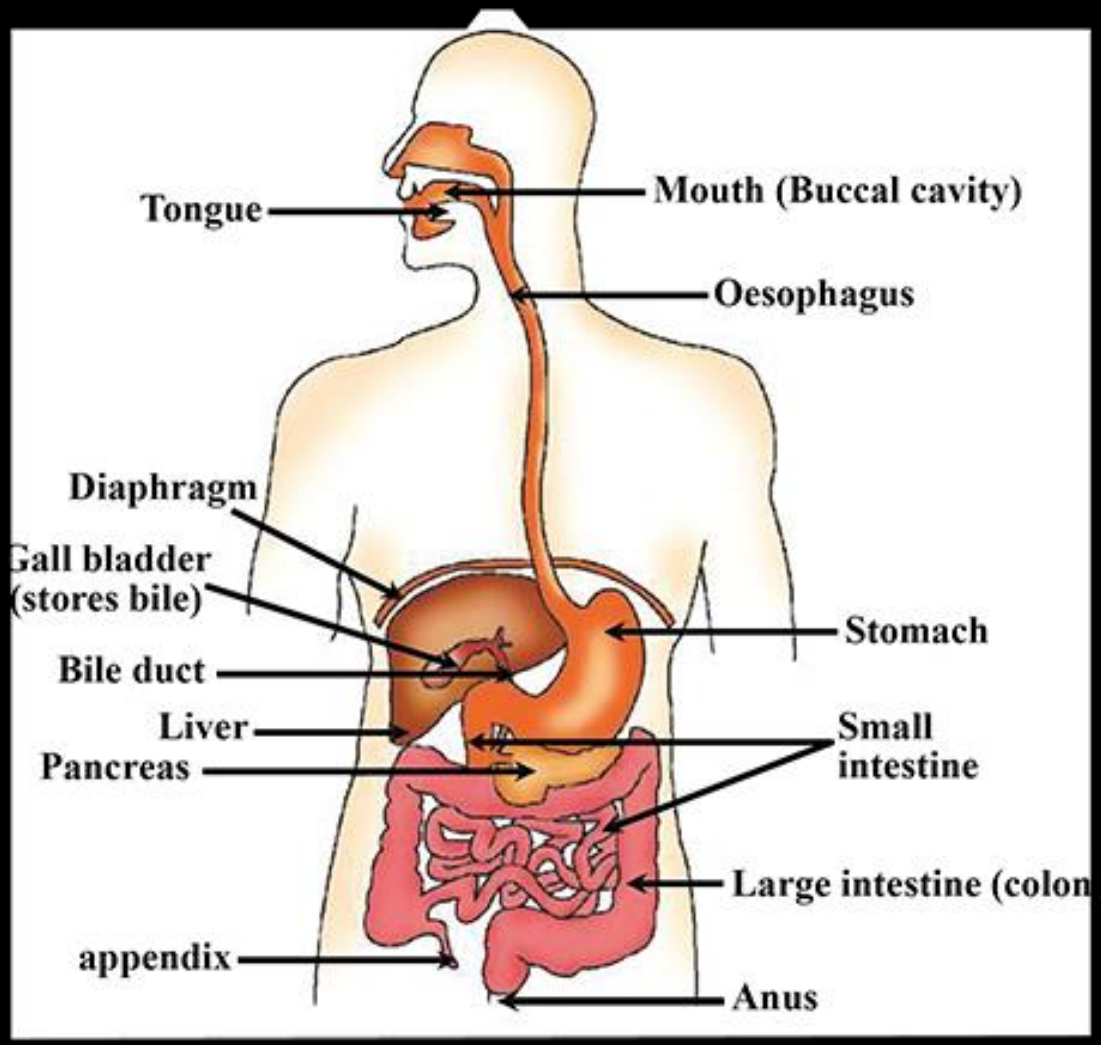
- Food is crushed into very small particles in mouth with the help of teeth.
- The food is also wetted with a watery substance (Saliva) to makes its passage smooth through our canal.
- Saliva is secreted by the Salivary glands.



Enzymes

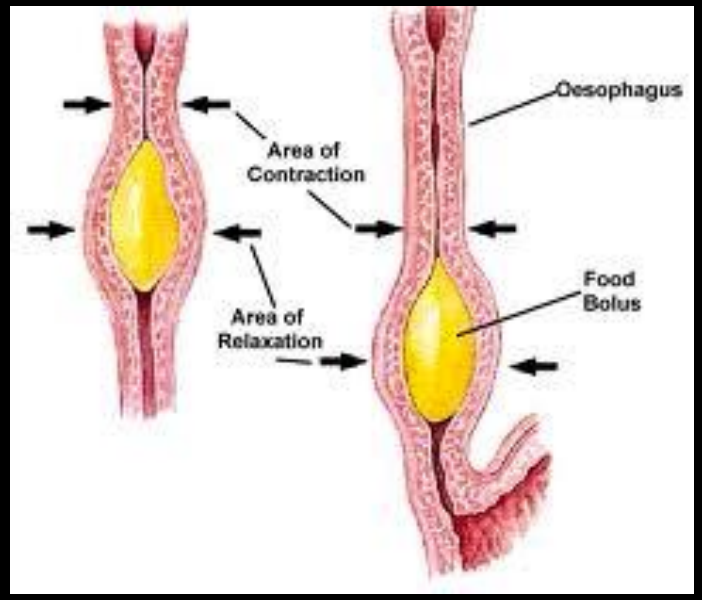
C H O

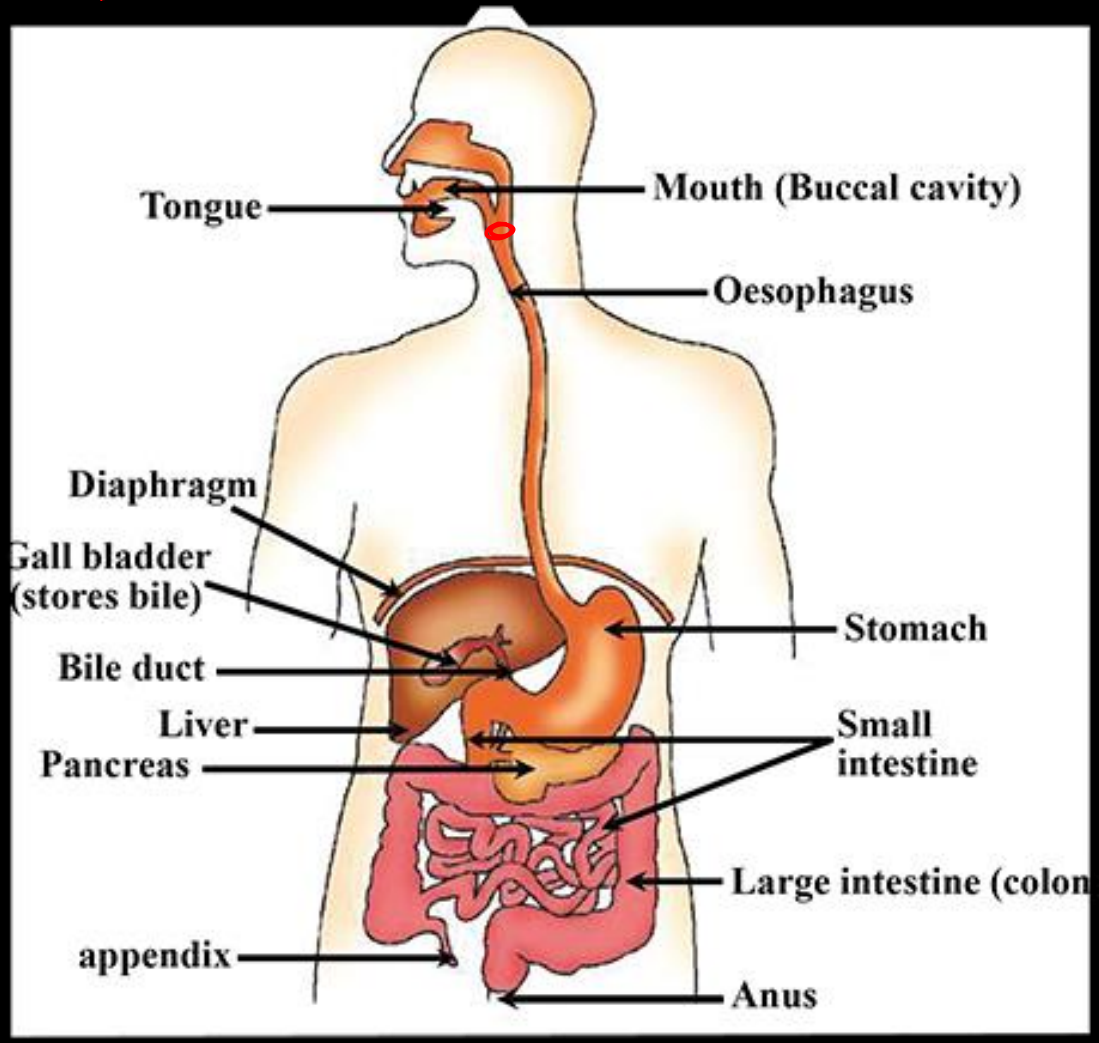
- Our alimentary canal is programmed to absorb only specific simple (smaller) molecules.
- Enzymes are biocatalyst, helps to break complex food which we eat into smaller molecules.
- Saliva contains an enzyme salivary amylase (ptyalin).
- Salivary amylase breaks down starch (complex molecule) into sugar.
- Saliva is mixed with food in mouth while chewing by the muscular tongue.



Movement of food in digestive tube: Peristalsis

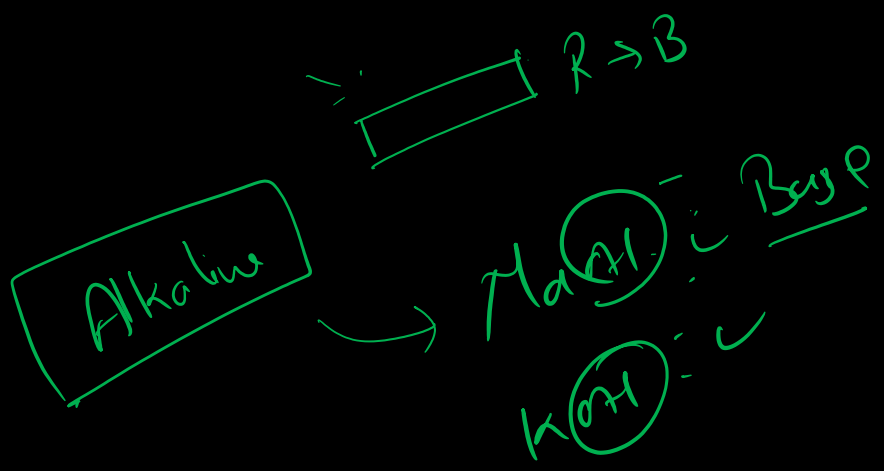
- Movement of food is regulated along digestive tract so that it can be processed properly in each part.
- Canal inner linings have muscles that contract rhythmically in order to push the food forward.
- Peristaltic movement occurs all along the gut.

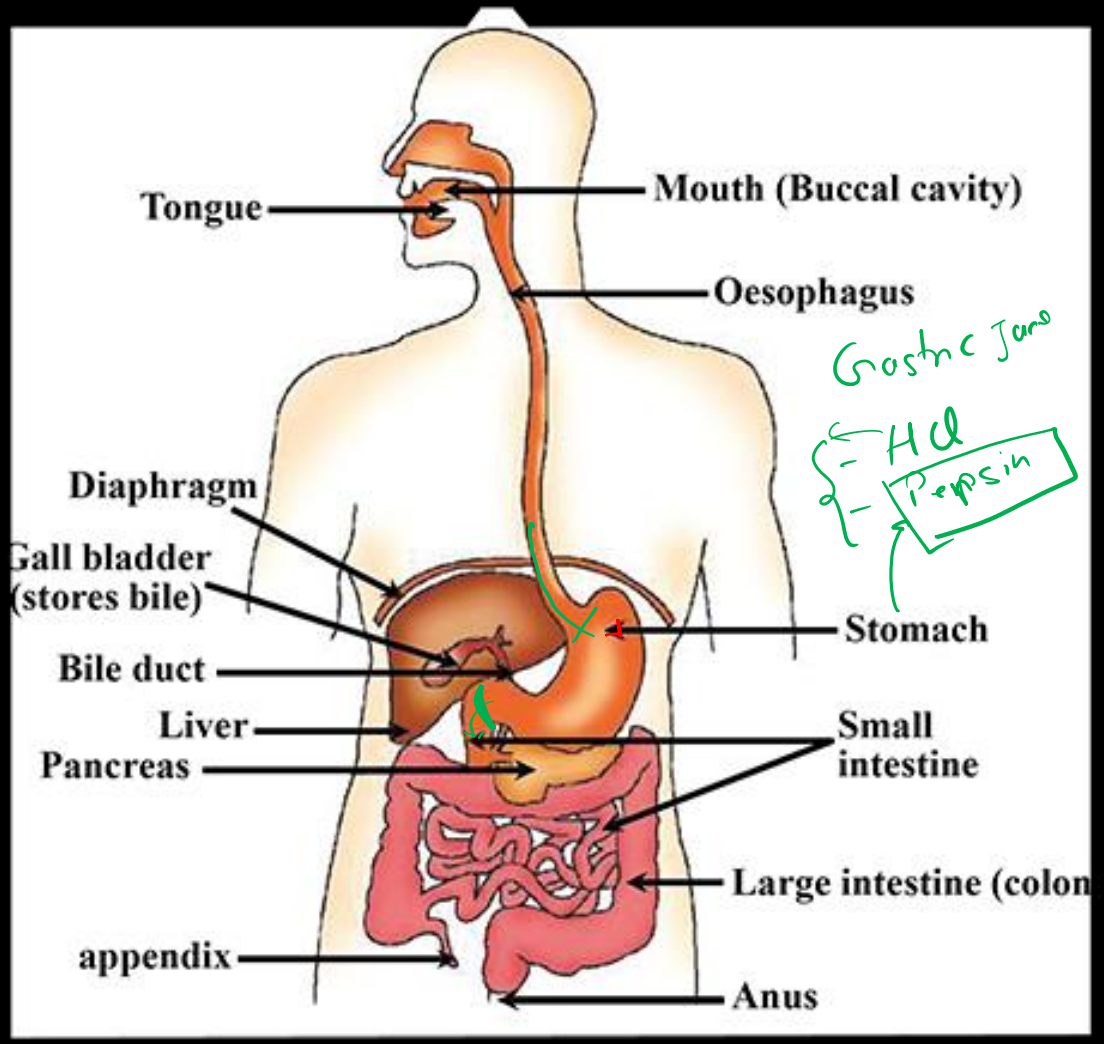




Oesophagus (Food Pipe)

- Oesophagus caries food from mouth and delivers it to stomach.
- Food enters stomach through cardiac sphincter (muscular valve between oesophagus and stomach)

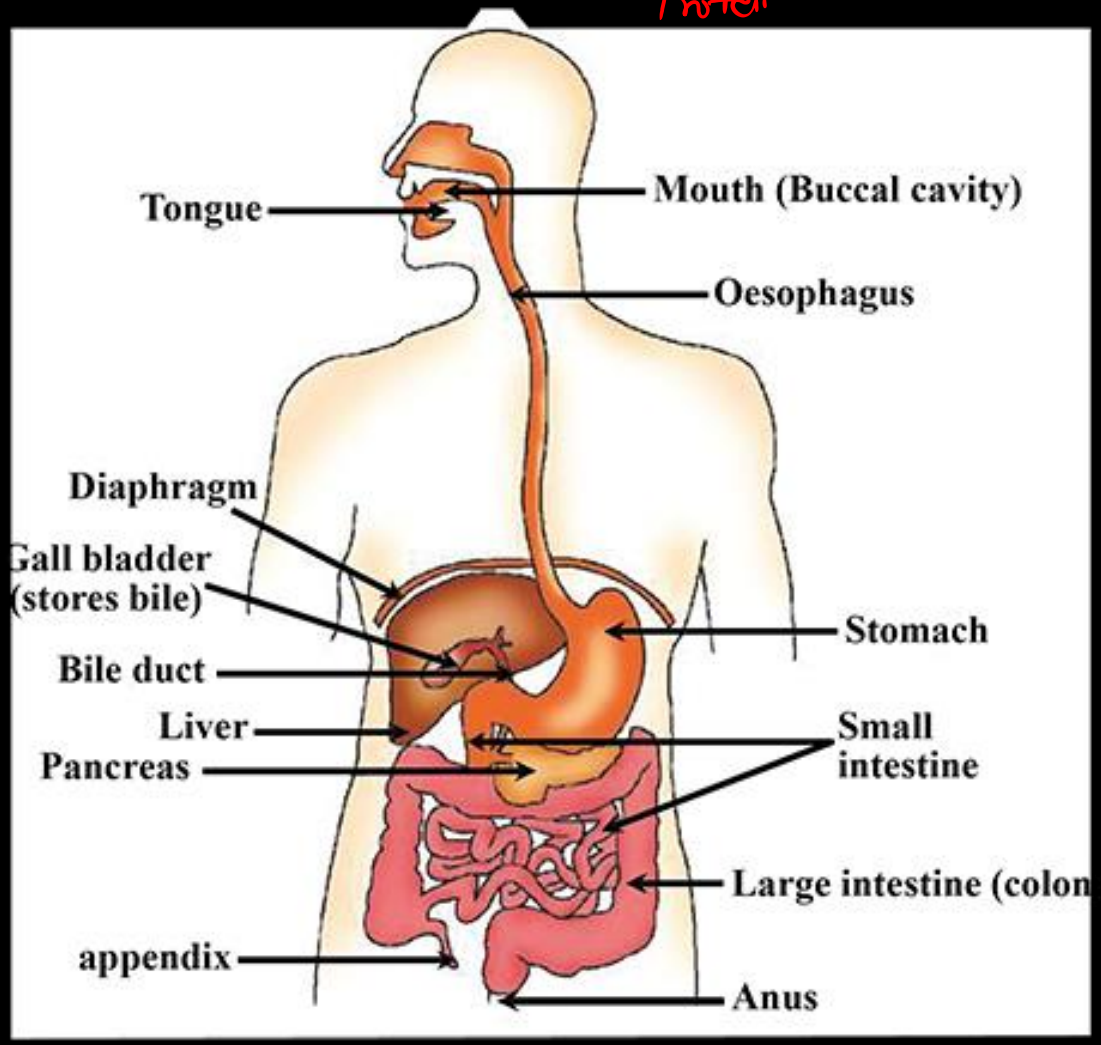




Stomach

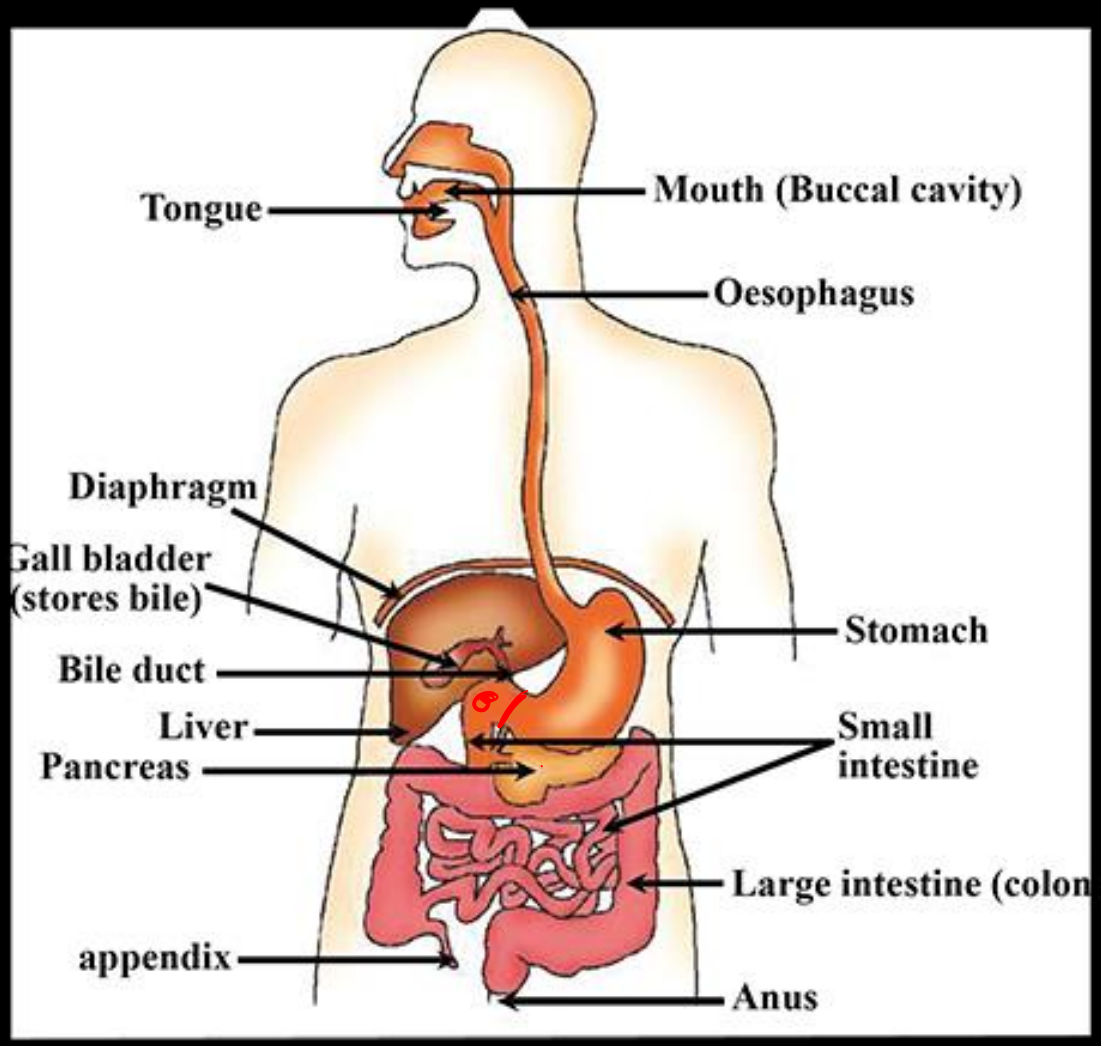
- Large muscular organ
- It expands when food enters into it.
- Muscular walls of stomach helps in mixing the food with digestive juices.
- Secretion of digestive juices are done by digestive glands present in the wall of stomach.
- They secrete:
  - **HCl**: creates an acidic medium for the action of pepsin. (HCl also kills germs, bacteria and other foreign particles)
  - **Pepsin**: protein digesting enzyme.
  - **Mucus**: Protects the inner lining of stomach from acid (HCl)
- Acidity is because of this HCl when in excess, or when we don't eat properly.

HCl may also cause ulcer (damaging muscular cells of inner layer of stomach), if mucus is not properly protecting the muscular walls of stomach.



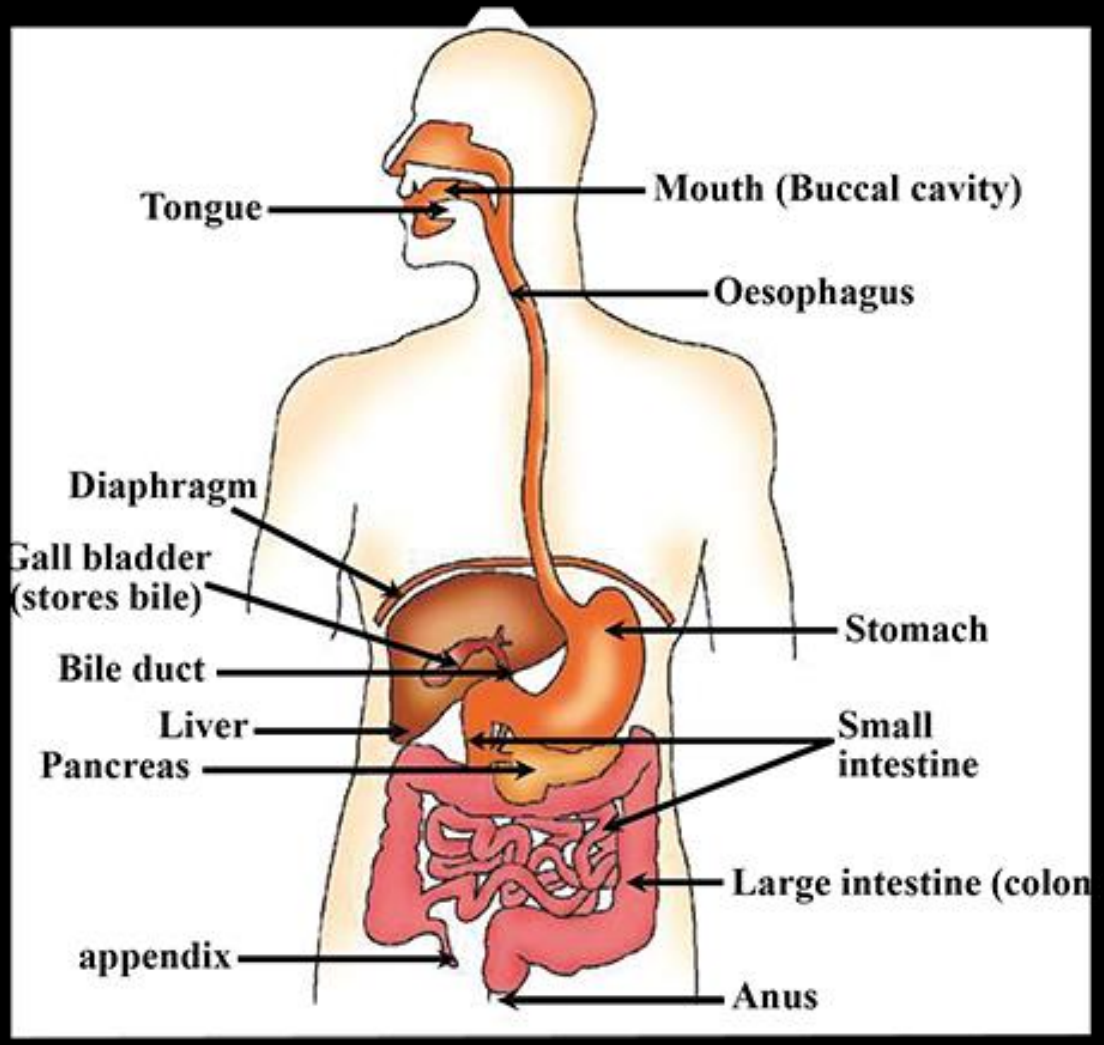
Small Intestine

- Pyloric **sphincter** muscle (valve) releases food from stomach to small intestine (duodenum) in small amounts.
- It is longest part of alimentary canal, fits into a compact space due to extensive coiling.
- Herbivores needs longer SI to allow digestion of cellulose. (cellulose is found in plants only)
- Carnivores have shorter SI as digestion of meat is easier than cellulose.
- Here complete digestion of carbohydrates, proteins and fat takes place.
- Role of Liver and Pancreas starts here which we will be discussing in the next slides



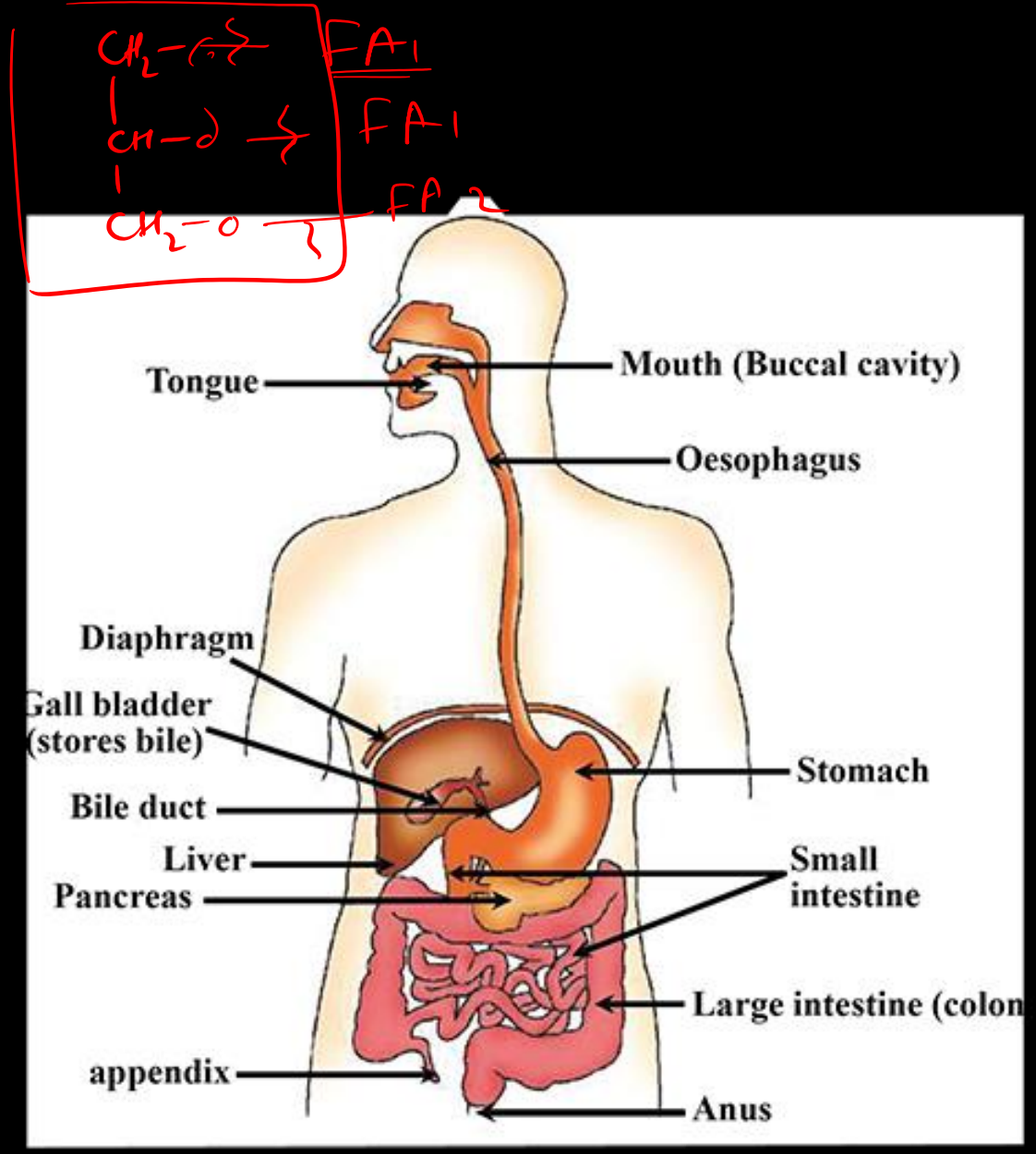
Small Intestine contd... Role of Liver and Pancreas

- Liver and Pancreas secretes juices into small intestine (Duodenum) for the digestion of Carbohydrates, Proteins and Fats.
- Food from stomach is acidic and it has to be made alkaline for the action of pancreatic enzymes.
- Liver Secretes:
  - Bile juice which contains bile salts.
  - Bile juice converts acidic food into alkaline.
  - Also bile salts breaks the large fat globules, present in the food, into smaller globules (emulsified fat). This increases the efficiency of enzymes acting on them for fat digestion.
- Pancreas secretes pancreatic juices containing several enzymes like:
  - Trypsin: to digest Proteins
  - Lipase: to break down emulsified fats.

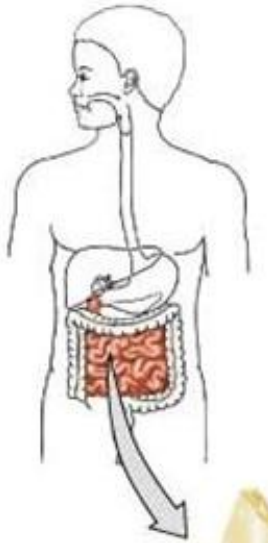


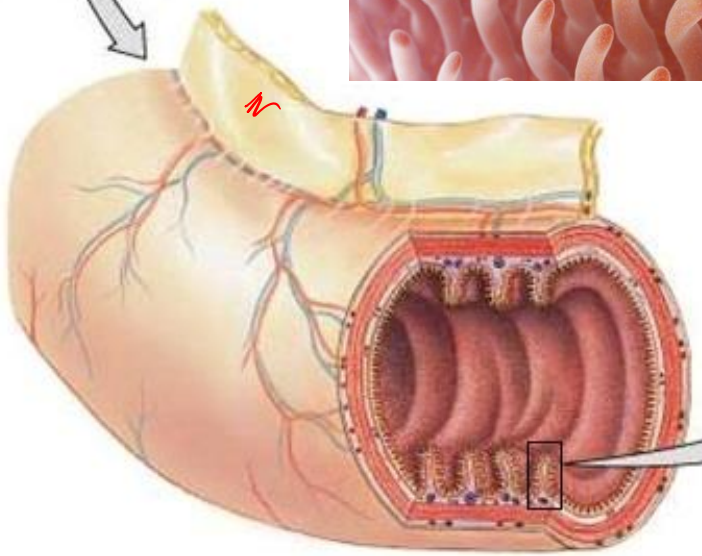
Small Intestine contd...

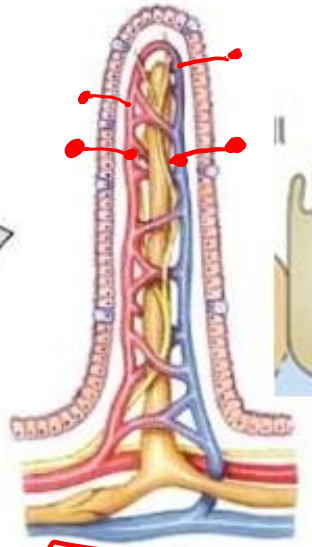
- Inner walls of SI contains glands.
  - Secretes intestinal juices containing several enzymes.
- These enzymes finally converts
  - proteins into amino acids
  - Carbohydrates into glucose
  - Fats into fatty acids and glycerol
- Digested food is absorbed by the inner walls of SI.
- Villi: inner wall of SI contains numerous finger like projections called villi which increases the surface area of absorption.
- Villi have rich supply of blood vessels, which take the absorbed food into blood stream, and it reaches each and every cell of the body.
- In the cells these foods are utilized for obtaining energy, building new tissues and repairing old tissues.



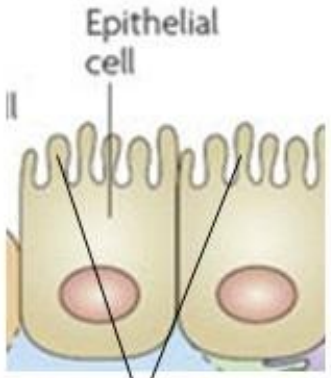
Villi





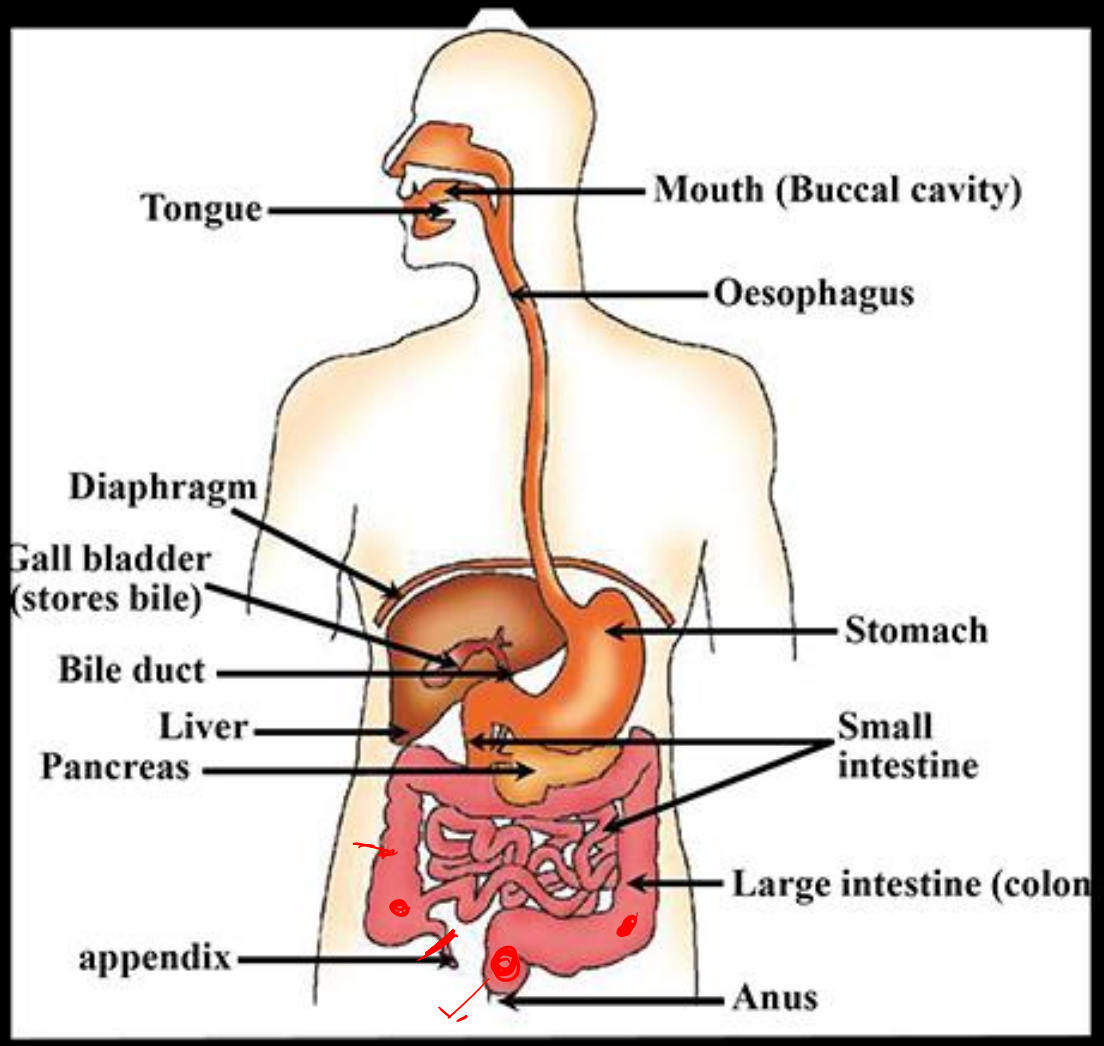


Villus



Large Intestine

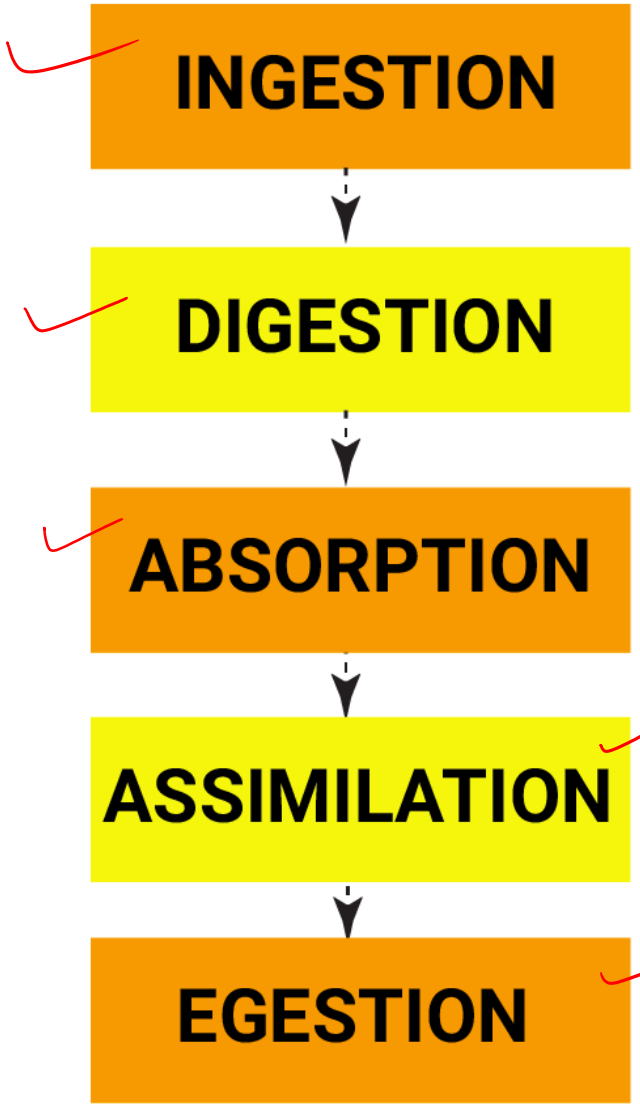
- Unabsorbed food is sent into Large intestine.
- Large intestine also contains villi which helps in absorption of water from unabsorbed food.
- Left over material (after absorption of water) is removed from body via anus.
- Exit of waste material via anus is regulated by anal sphincter (a muscular valve).



Major Digestive Enzymes

Enzyme	Produced In	Site of Release	pH Level
Carbohydrate Digestion:			
Salivary amylase	Salivary Glands	Mouth	Neutral
Pancreatic amylase	Pancreas	Small Intestine	Basic
Maltase	Small intestine	Small intestine	Basic
Protien Digestion:			
Pepsin	Gastric glands	Stomach	Acidic
Trypsin	Pancreas	Small intestine	Basic
Peptidases	Small Intestine	Small intestine	Basic
Nucleic Acid Digestion:			
Nuclease	Pancreas	Small intestine	Basic
Nucleosidases	Pancreas	Small intestine	Basic
Fat Digestion:			
Lipase	Pancreas	Small intestine	Basic

The 5 processes in digestion in Humans



Intake of food

Breakdown of complex food substances into smaller soluble food substances

Digested food is absorbed into blood and reaches each body cell

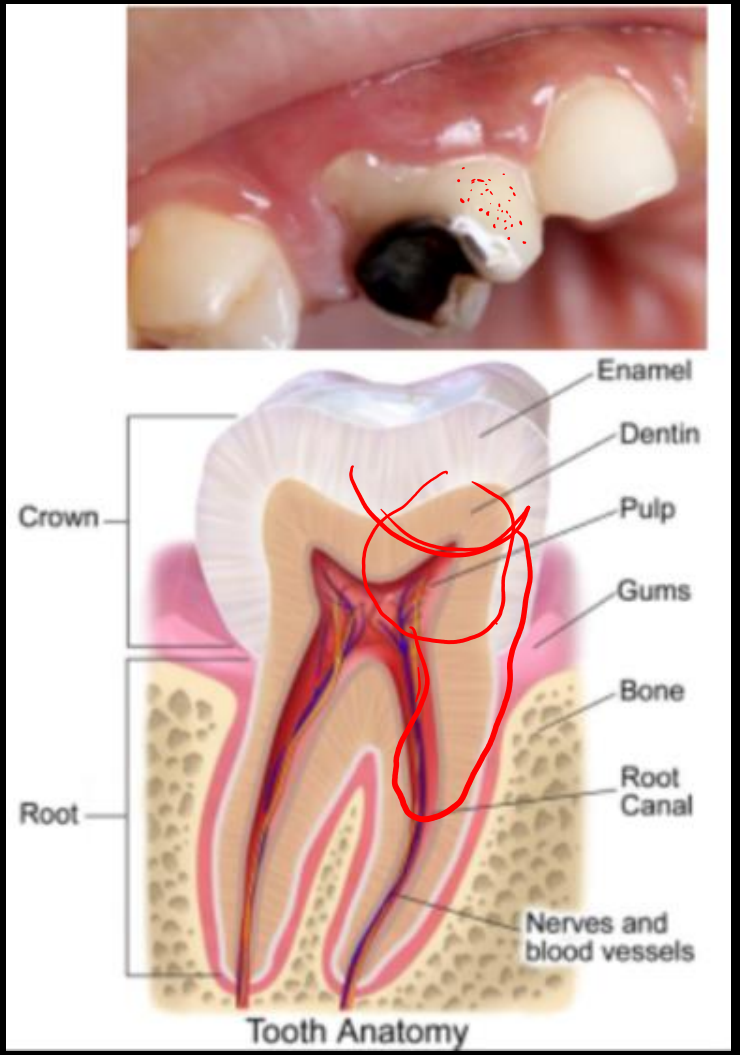
Absorbed food is used to provide energy or form new protoplasm

Removal of unabsorbed/undigested food in the form of waste

Dental caries (Tooth Decay)

Gradual softening of enamel and dentine

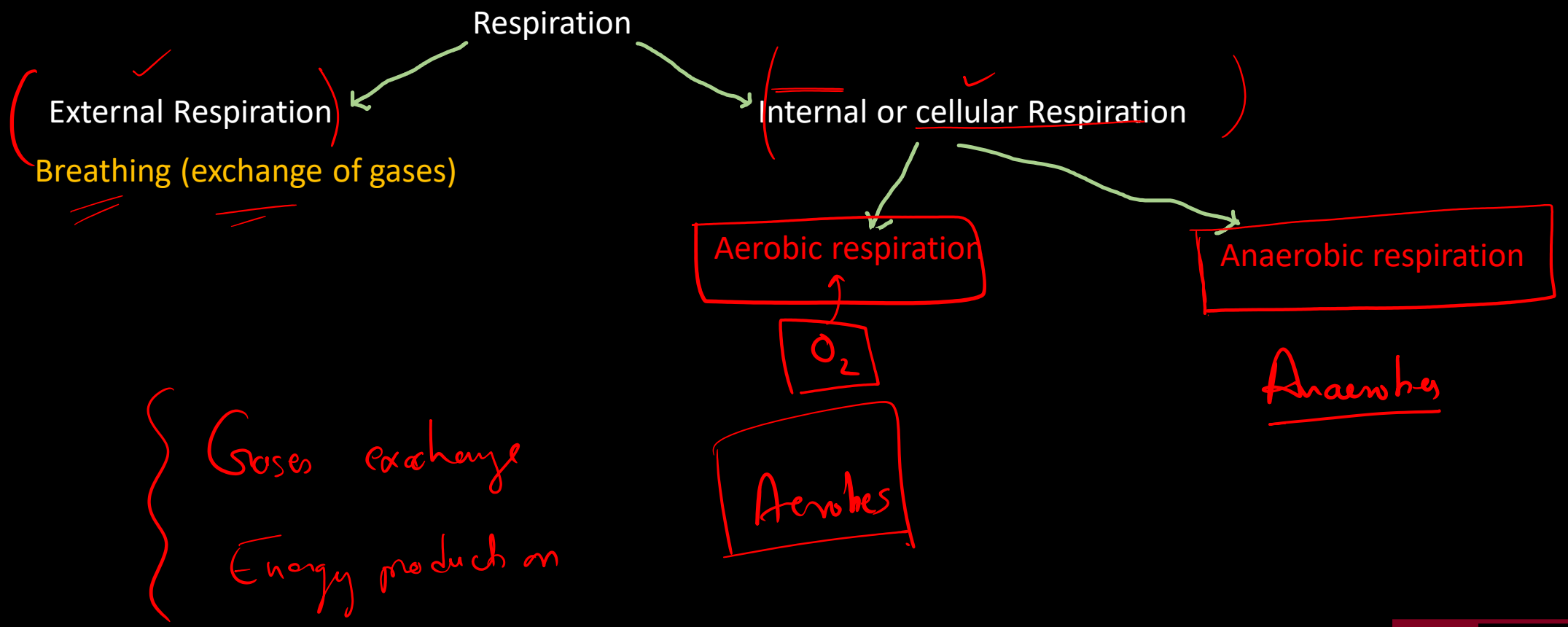
- Bacteria acting on sugar produces acids which soften or demineralizes the enamel.
- Bacterial mass along with food particles stick to teeth to form dental plaque.
- Saliva cannot reach the tooth surface to neutralize the acid as tooth surface is covered with plaque.
- Brushing the teeth after eating removes the plaque minimizing the chances for bacteria to produce acid.
- If not treated in time, bacteria may invade pulp causing inflammation and infection.
- Acidic medium helps in the growth of these bacteria and therefore we should always wash our mouth with medicated alkaline solution after eating any sweet food.



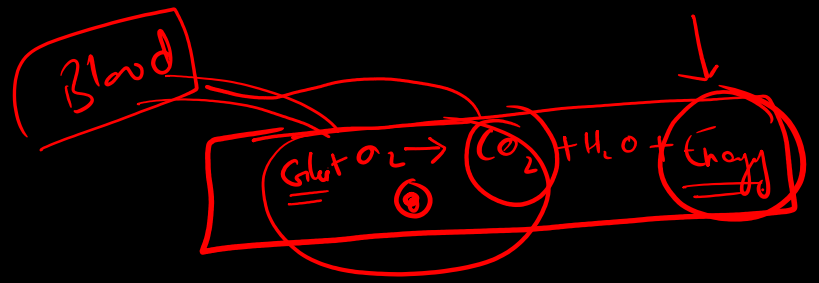
Respiration

Respiration

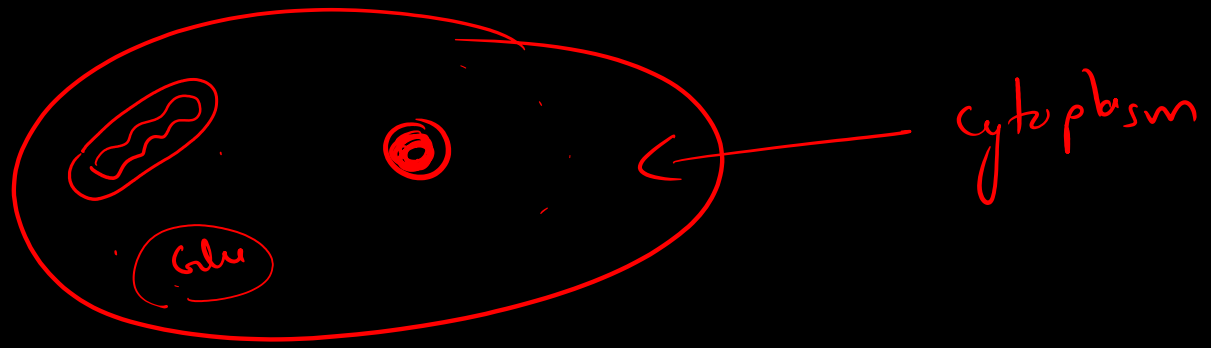
A process in living organism involving the production of energy, typically with intake of oxygen and release of carbon dioxide from the oxidation of complex organic substances.



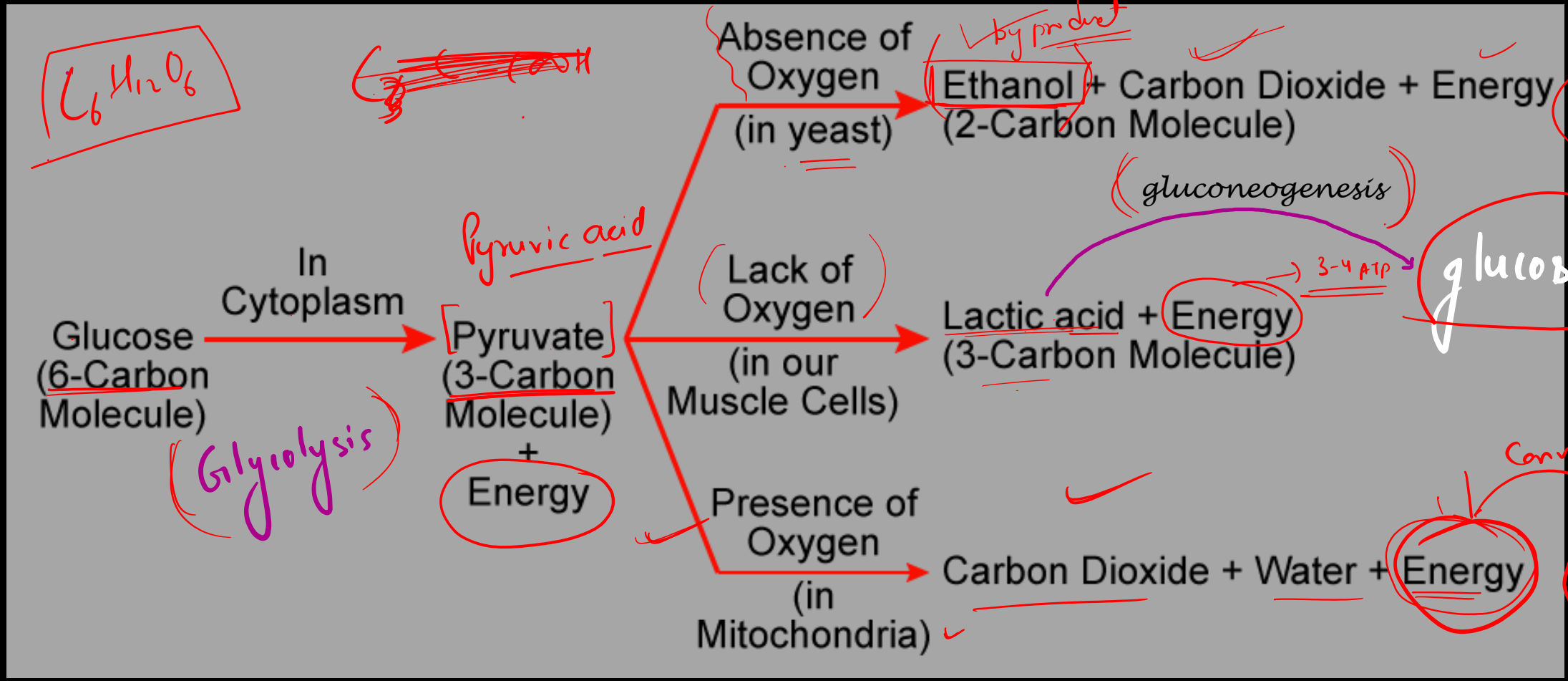
Cellular respiration



- Food materials absorbed in the cell during nutrition is used to provide energy for various other life processes.
- Some organisms uses oxygen to break-down glucose to provide energy. (aerobic respiration)
- Some organism do not use oxygen for this process. (anaerobic respiration).



Cellular respiration

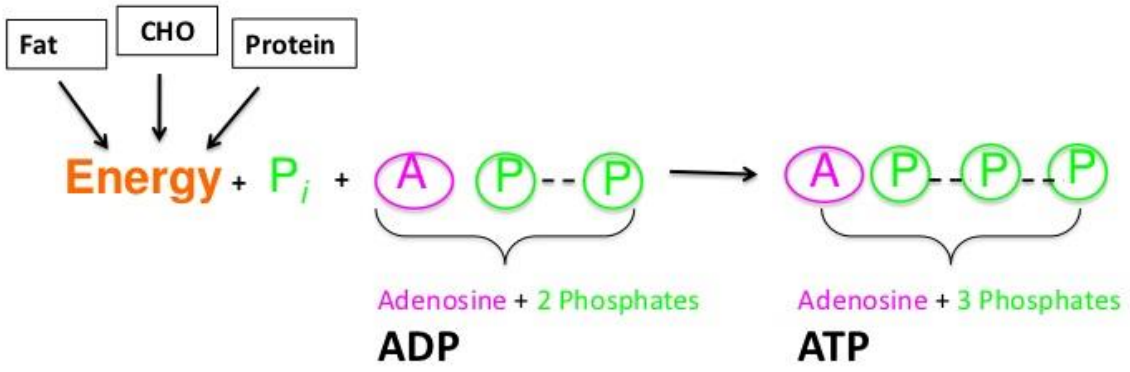


ATP: Adenosine Triphosphate

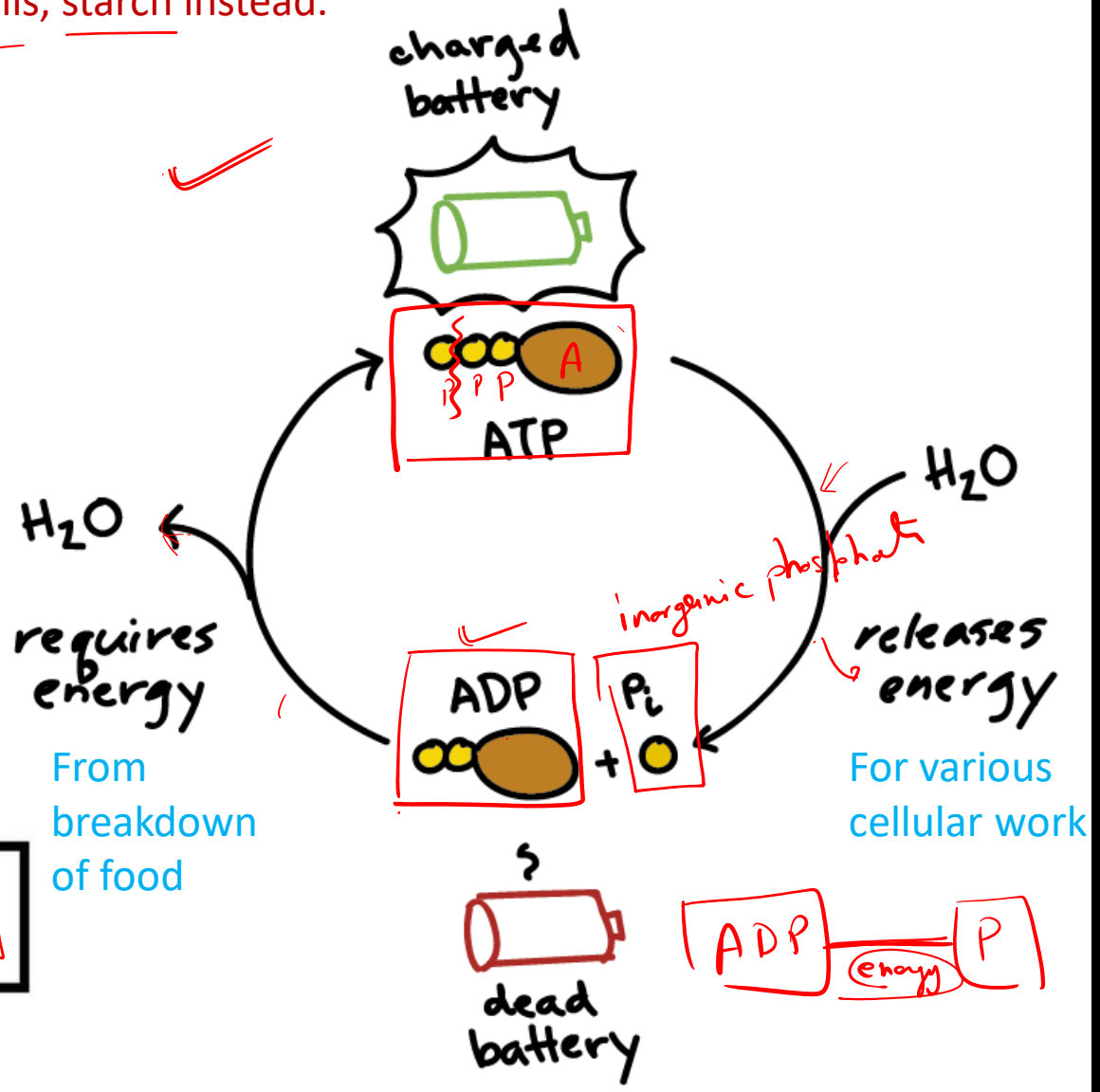
Organisms do not store ATP for long periods. Stores fats, oils, starch instead.

Rebuilding ATP

- A muscle fibre stores only a limited amount of ATP!
- 'ATP Splitting' is **reversible** process, whereby ADP undergoes **phosphorylation** (rejoins with a phosphate) with the assistance of energy to **resynthesize ATP:**



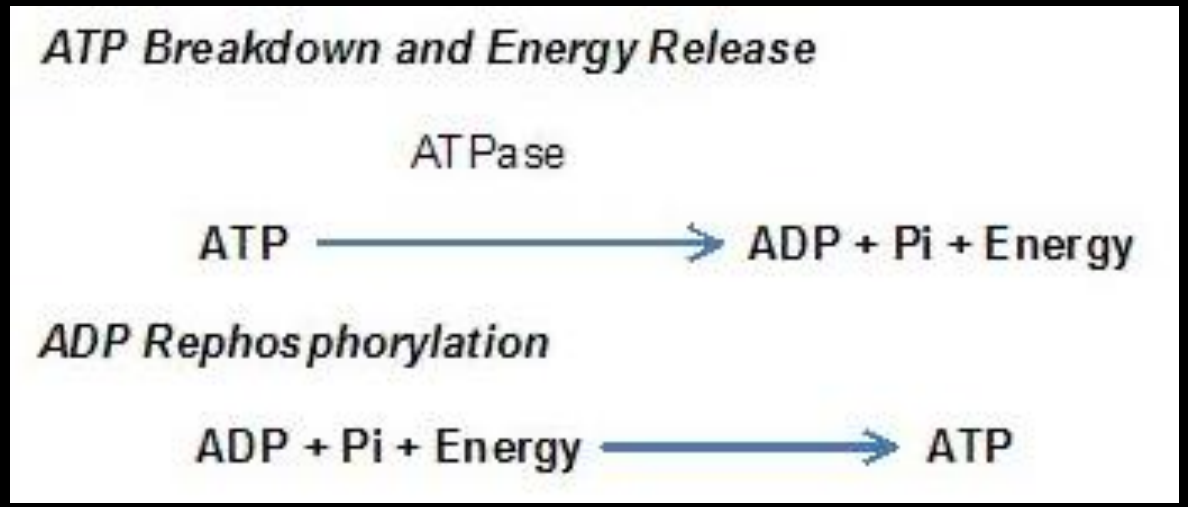
$$ATP + H_2O \xrightarrow[\text{hydrolysis}]{\text{ATPase}} ADP + Pi \qquad \Delta G = -30.5 \text{ kJ/mol}$$



ATP: Adenosine Triphosphate

Organisms do not store ATP for long periods.

Stores fats, oils, starch instead.



Oxygen is essential in aerobic respiration

- Aerobic organism requires lot of oxygen.
- Various organism have developed different mechanism for intake oxygen.
- **Plants** do this through opening/closing stomata (exchange of gases)
  - All cells are in contact with air due to large intercellular spaces.
  - CO_2 and O_2 are exchanged by diffusion process.

Direction of diffusion depends on the environmental conditions and requirements of the plant

At Night:

No Photosynthesis.

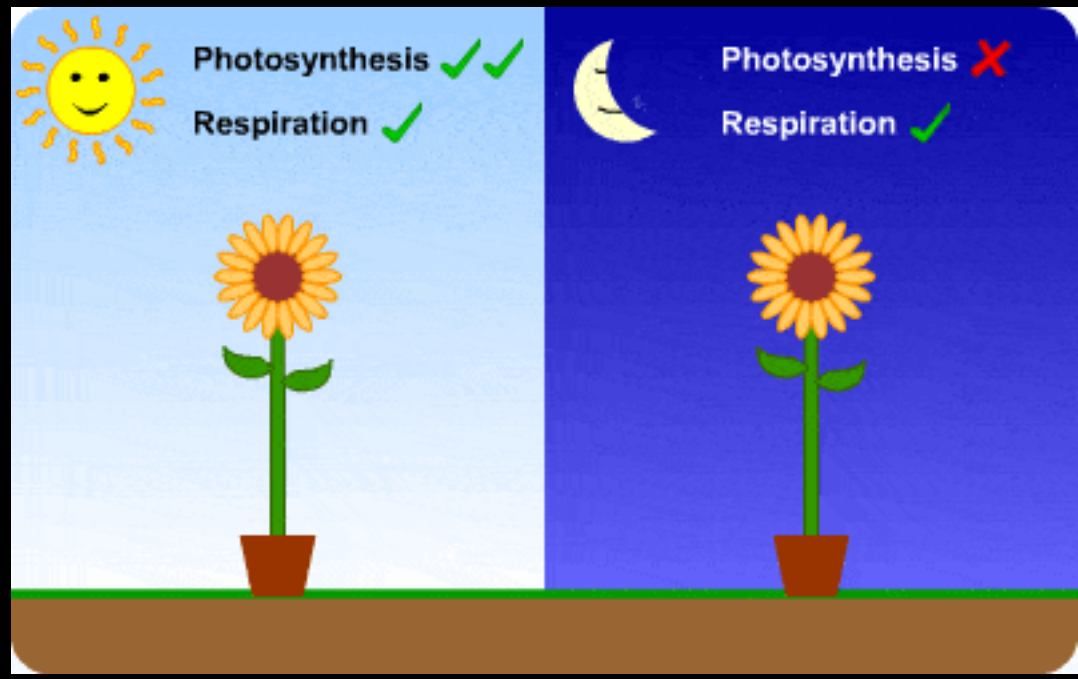
CO_2 elimination is the major activity done by the plant cells/stomata.

During Day:

CO_2 generated in respiration is used in photosynthesis.

Therefore, no net CO_2 release by plant cell.

O_2 release is the major event by cell/stomata.



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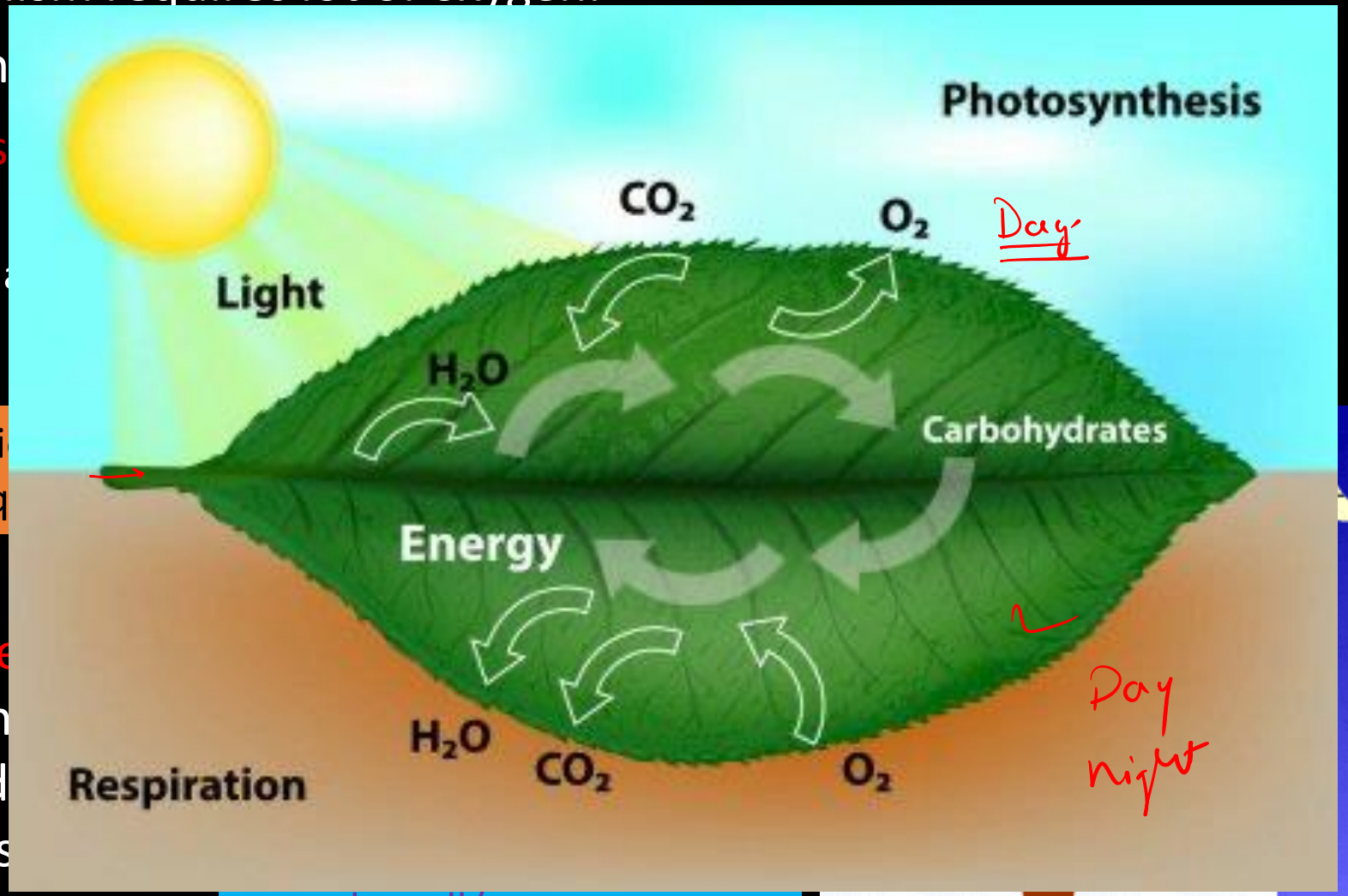
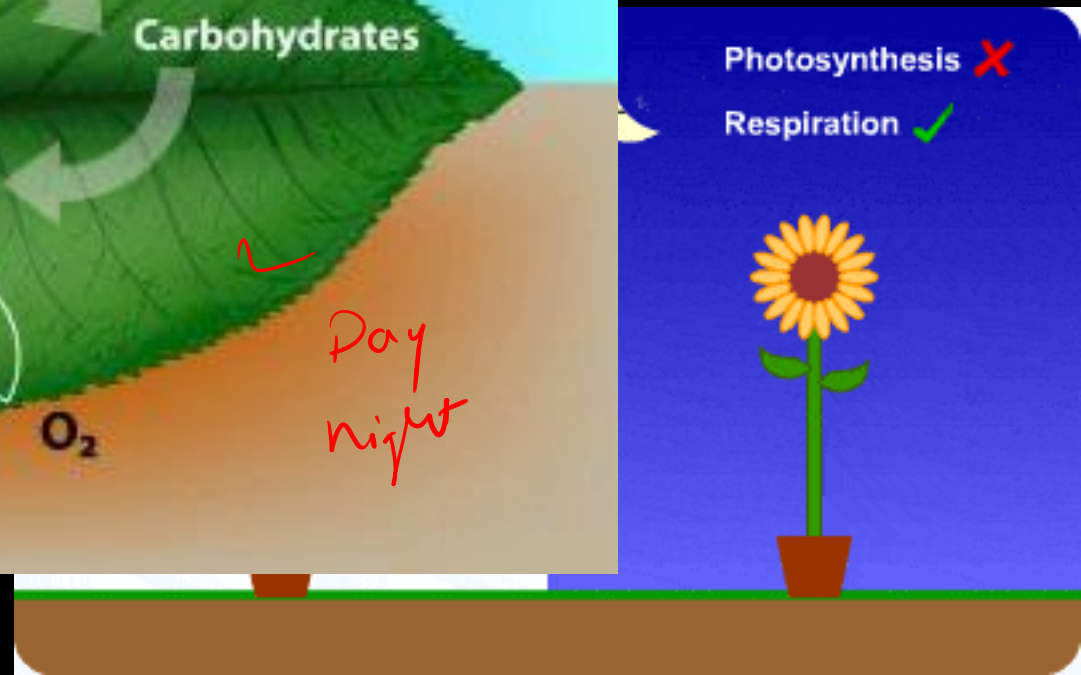




event by cell/stomata.

Oxygen is essential in aerobic respiration

Animals have evolved different organs for the uptake of oxygen from environment and getting rid of CO_2 produced during cellular respiration

Terrestrial Animal (live on land) breathe the oxygen present in the atmosphere i.e. in air

H_2O

~ 21 %

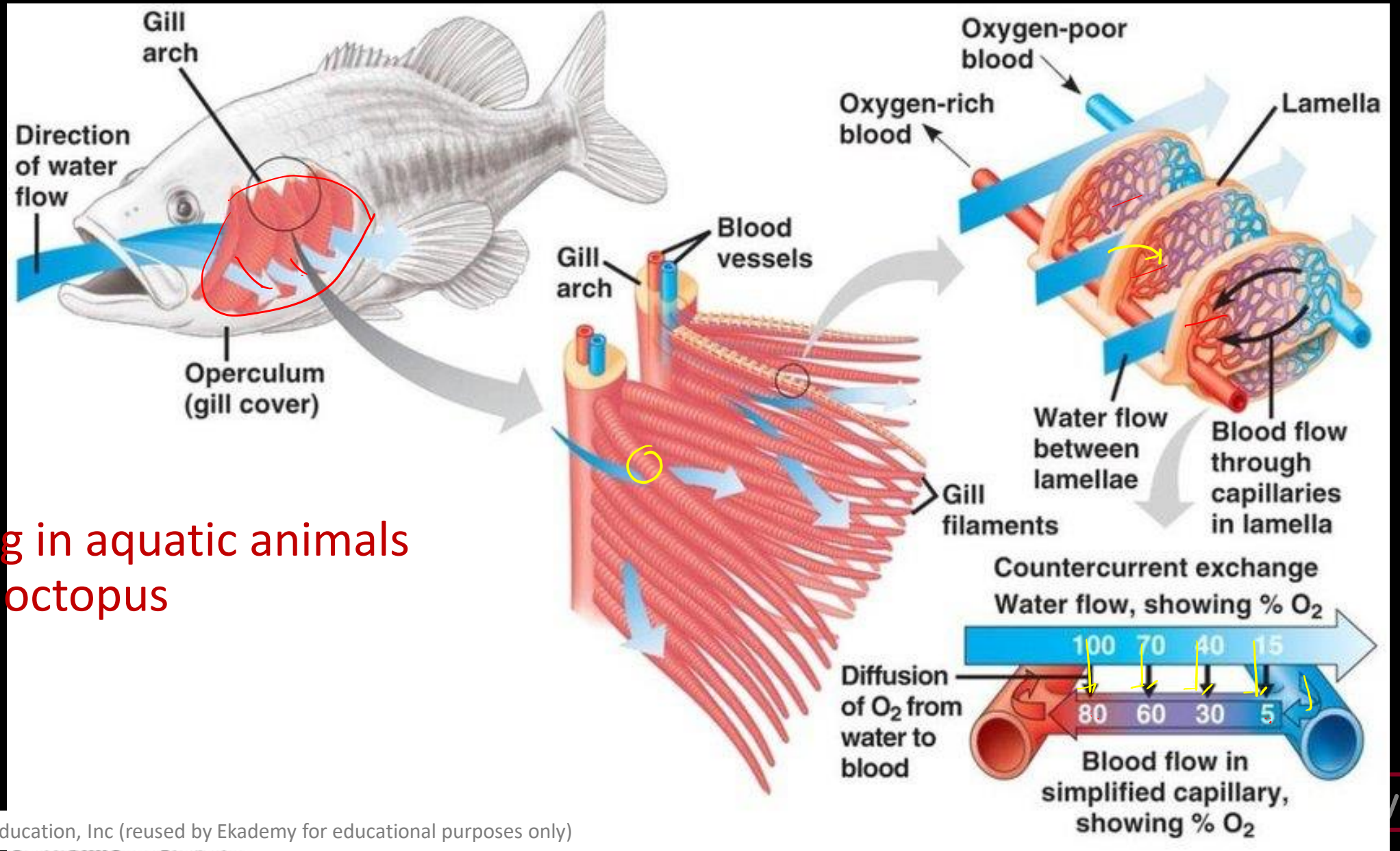
Lungs

Aquatic Animals (live in water) breathe oxygen dissolved in water.

Gills

Since the amount of dissolved O_2 in water is very low therefore rate of breathing in aquatic animals is much faster.

Oxygen is essential in aerobic respiration



Breathing in aquatic animals like fish, octopus

Oxygen is essential in aerobic respiration

Breathing in terrestrial animals like dog, humans, etc.

Such organisms use oxygen in the air (atmosphere) for respiration.

Oxygen is absorbed by different organs in different animals.

These organs have certain structure to increase the surface area (for absorption of oxygen) which is in contact with oxygen rich air.

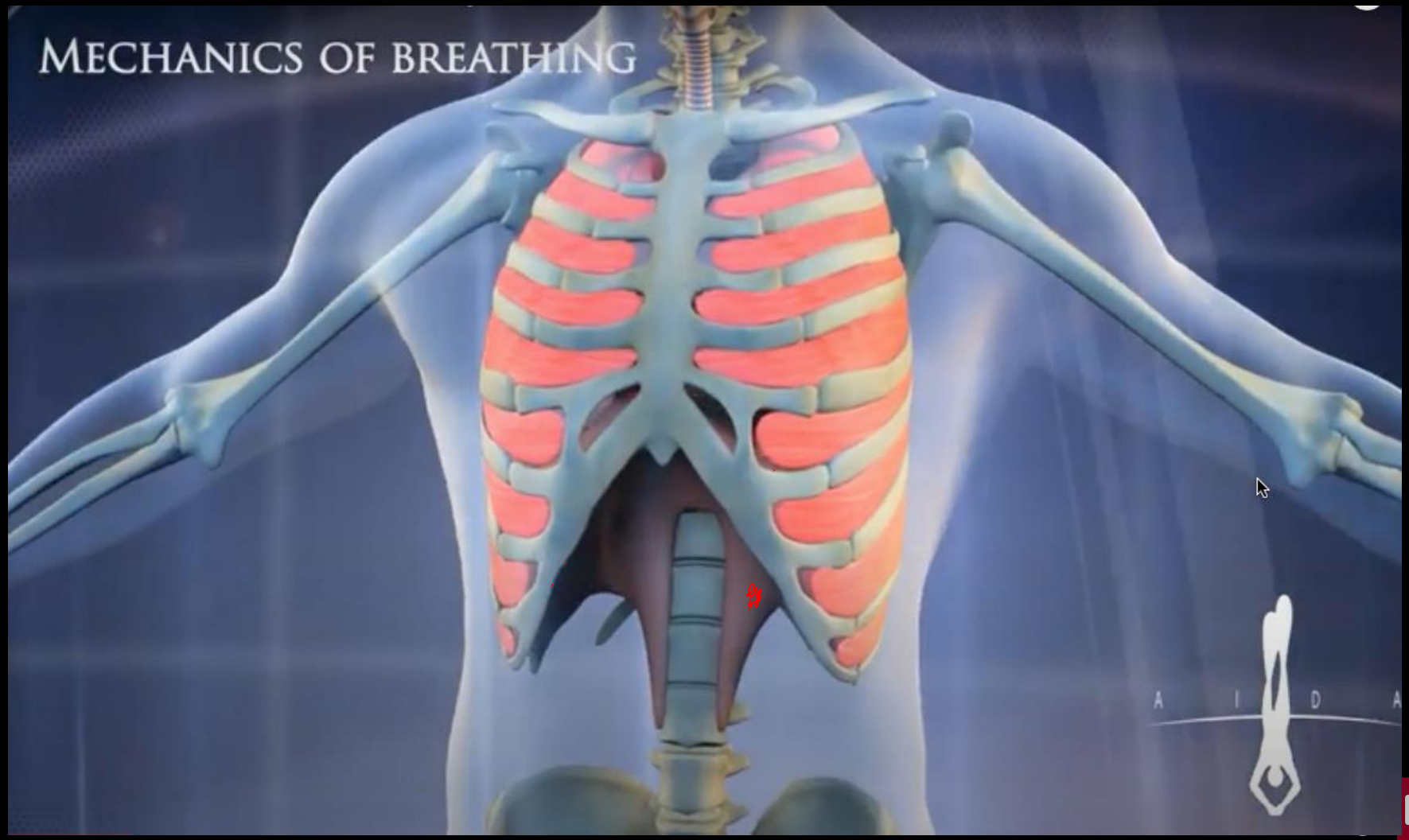
Since exchange of gases has to take place with this surface, therefore this surface is very delicate and fine.

To protect this fine and delicate surface it is usually placed within the body and hence there is passage that takes air in/out of this area.

Also there is a mechanism for moving air in and out of this area where oxygen is absorbed into the blood and carbon dioxide is released into the air.

Oxygen is essential in aerobic respiration

Breathing in Human beings



Oxygen is essential in aerobic respiration

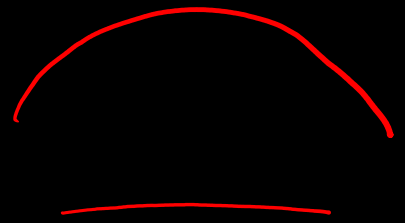
Breathing in Human beings

Oxygen is essential in aerobic respiration

Breathing in Human beings

Breathing cycle involves inhalation and exhalation

Lung always contains some residual volume of air so that there is sufficient time for oxygen to be absorbed and carbon dioxide to be released.



BREATHING INVOLVES TWO PROCESSES

INHALATION

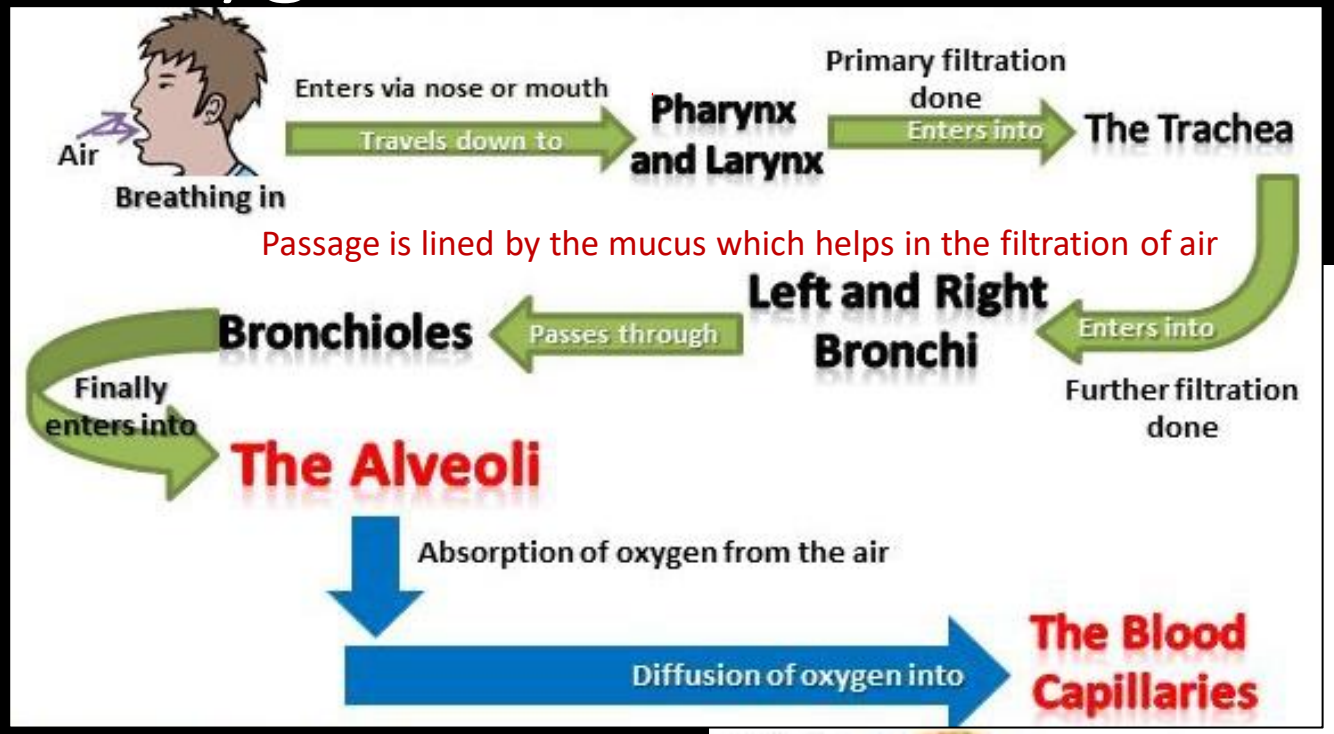
- Breathe in
- The diaphragm contracts and flattens
  Volume in the thoracic cavity increased
- The lungs expand
- Air pressure in the lungs decreased
- The difference in air pressure causes air to rush into the lungs

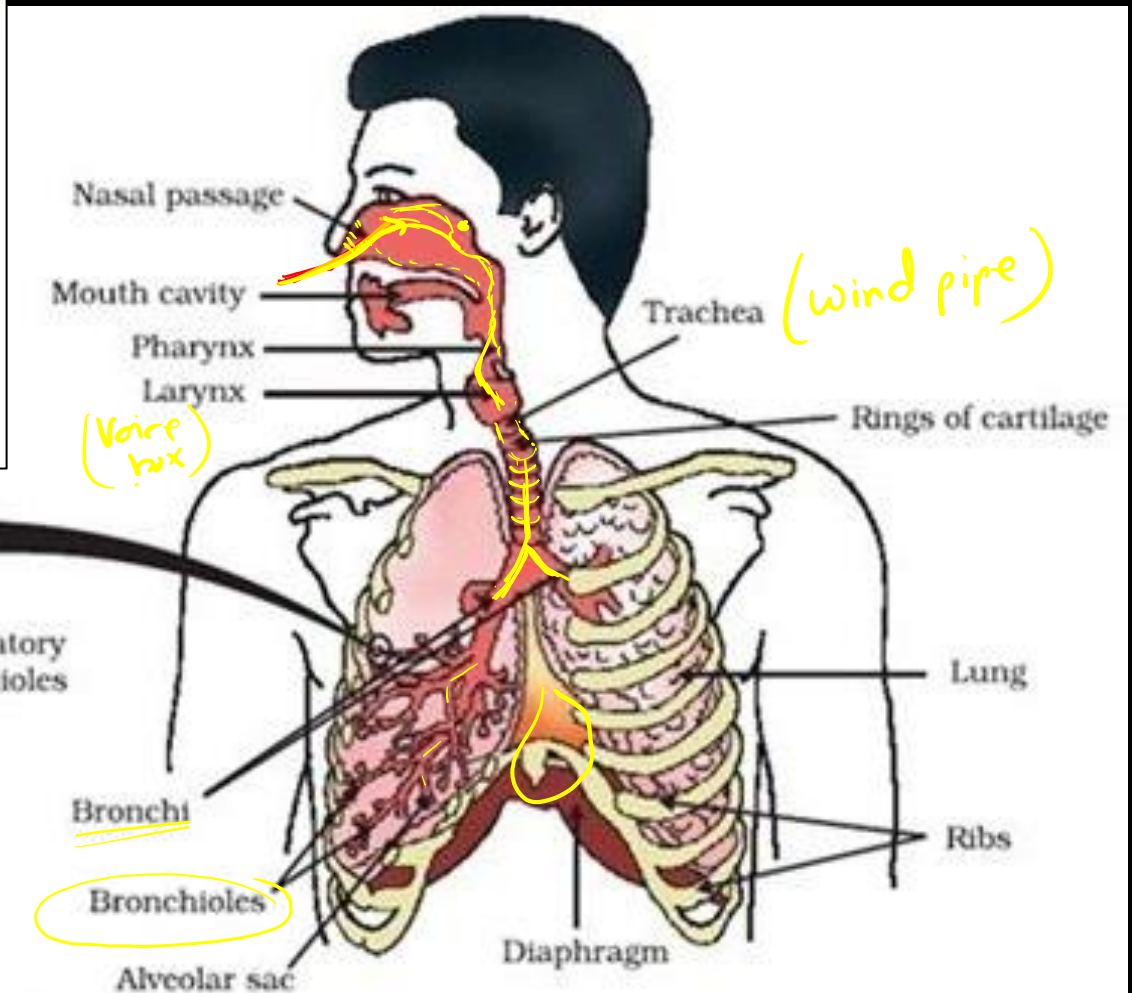
EXHALATION

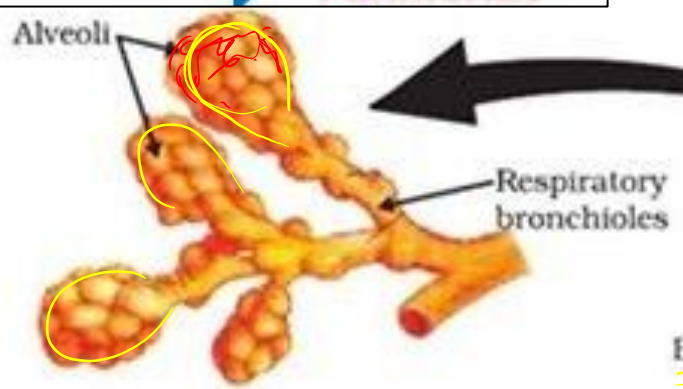
- Breathe out
- The diaphragm expand and relax
- Volume in the thoracic cavity decreased
- The lungs compress
- Air pressure in the lungs increased
- Air rush out of the lungs

Oxygen is essential in aerobic respiration

Breathing in Human beings



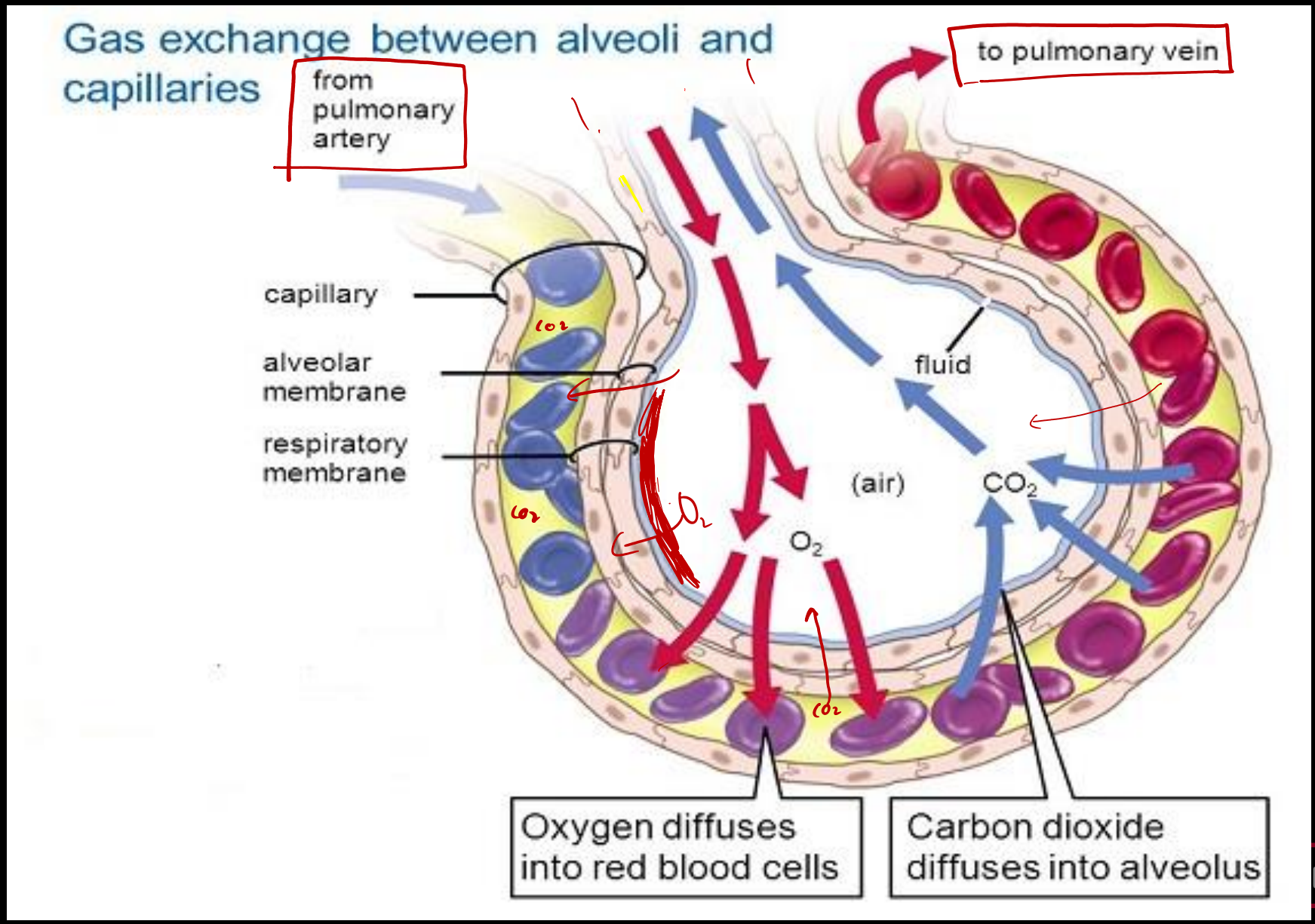




Rings of cartilage are present in the throat and ensure that air-passage does not collapse

Oxygen is essential in aerobic respiration

Breathing in Human beings



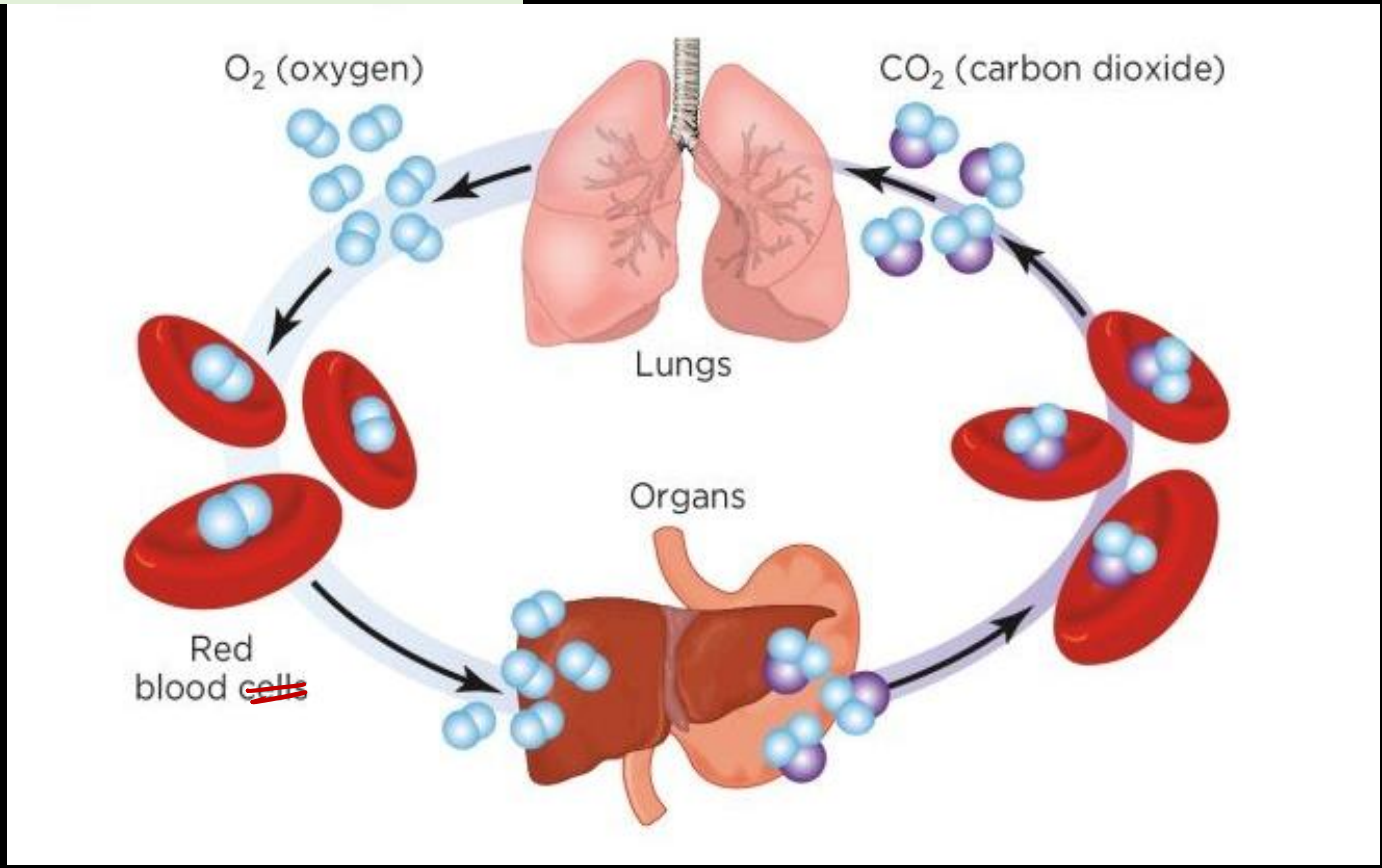
Oxygen is essential in aerobic respiration

Breathing in Human beings

For bigger animals diffusion alone can not deliver oxygen to all part of the body.

In this case respiratory pigments present in body fluids take up oxygen from the air in lung and carries to to all cells of the body

- In Human beings haemoglobin (Hb) is the respiratory pigment.
- Hb has very high affinity with oxygen.
- Hb is present RBC (red blood corpuscles) of blood.
- CO_2 is mostly transported in the dissolved form in our blood as CO_2 is more soluble in water than O_2

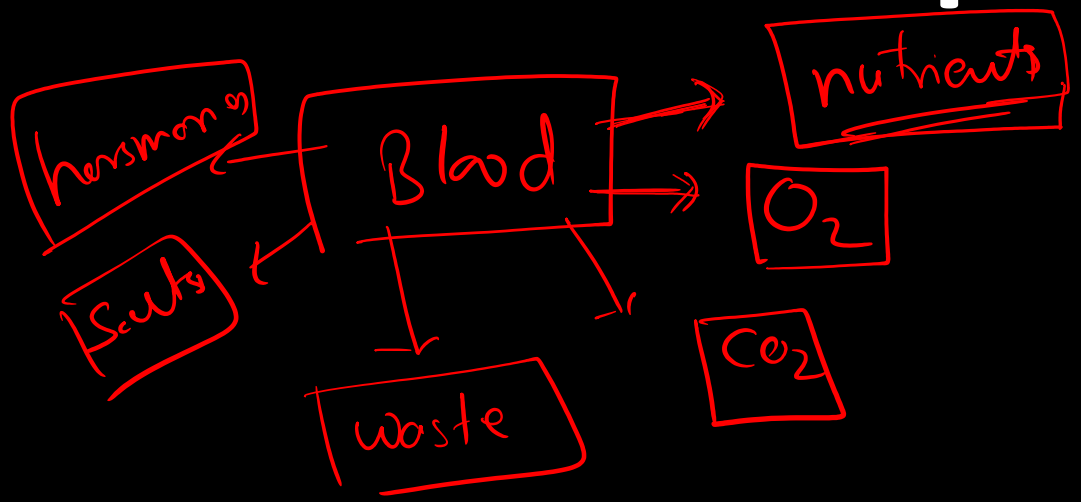


More to Know

- If alveolar surface is spread out, it would cover about 80 m^2. Such large area make efficient exchange of gases.
- If oxygen moves in our body only by diffusion then it would take around 3 years for one oxygen molecule to reach our toes from our lungs. (that's why Hb is so important)

3D Model

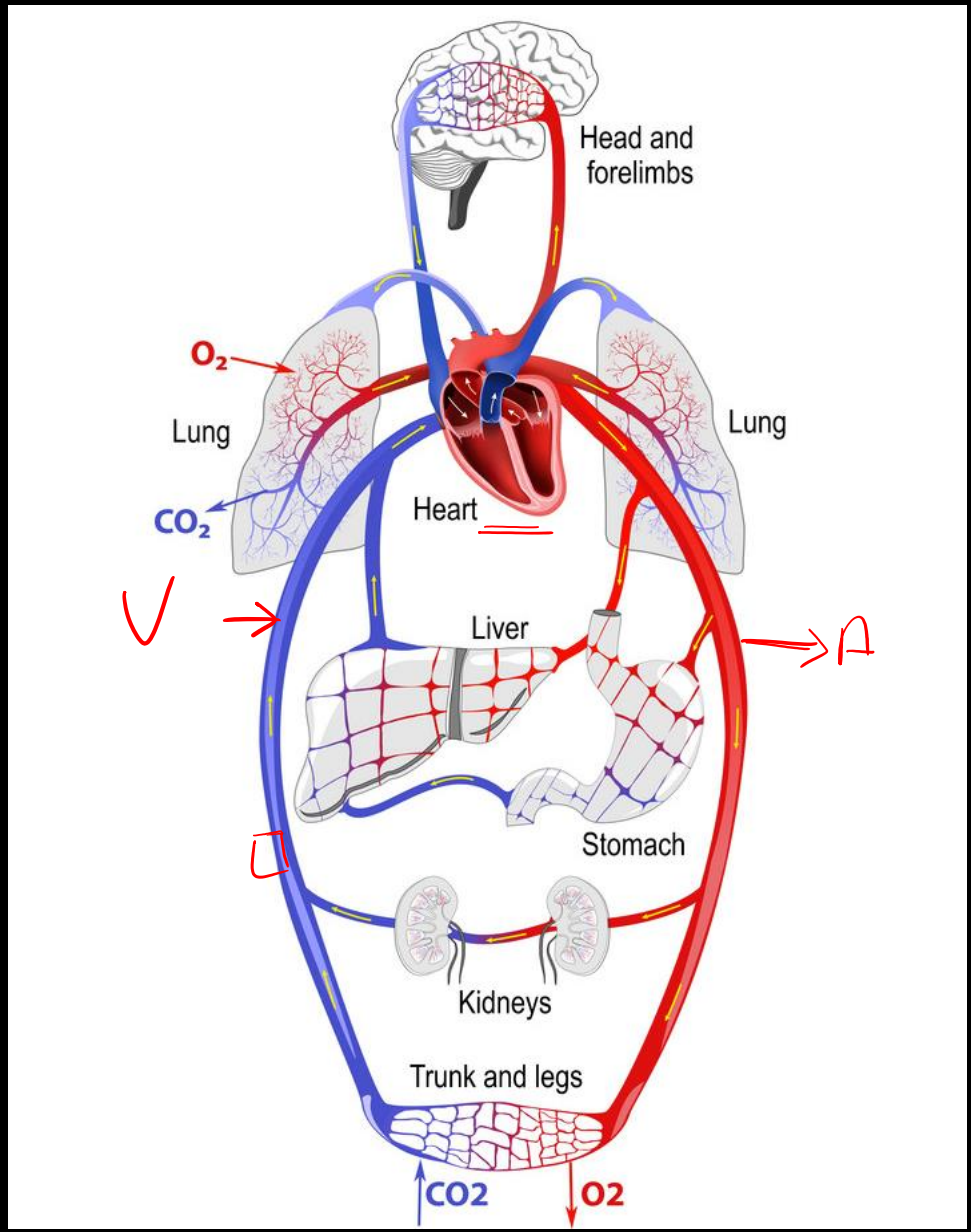
Transportation



Transportation in Human Beings

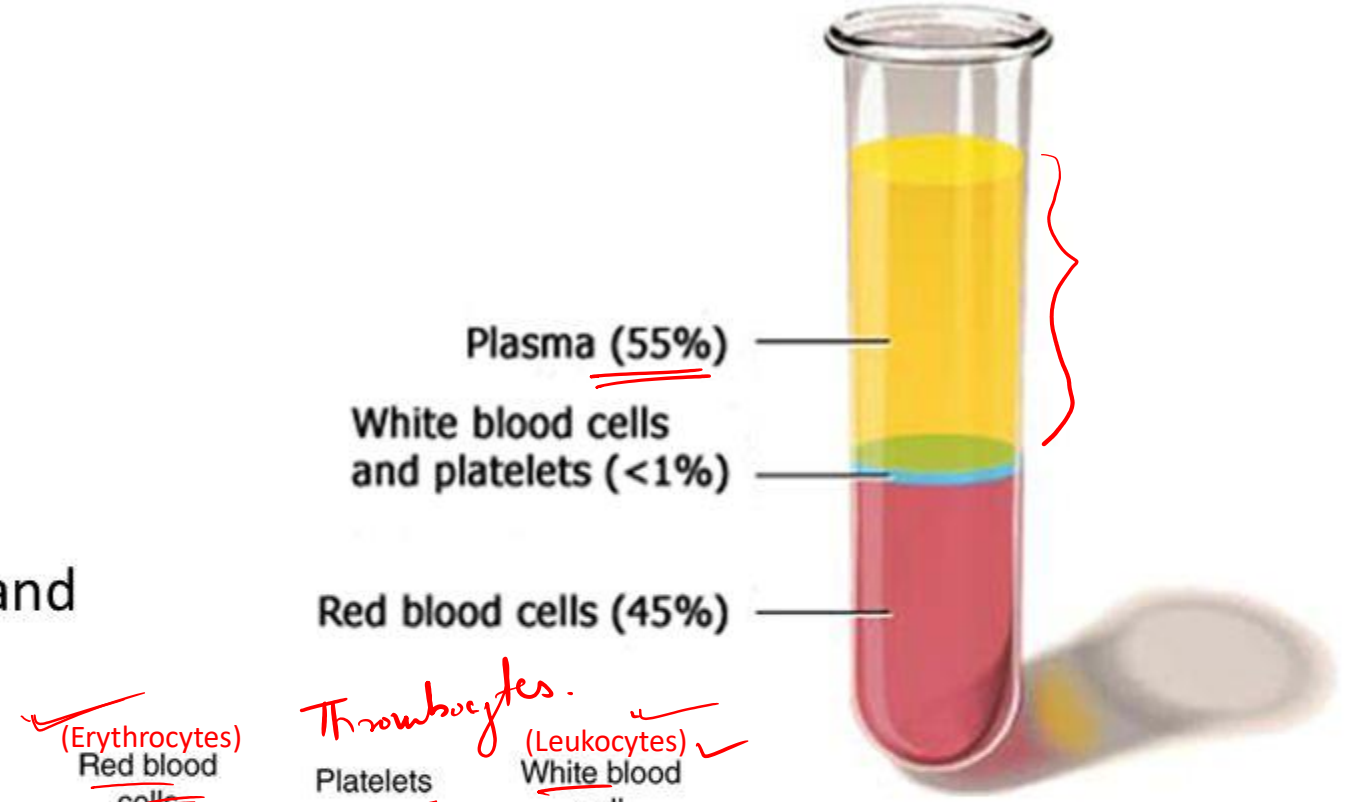
- Done by blood
- Transports food/nutrients, oxygen and waste material within our body.
- Also transports, salts, hormones, etc.
- We need a pumping system to push the blood around the body to reach all the tissues.

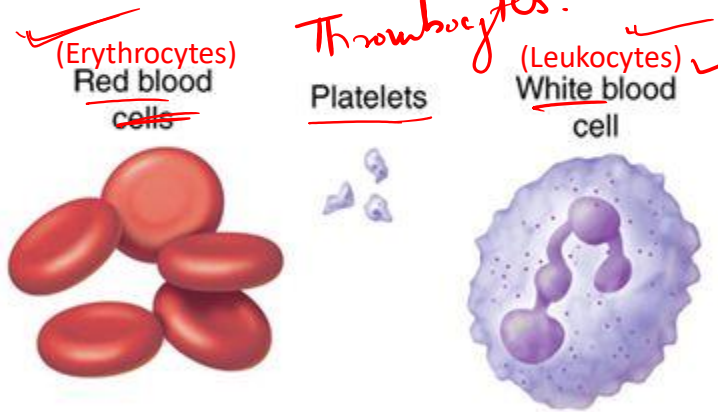
Blood | Heart | Vessels A V C

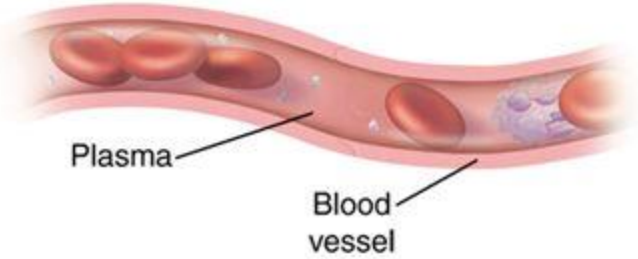


Blood

- Contains plasma
  - 90% water
  - 10% dissolved gases, salts, nutrients, enzymes, hormones and waste
- Contains red blood cells
  - Also called erythrocytes
  - Carry oxygen with the protein hemoglobin





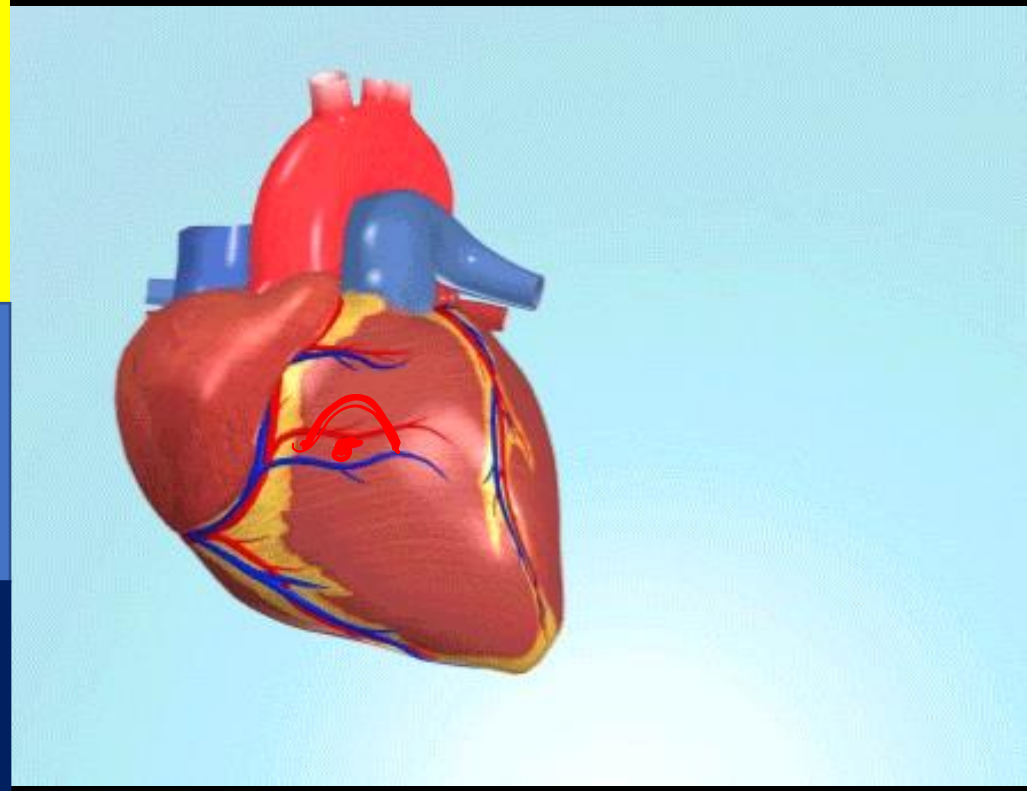


The Heart: our pumping organ

- Heart is a muscular organ
- Size is around our fist.
- It has 4 chambers.
- Oxygenated and deoxygenated bloods are kept separately in these chambers.
- Chambers prevents the mixing of oxygen rich blood with carbon dioxide rich blood.

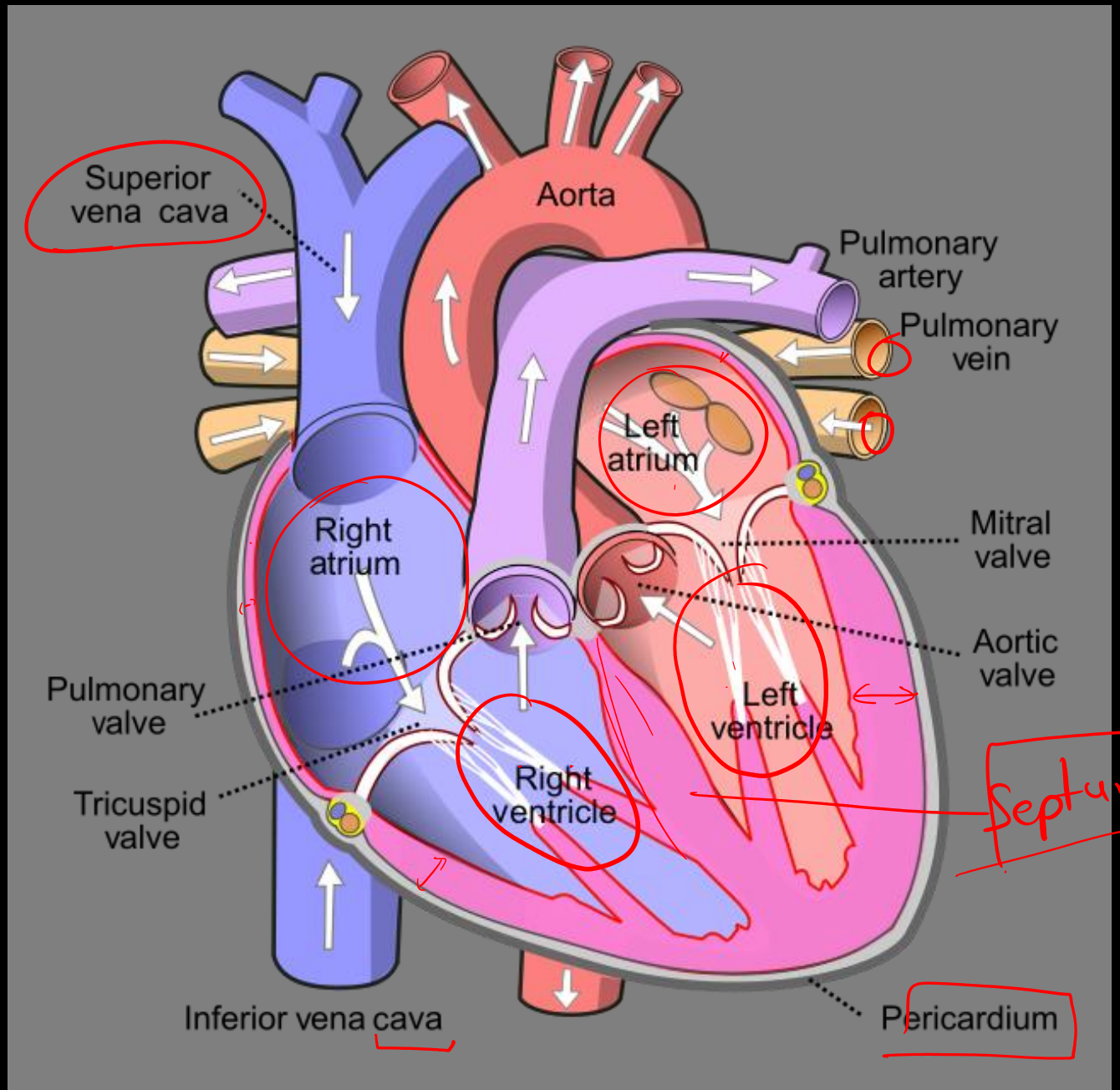
- Deoxygenated blood has to reach lungs to release CO2 and absorb O2
- Oxygenated blood has to be brought back to the heart.
- Heart pump this oxygenated blood to rest of the body.

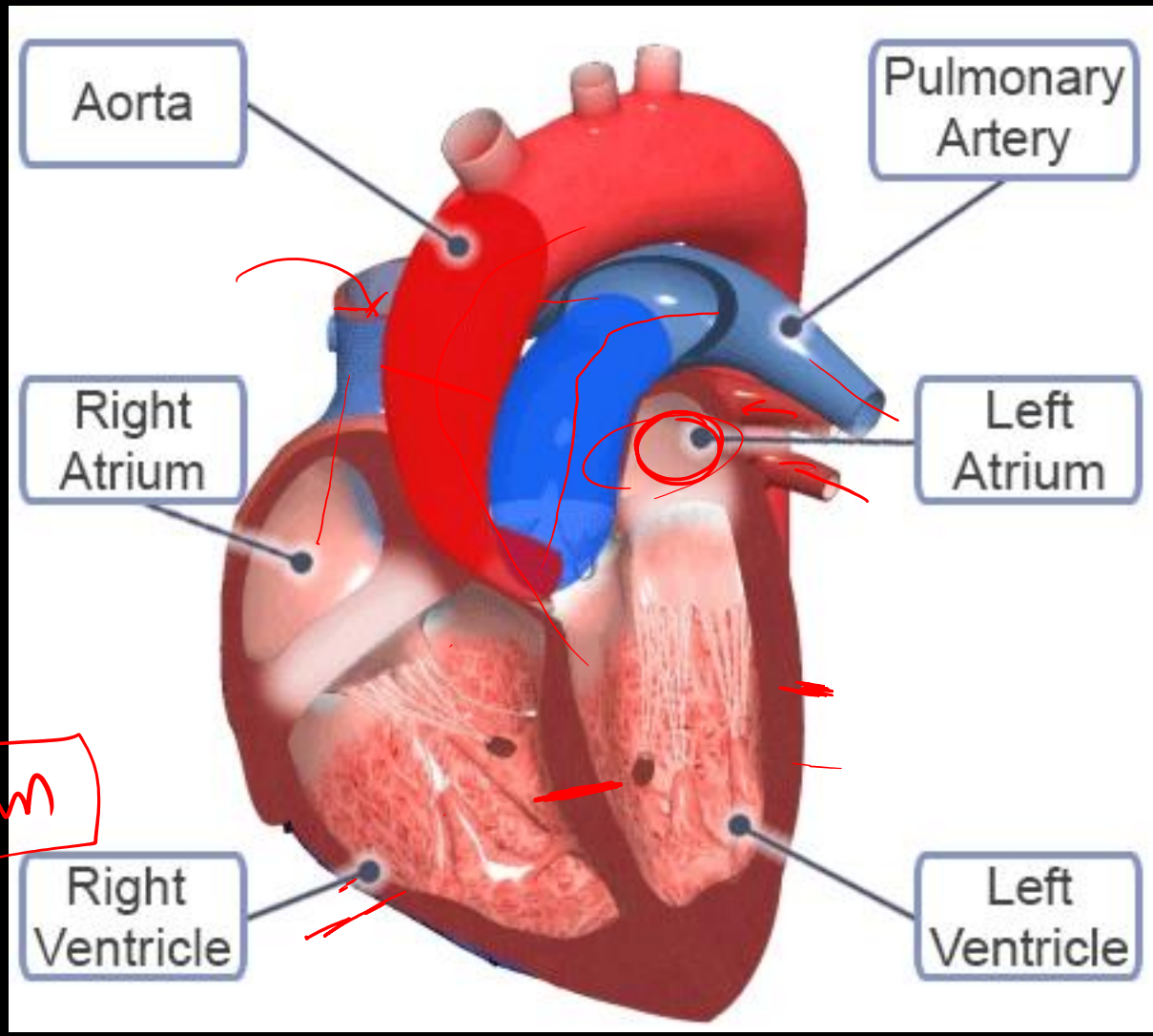
- Left chambers (atrium and ventricles) contains oxygenated blood.
- Rights chambers contains deoxygenated blood.
- Both the upper chambers (atria) are thin walled while lower chambers (ventricles) are thick walled.
- L-ventricle's wall is thicker than R-ventricle's wall, as it has to pump blood to whole body.



Heart Anatomy and function

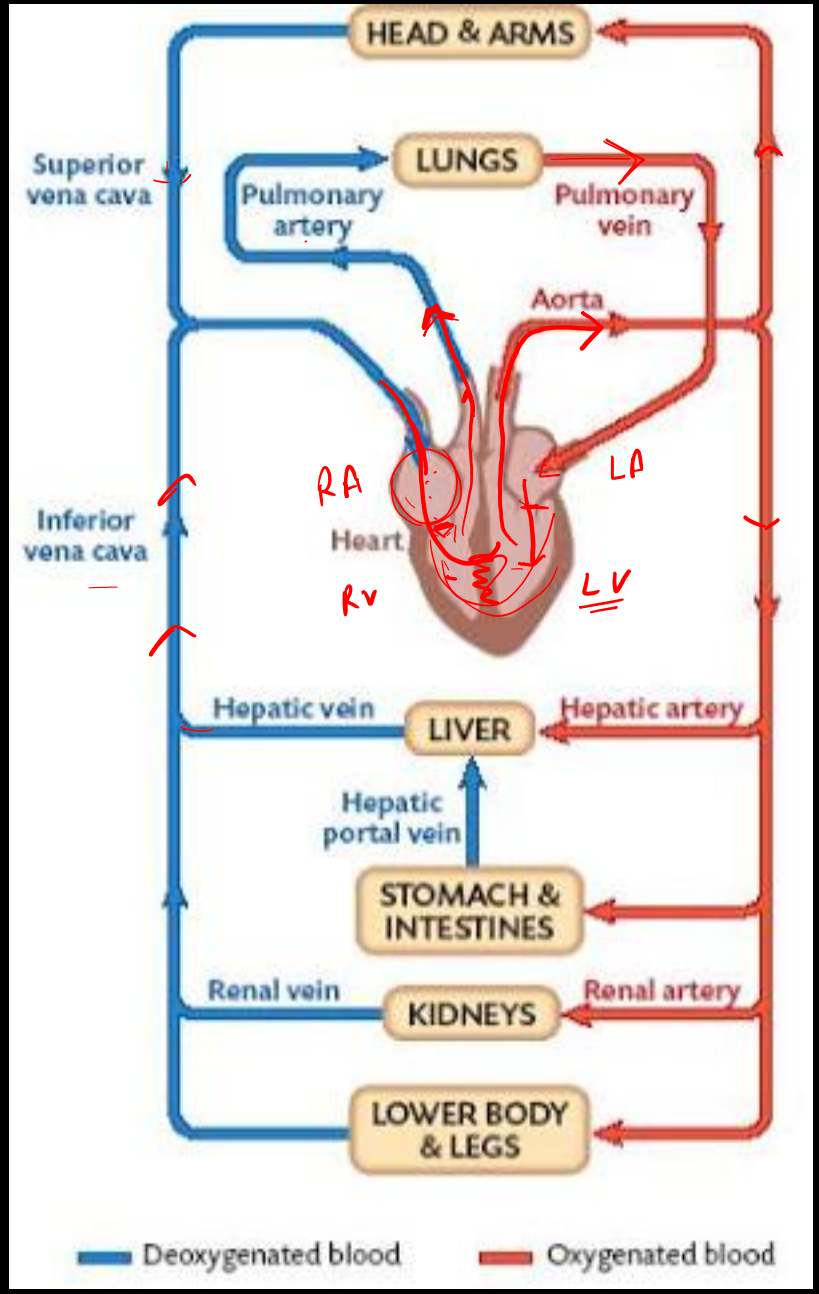
Head & lung mad





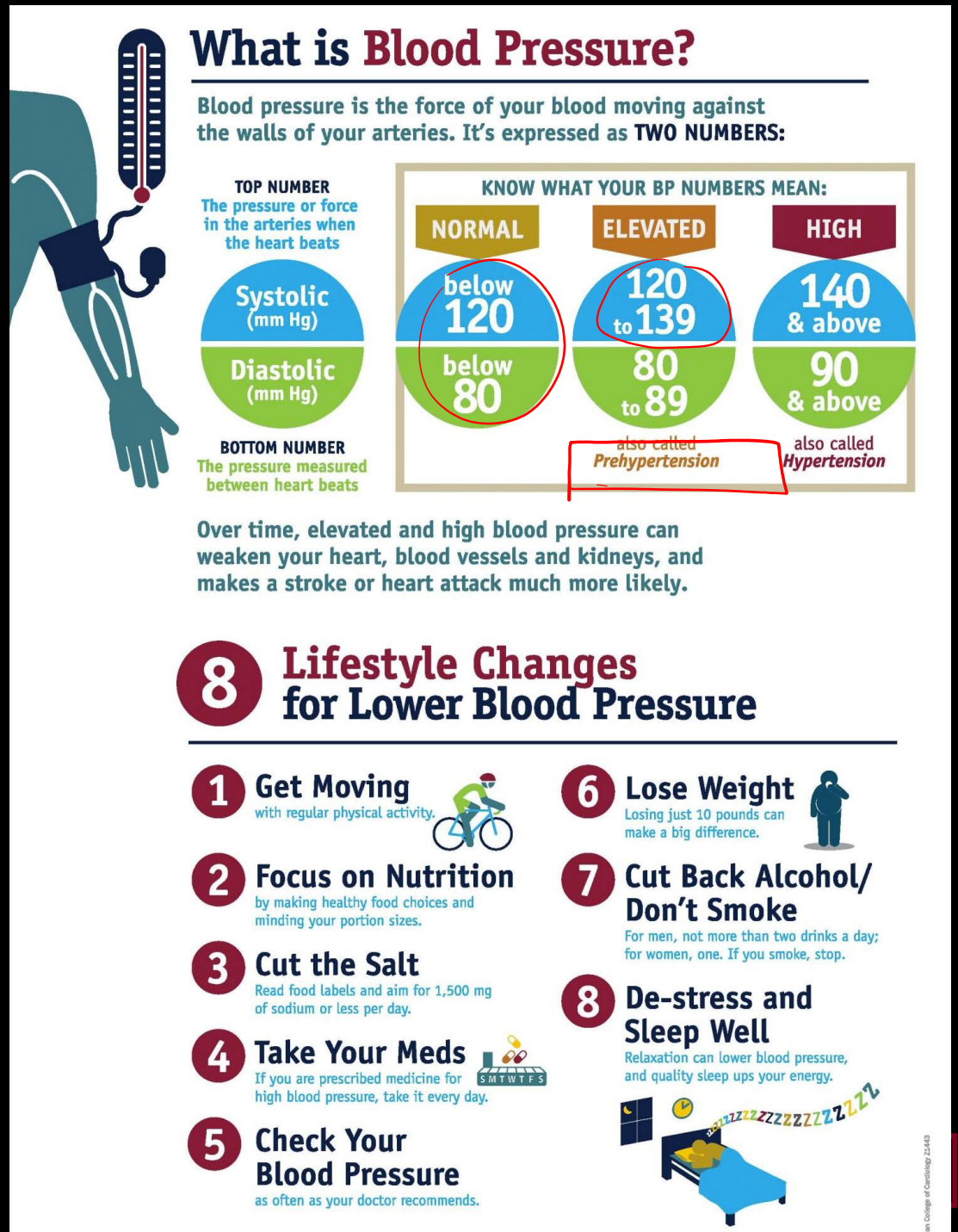
Schematic representation of transportation and exchange of gases

- Left and right chambers prevents the mixing of oxygenated and deoxygenated blood and hence allows highly efficient supply of oxygen to the body.
  - This is useful for vertebrate (birds, mammals) as they have high energy needs.
  - Constant supply of energy is required to maintain the body temperature.
- Amphibians and reptiles body temp depends on environment temp and hence they do not require constant energy supply and hence tolerate some mixing of blood.
  - They have three chambered heart.
- Fishes have two chambered heart.
  - Blood is pumped to gills -> gets oxygenated -> passes to body.
  - Blood goes only once through fish heart during one cycle of passage through the body.
- In vertebrate, blood passes twice through the heart during each cycle of passage through the body. This is called **Double Circulation**



Blood Pressure

- Force that blood exerts against the wall of a vessel is called blood pressure.
- BP is much greater in arteries than veins.
- Systolic Pressure (120 mm of Hg): pressure of blood inside arteries during ventricular systole (contraction).
- Diastolic Pressure (80 mm of Hg): pressure in artery during ventricular diastole (relaxation).
- Sphygmomanometer: Instrument for measuring BP.
- High BP is also called hypertension caused by constriction of arterioles (increased resistance to blood flow).
- May lead to rupture of arteries and internal bleeding.

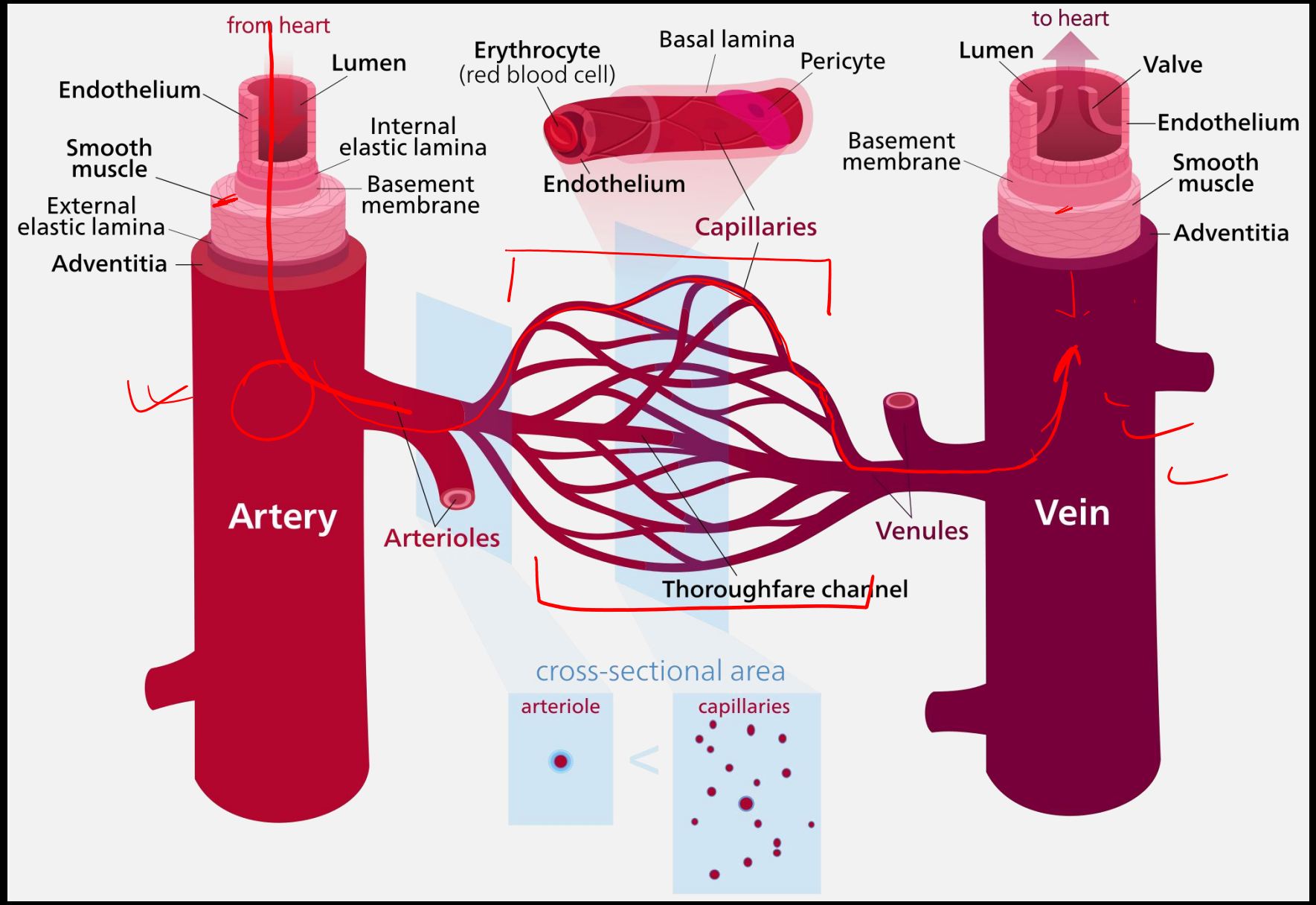


Blood Vessels: The tubes

Lub dup

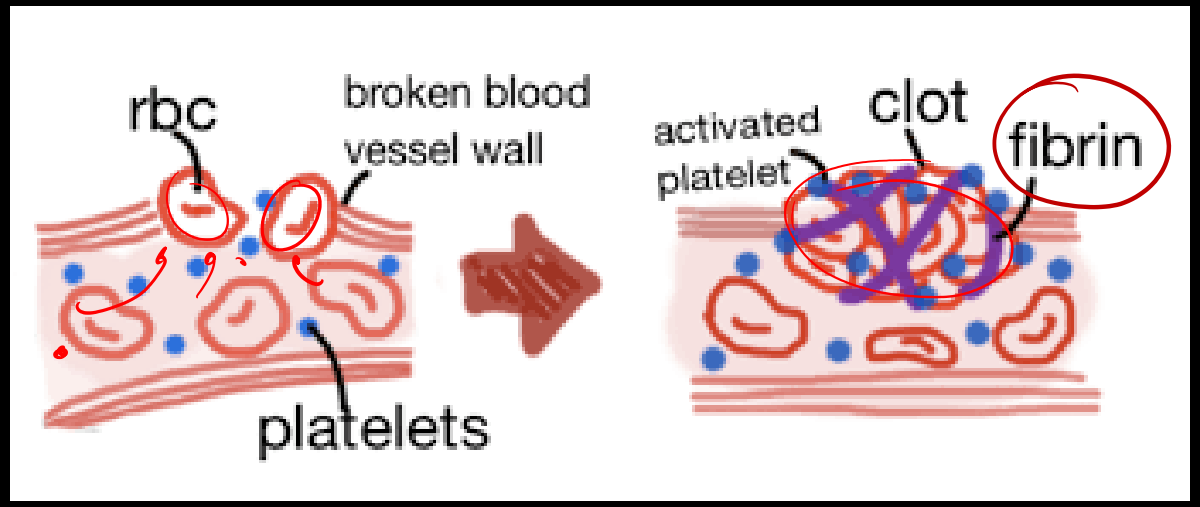
- Artery: Arteries are the blood vessels which carry blood from the heart to various organs of the body.
  - Arteries have thick and elastic wall as it carries the blood under high pressure.
  - Arteries carries oxygenated blood except pulmonary artery which carries deoxygenated blood from heart to lungs.
  - Arteries are further subdivided into several branches.
  - On reaching an organ or tissue, arteries divides into smaller and smaller vessels.
  - Finer branches of arteries are called arterioles which further divides into finer vessels called capillaries.
  - Walls of capillaries are one cell thick and exchange of materials between the blood and surrounding cells takes place through this capillary wall.
  - Capillaries then join to form veins that carry blood from the organ or tissue.
- Veins collects blood from organs the bring it back to heart.
  - They do not need thick walls as blood is no longer under pressure.
  - Veins carry deoxygenated blood except pulmonary veins which carry oxygenated blood from lungs to the heart.

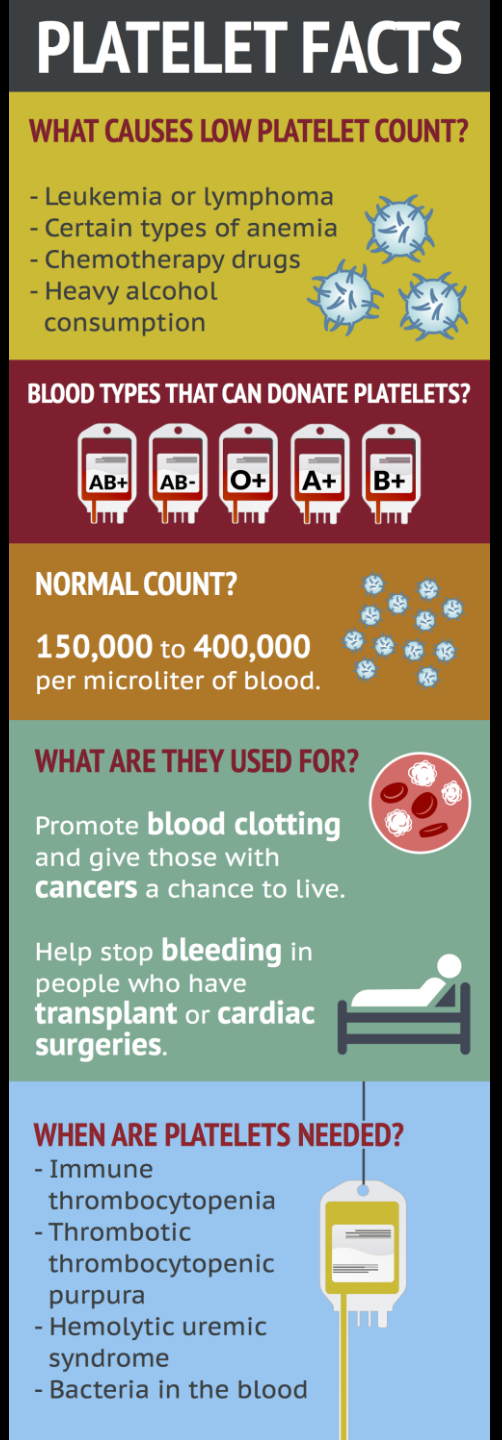
Blood Vessels:



Blood Platelets: for maintenance

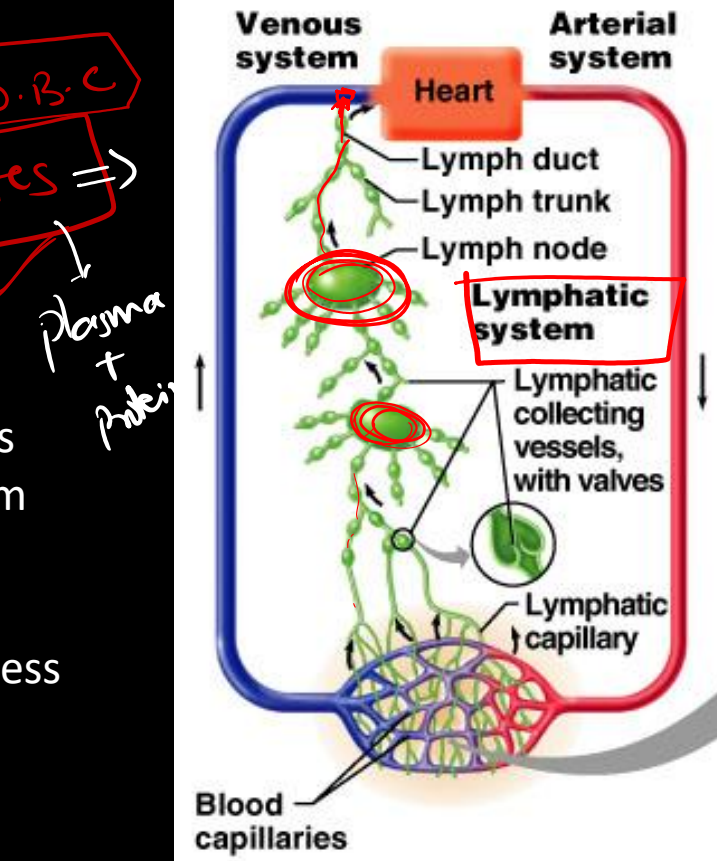
- Platelets helps in clotting blood at the wound site to stop the further loss of blood from the body and to heal the puncture in the blood vessels.
- Punctured blood vessel may lead to a loss of pressure and this may reduce the efficiency of the heart. Platelets helps in instant healing of the puncture.

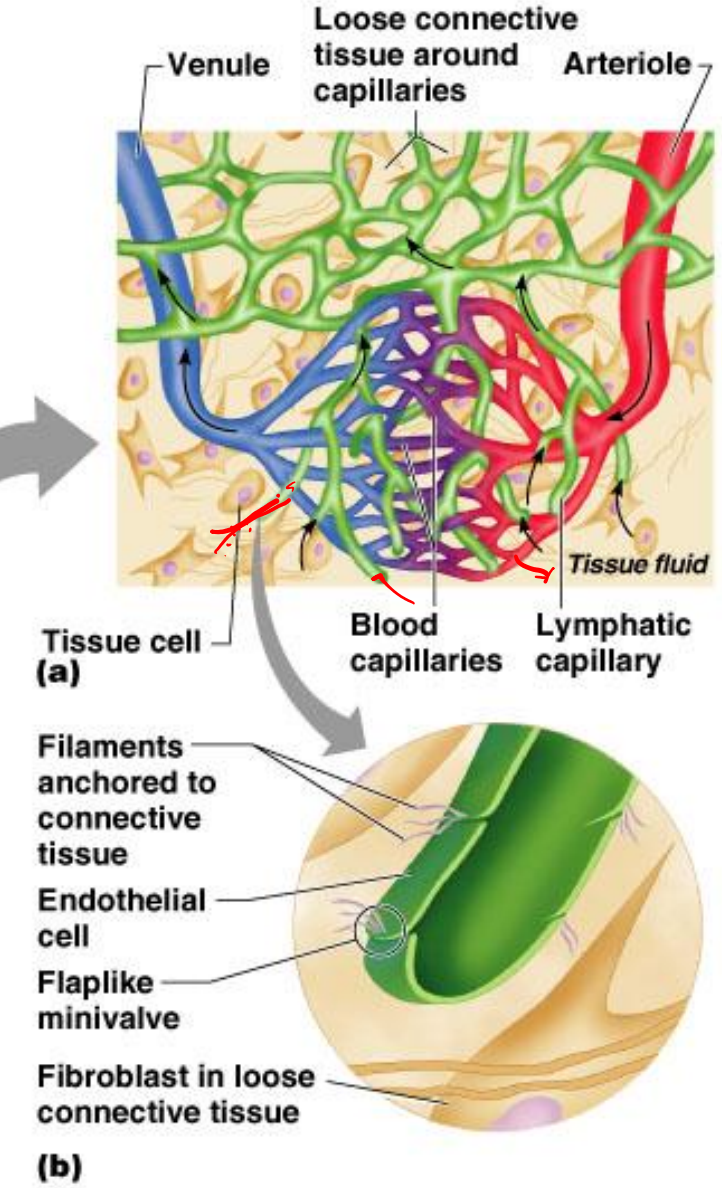




Lymph

- aka Tissue fluid
- Consists mainly of white blood cells (Lymphocytes), plasma and protein.
- They escape from capillaries and enters intercellular spaces in the tissue to form tissue fluid/lymph.
- It is similar to blood plasma, but it is Colorless to white color fluid contains less protein than plasma.
- Lymph drains into lymphatic capillaries from intercellular spaces.
- Lymph capillaries joins to form large lymph vessels that finally opens into larger veins.
- Lymph carries digested and absorbed fat from intestine and drains excess fluid from extracellular space back into the blood.



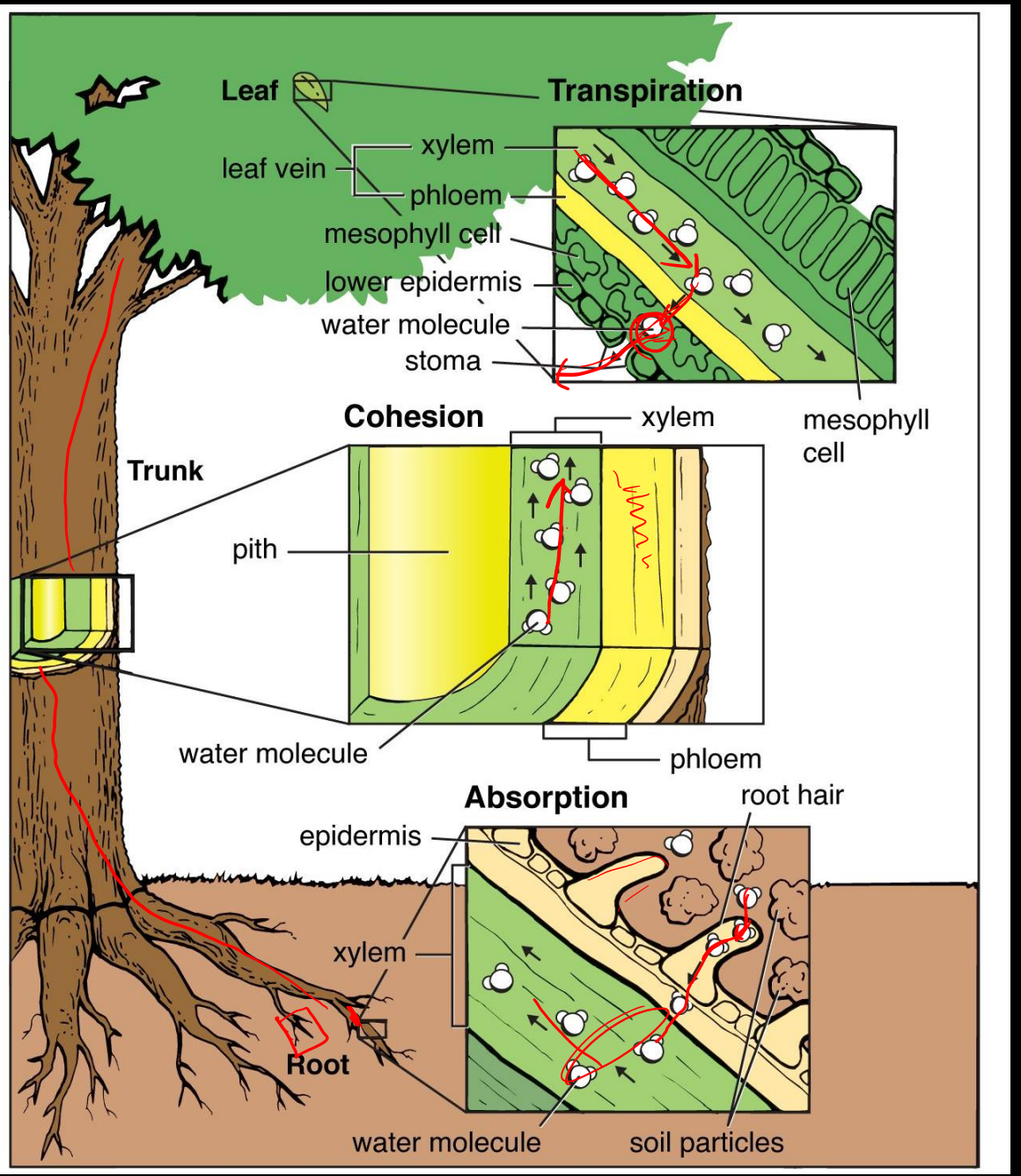


Transportation in plants

- Why is it needed?
  - Plant needs water and raw materials for proper growth and development.
  - Soil is the nearest richest source of raw materials like N, P, K, etc.
  - These are absorbed by the roots and transported to various parts of the plant.
  - Plants have low energy needs (as they do not move, and plant body have largely dead cells) so they can use relative slow transport system.
  - Distance of transport vary largely in plants such as transportation in very big tree as compared to small plant.
- Plant transportation systems includes
  - transportation of energy/food from leaves
  - Transportation of raw materials (minerals) and water from roots.
- Two pathways are constructed by independently organized conducting vessels/tubes.
  - The Xylem: moves water and minerals absorbed from the soil.
  - The Phloem: transport the product of photosynthesis (food) from the leaves to other parts of the plant.

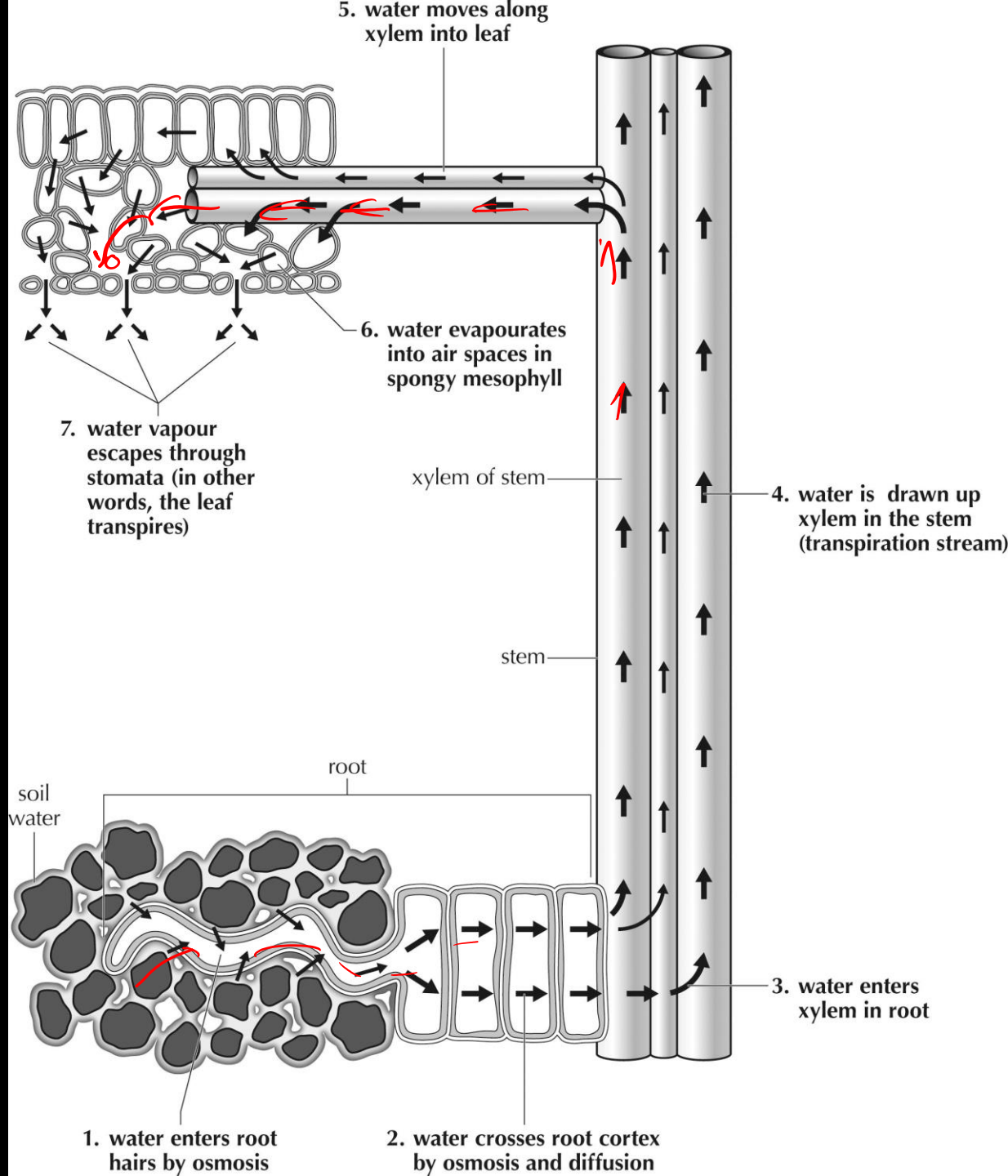
Transport of water: Root Pressure

- Xylem vessels and tracheids of root, stems and leaves are interconnected to form a continuous water conducting channels reaching all parts of the plants.
- Root hair actively take up ions (minerals) from soil inside root cell.
  - This creates a difference in the concentration of these ions between the root and the soil.
  - Water moves into the root from the soil to eliminate this difference thorugh osmosis.
  - So this creates a steady movement of water into the root xylem, creating a column of water that is steadily pushed upward (root pressure)
  - However this pressure is not enough to move water in the xylem upwards in bigger trees.


Leaf
Transpiration
xylem
leaf vein
phloem
mesophyll cell
lower epidermis
water molecule
stoma
Cohesion
xylem
mesophyll cell
Trunk
pith
water molecule
phloem
Absorption
root hair
epidermis
xylem
Root
water molecule
soil particles

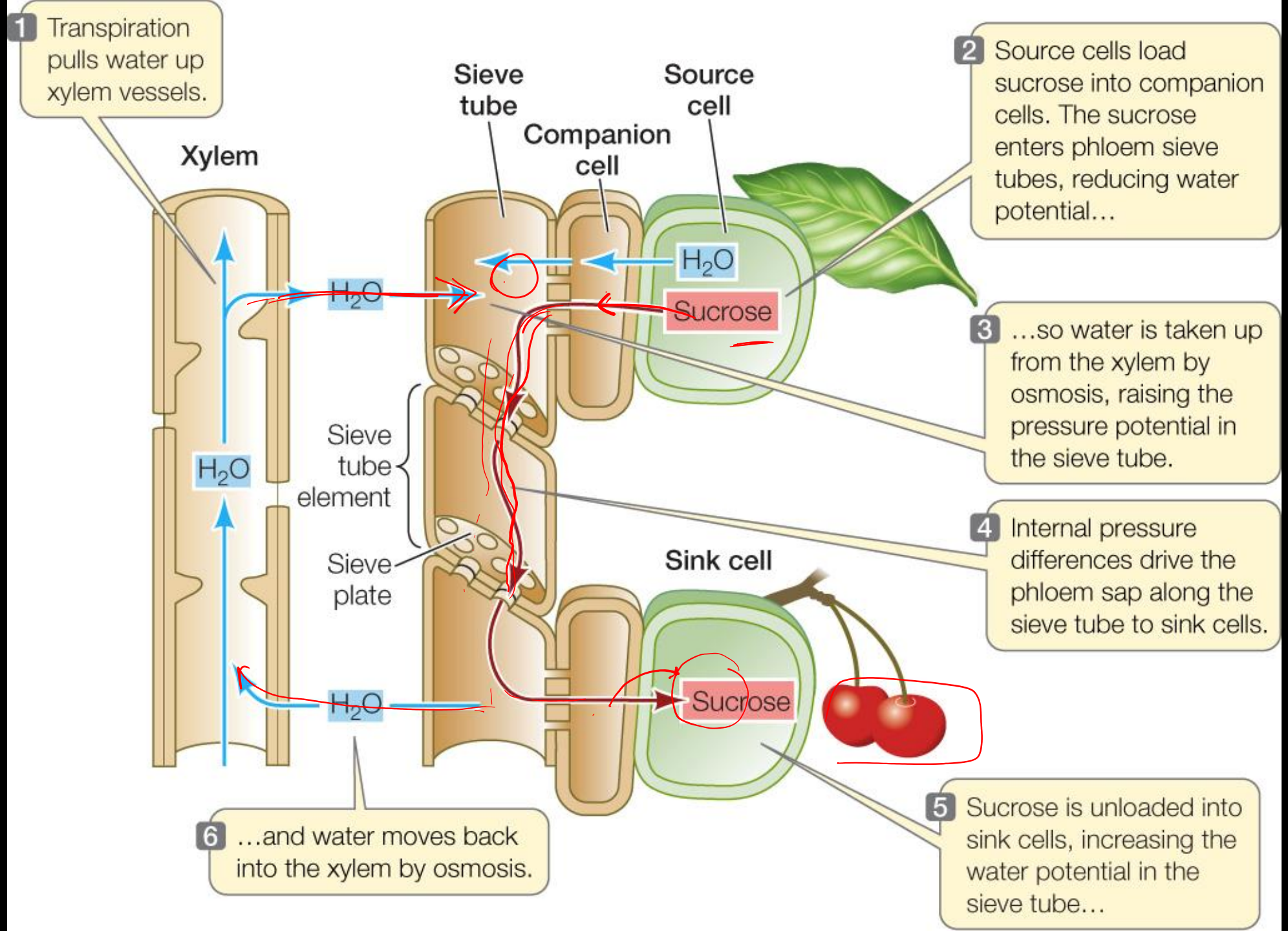
Transport of water: TP

- The water which is lost through the stomata (transpiration) is replaced by water from the xylem vessels in the leaf.
- Evaporation of water molecules from the cells of a leaf creates a suction pressure which pulls water from xylem cells of the roots.
- This suction pressure is called transpiration pull (TP)
- The loss of water in the form of vapour from the aerial parts of the plant is known as transpiration.
- Transpiration helps in: →
  - Absorption and upward movement of water and minerals from roots to leaves.
  - Temperature regulation of plants.
- At night (stomata closed), root pressure is the major driving force in the movement of water and minerals upwards in xylem.
- During Day (stomata open), transpiration pull is the major driving force in the movement of water and minerals upwards in xylem.



Transport of food and other substance

- Transport of soluble products of photosynthesis is called translocation.
- It is done by the vascular tissue called phloem.
- Phloem also transports amino acids and hormones and other substances.
- These substances are especially delivered to the storage organs of roots, fruits, seeds and to the growing organs.
- Translocation of food and other substances takes place in the sieve tubes with the help of adjacent companion cells but is upward and downward directions.


1 Transpiration pulls water up xylem vessels.
Xylem
Sieve tube
Companion cell
Source cell
2 Source cells load sucrose into companion cells. The sucrose enters phloem sieve tubes, reducing water potential…
H_2O
H_2O
Sucrose
3 …so water is taken up from the xylem by osmosis, raising the pressure potential in the sieve tube.
H_2O
Sieve tube element
Sieve plate
4 Internal pressure differences drive the phloem sap along the sieve tube to sink cells.
Sink cell
H_2O
Sucrose
5 Sucrose is unloaded into sink cells, increasing the water potential in the sieve tube…
6 …and water moves back into the xylem by osmosis.

Transport of food and other substance

- Translocation in phloem is achieved by utilizing energy, unlike transportation in the xylem (where no energy is required, only done by physical forces).
- Materials like sucrose is transferred into phloem tissue using energy from ATP.
- This increases the osmotic pressure of the phloem tissue causing water to move into it.
- This osmotic pressure moves the material in the phloem to tissues which have less pressure.
- This allows the phloem to move the material according to plants need.
- For example, in spring, sugar stored in the roots or stem tissue would be transported to the buds which need energy to grow.

Excretion

Excretion

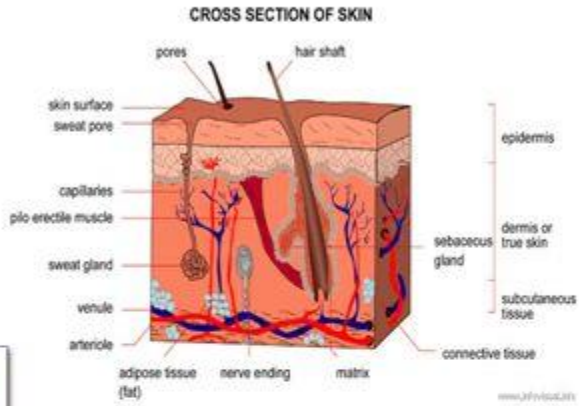
- Several waste products are generated by organism during various life processes like respiration, photosynthesis, digestion, etc.
- There are specialised organs in multicellular organism to get rid of various metabolic wastes like CO_2, O_2, nitrogenous waste etc.
- Unicellular organisms do not have specialised organs and they remove waste simply by diffusion.

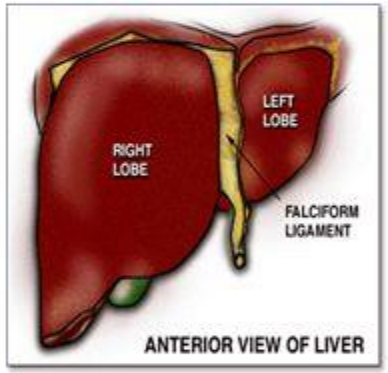
Excretion in Human Beings

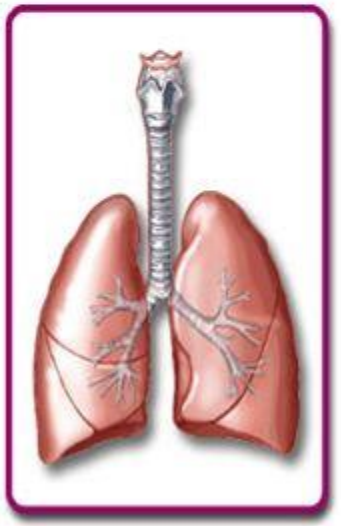
- Human body produces wastes during various metabolic activities.
- There are specialised organs to remove various types of wastes.
- Major waste that is produced in human body is nitrogenous waste.
  - Humans have a pair of kidney to get rid of harmful nitrogenous wastes.
  - **Kidney is major excretory organ in Humans.**

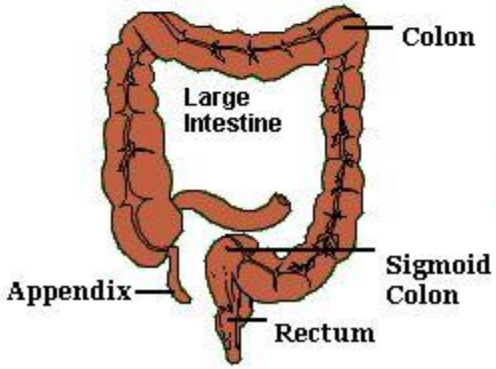
OTHER EXCRETORY ORGANS

1. **Skin** – sweat
   (salt, urea, water)
2. **Lungs** - CO_2, H_2O
   and heat
3. **Liver** – bilirubin,
   ammonia, urea
4. **Large Intestines**:
   Excretion of heavy metals
   some salts and water



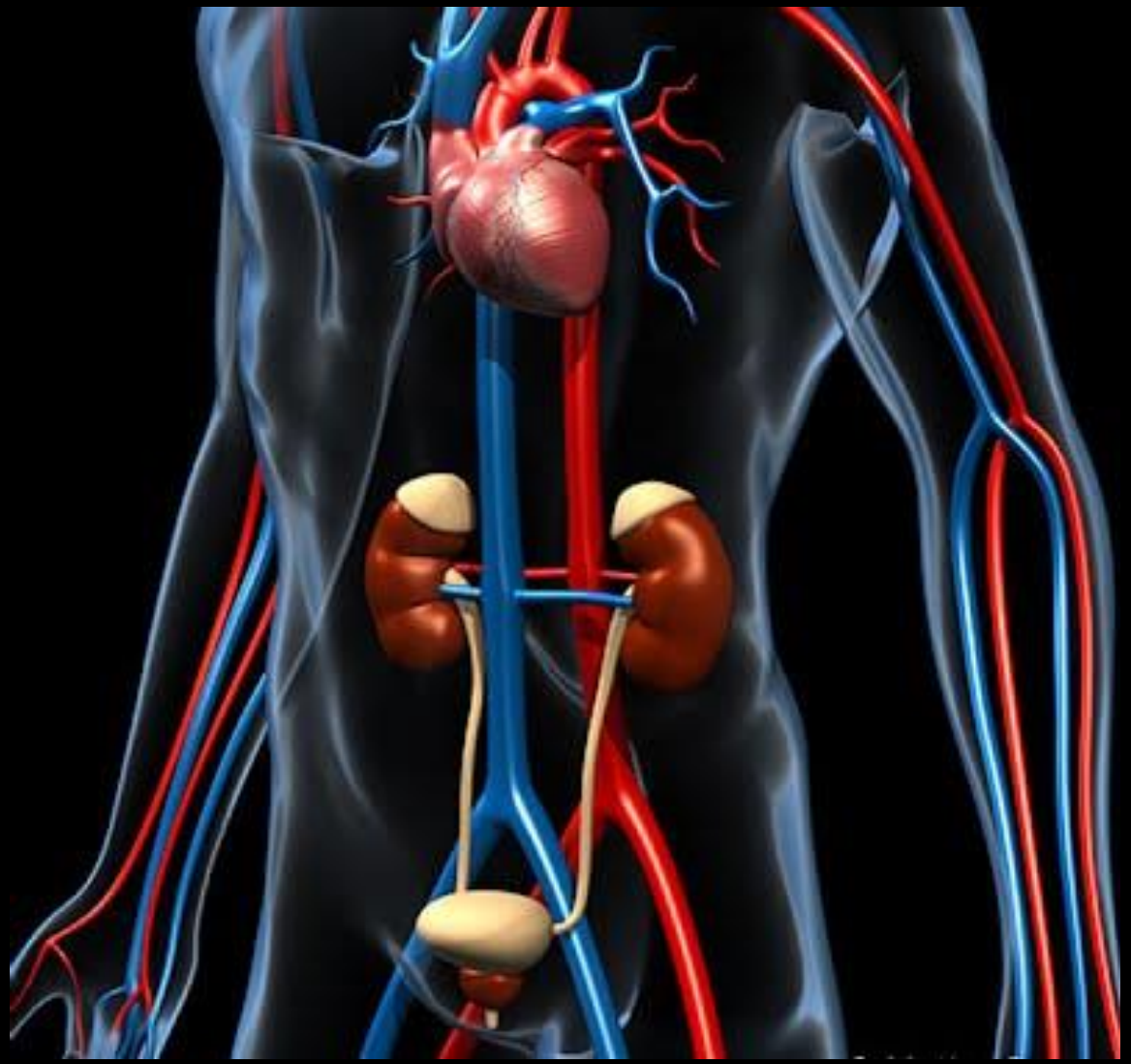




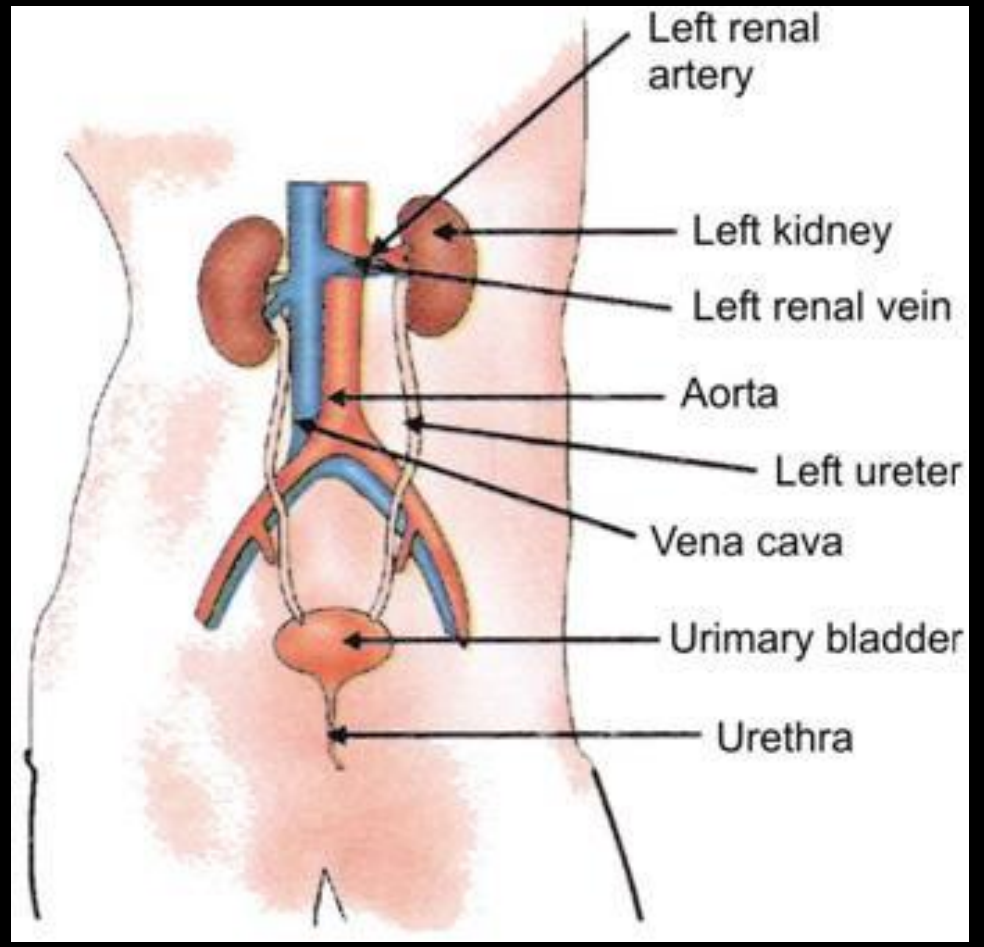


Excretory System

- Excretory system of human beings includes:
  - A pair of kidneys
  - A pair of ureters
  - A urinary bladder
  - A urethra
- Kidneys are located on either side of the backbone.
- Urine produced in kidneys passes through the ureters into the urinary bladder.
- Urine gets stored into urinary bladder until it is released through urethra

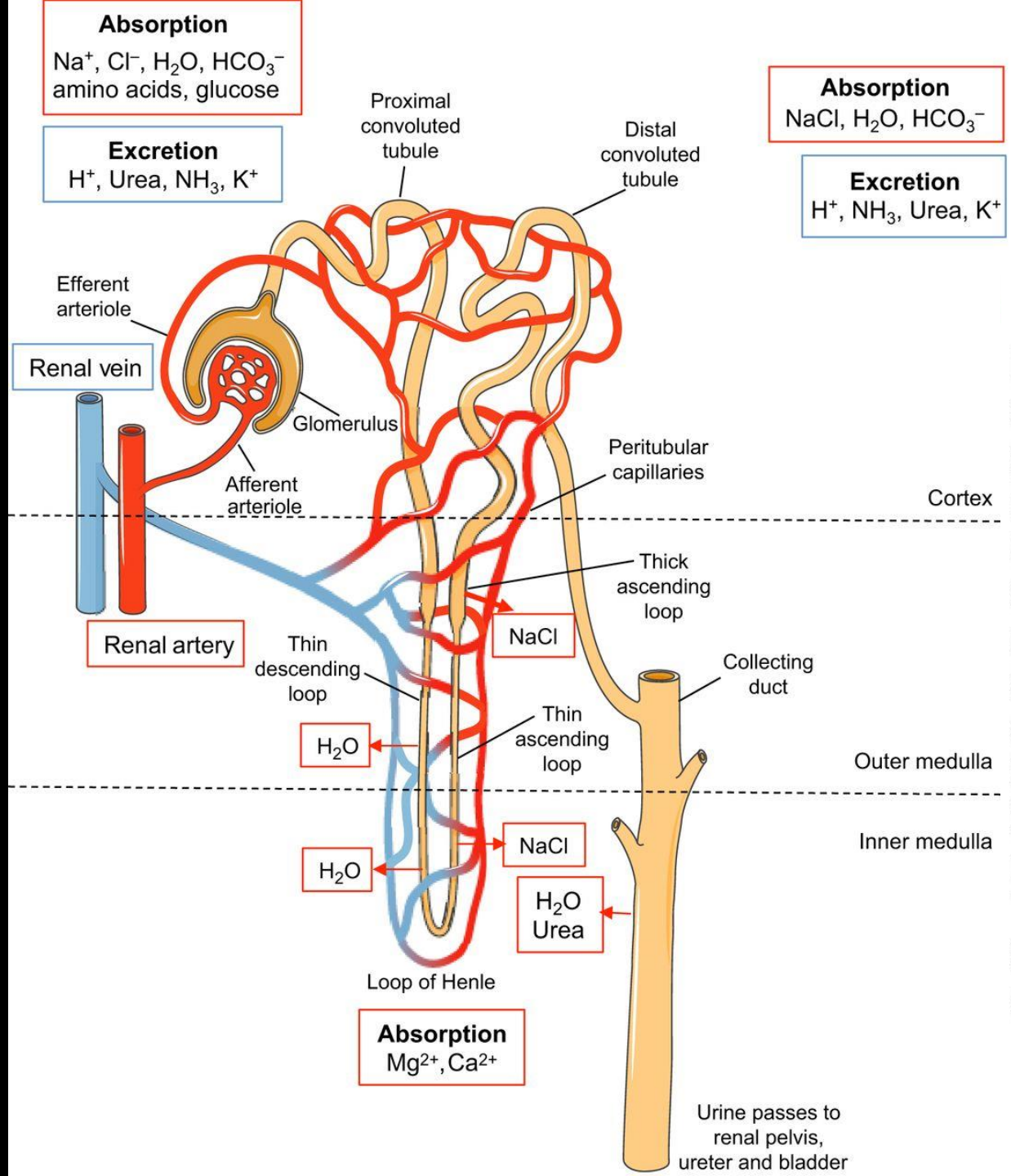


Labelled diagram



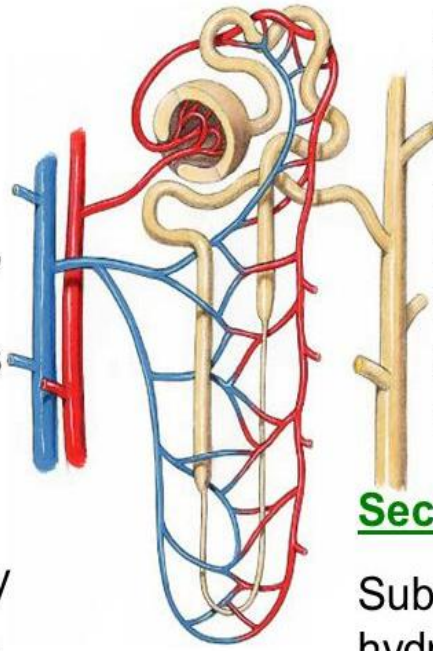
How urine is produced

- Urine is waste that is filtered out from blood.
- Nitrogenous waste such as urea and uric acid is removed from blood in kidney.
- Blood contains useful and harmful substances.
- Kidneys separates useful substances from toxic substances by producing urine.
- Each Kidney contains millions of filtration units called Nephrons.
- Nephron is structural and functional unit of kidney.
- Capillaries of the kidney filters blood and essential substances like glucose, amino acids, salts and required amount of water is reabsorbed into the blood.
- Excess water and nitrogenous wastes are converted into urine.
- Urine thus produced is passed to the urinary bladder through ureters.
- Urinary bladder is under the control of CNS. The brain signals the urinary bladder to contract and thus we pass out urine through the urethra (the urinary opening).



Filtration

Most filtration occurs in the glomerulus. Blood pressure forces water, salt, glucose, amino acids, and urea into Bowman's capsule. Proteins and blood cells are too large to cross the membrane; they remain in the blood. The fluid that enters the renal tubules is called the filtrate.



Reabsorption

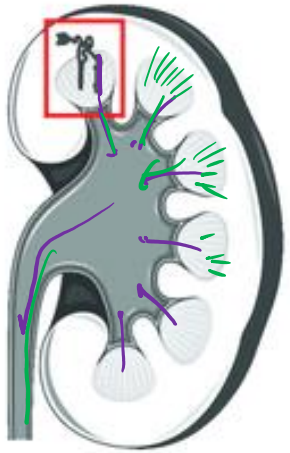
As the filtrate flows through the renal tubule, most of the water and nutrients are reabsorbed into the blood. The concentrated fluid that remains is called urine.

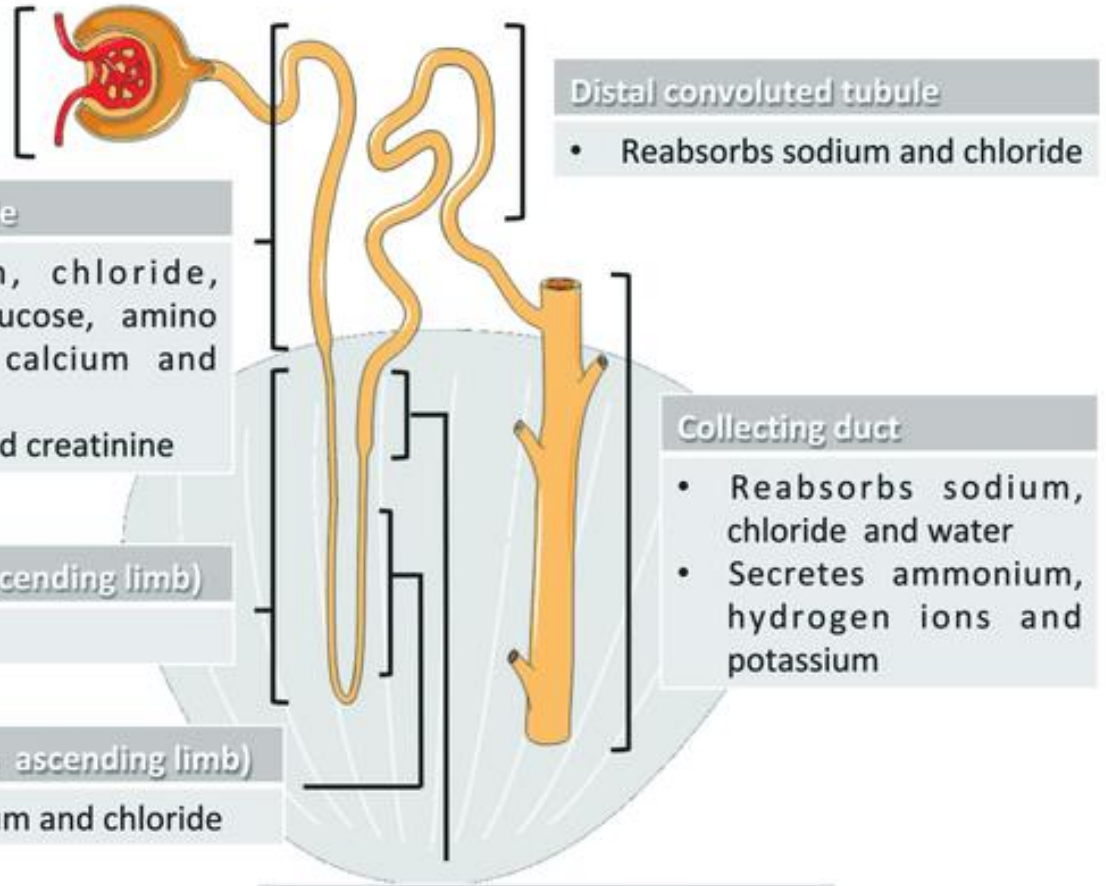
Secretion

Substances such as hydrogen ions are transferred from the blood to the filtrate.

Renal corpuscle

- Generates the glomerular filtrate composed by water, ions, and small molecules





Proximal convoluted tubule

- Reabsorbs sodium, chloride, potassium, water, glucose, amino acids, bicarbonate, calcium and phosphate
- Secretes ammonium and creatinine

Loop of Henle (thin descending limb)

- Reabsorbs water

Loop of Henle (thin ascending limb)

- Reabsorbs sodium and chloride

Distal convoluted tubule

- Reabsorbs sodium and chloride

Collecting duct

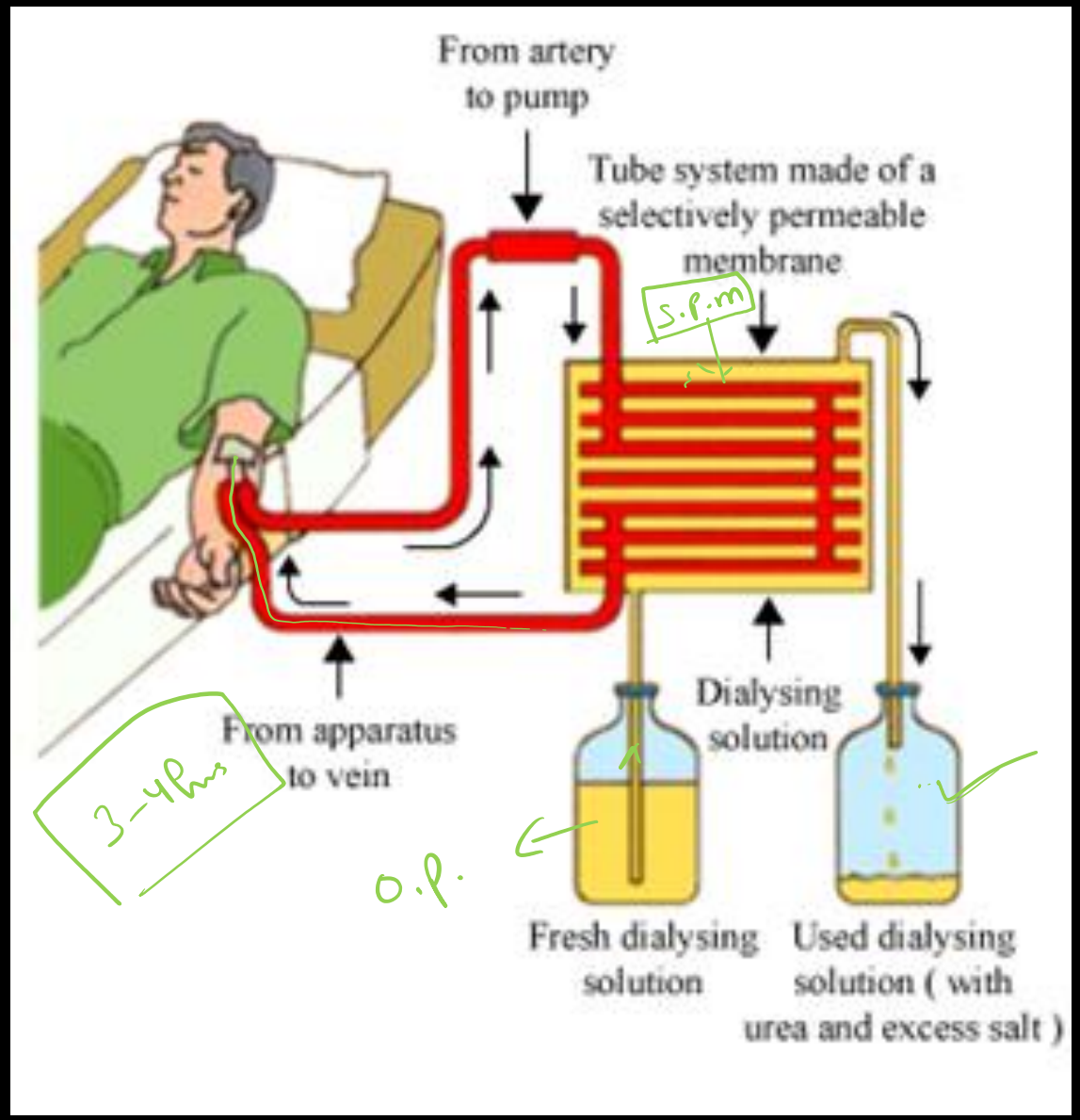
- Reabsorbs sodium, chloride and water
- Secretes ammonium, hydrogen ions and potassium

Loop of Henle (thick ascending limb)

- Reabsorbs ammonium, sodium, chloride

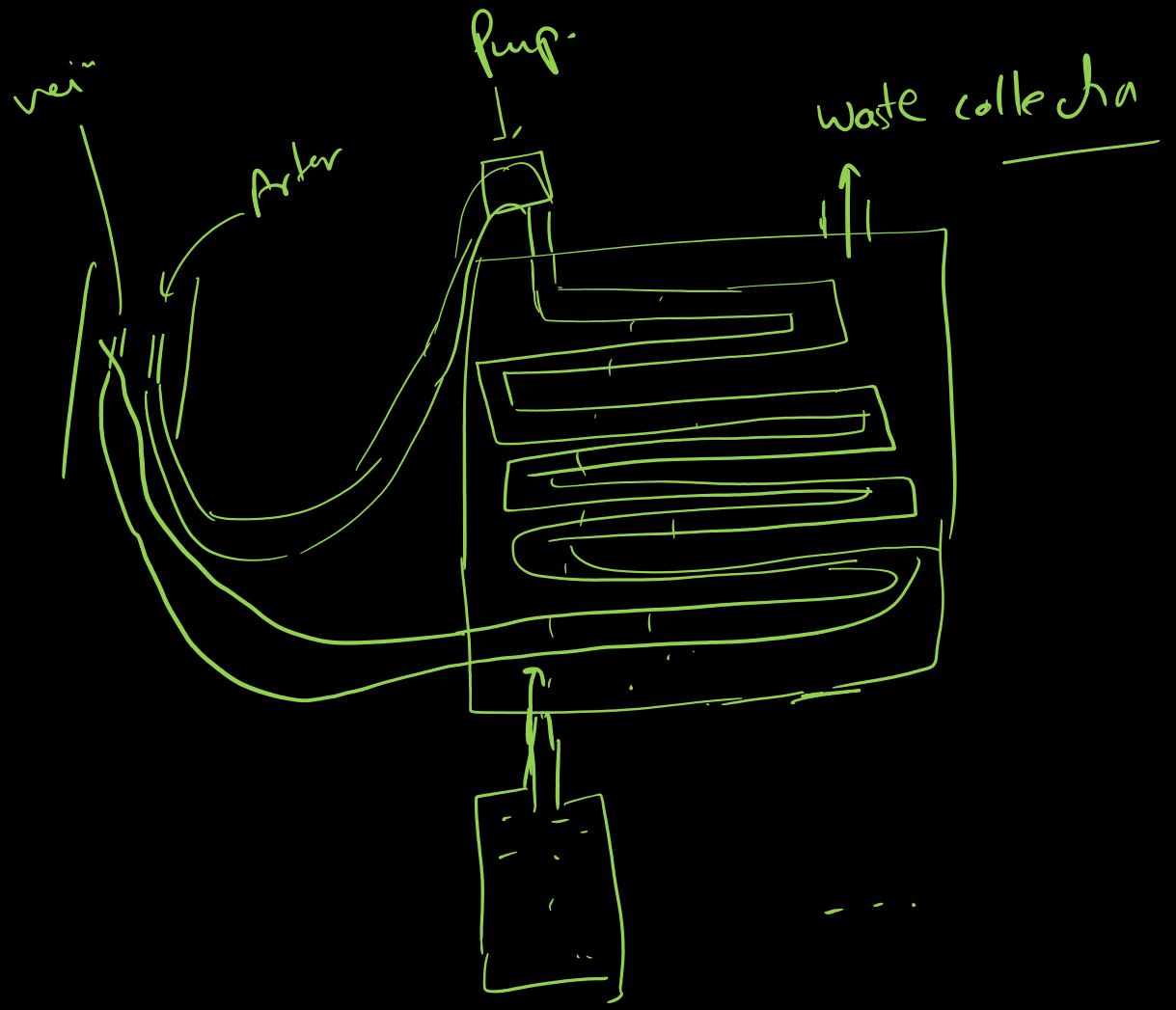
Hemodialysis

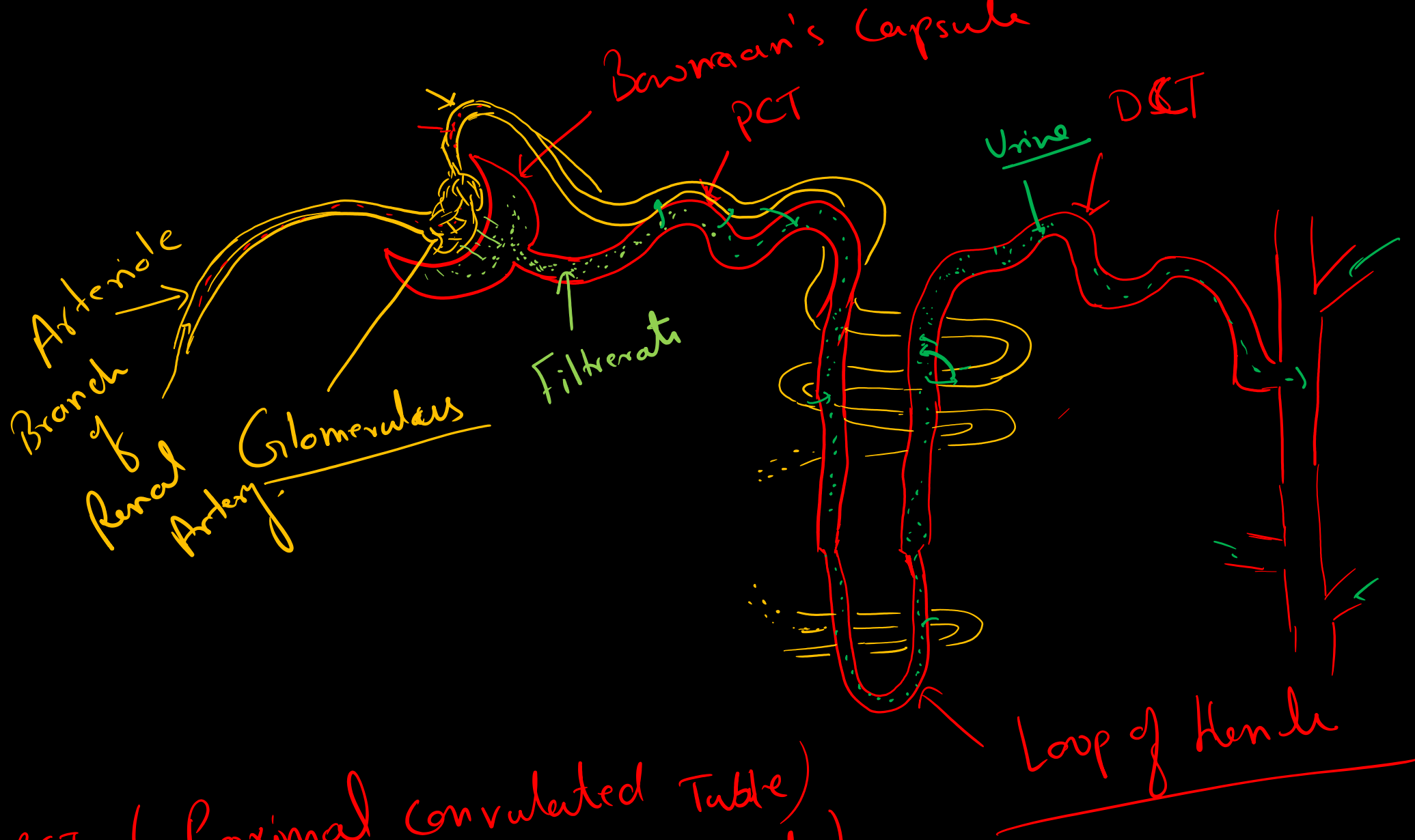
- Kidney filters poisonous nitrogenous waste from our body.
- Failure of kidney results in accumulation of these wastes in our body which may lead to death.
- In case of kidney failure, artificial kidney can be used to filter the blood.
- Artificial Kidney is a device to remove nitrogenous waste products from the blood through dialysis.
- It uses a semi-permeable membrane (aka selective permeable membrane) and a dialysing fluid (have same osmotic pressure as blood) to filter out urea and excess slats from the blood.


From artery
to pump
Tube system made of a
selectively permeable
membrane
S.P.M
From apparatus
to vein
3-4hrs
Dialysing
solution
O.P.
Fresh dialysing
solution
Used dialysing
solution (with
urea and excess salt)

Excretion in Plants

- Plants do not have any specialized organ for excretion of waste.
- O_2 (photosynthetic waste) and CO_2 (respiratory waste) may be excreted out through diffusion from stomata.
- Excess water is removed by transpiration and guttation.
- Plants can afford to loose some parts (made up of dead cells) of their body like leaves when they die.
- Plants can store waste products into the leaves and barks that fall off latter, into their large cellular vacuoles.
- Waste products are also stored as resins and gums in old xylems as well as alkaloids like quinine
- Plants also secretes some waste into soil around them.
- Plants also store waste into fruits, like citric acid in lemon, maleic acid in apple, tartaric acid in tamarind, etc are all plant waste.
- Many plant wastes are useful for us like gums, resins (used in oils), rubber latex, etc.





PCT (Proximal convulated Tubule)
DCT (Distal Tubule)