Physiology
MID|Lecture 1

Introduction1

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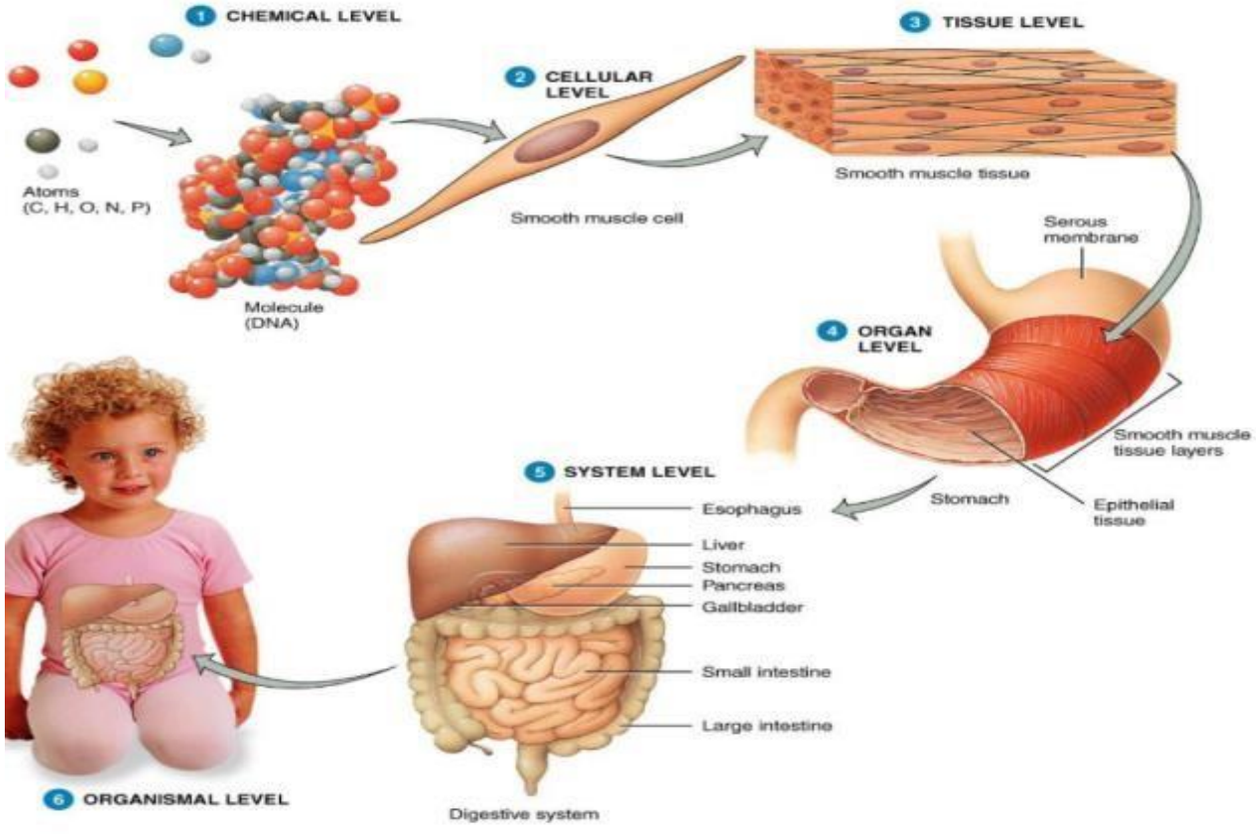
Introduction

■ Physiology Definition:

is a branch of science that can deal with function of our body parts, and how. these functions are regulated, and what are the chemical and physical forces that control and regulate these functions .

- structure of the body

Cell -> Tissue -> organ -> system -> organism



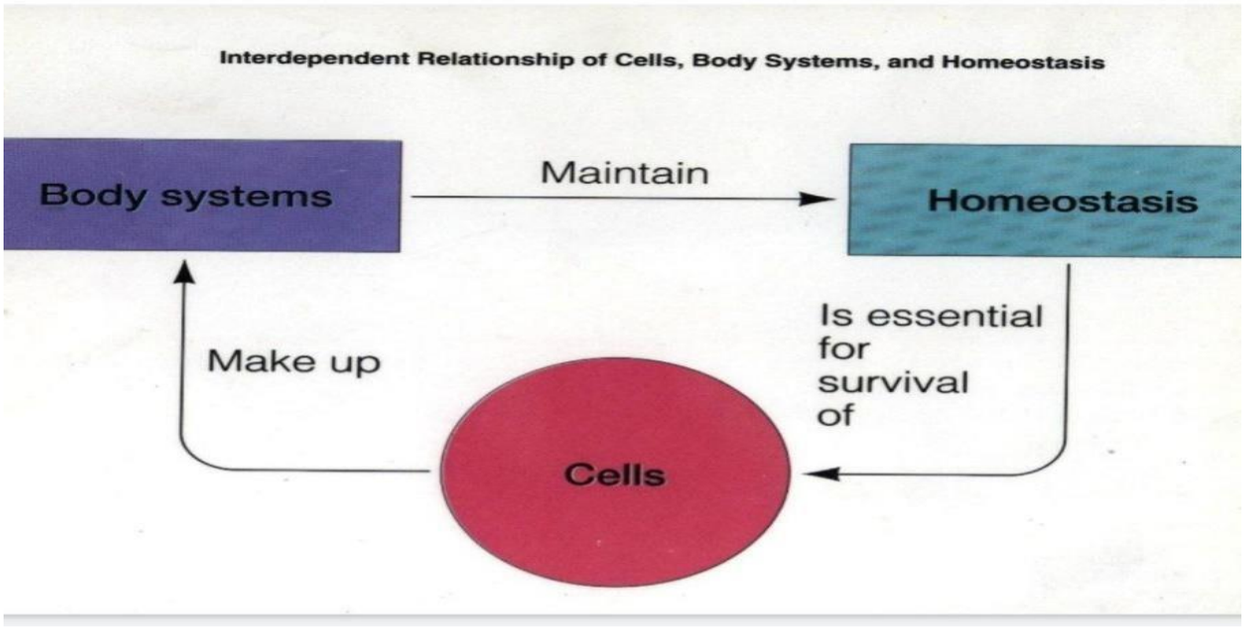
■ What is the homeostasis ?

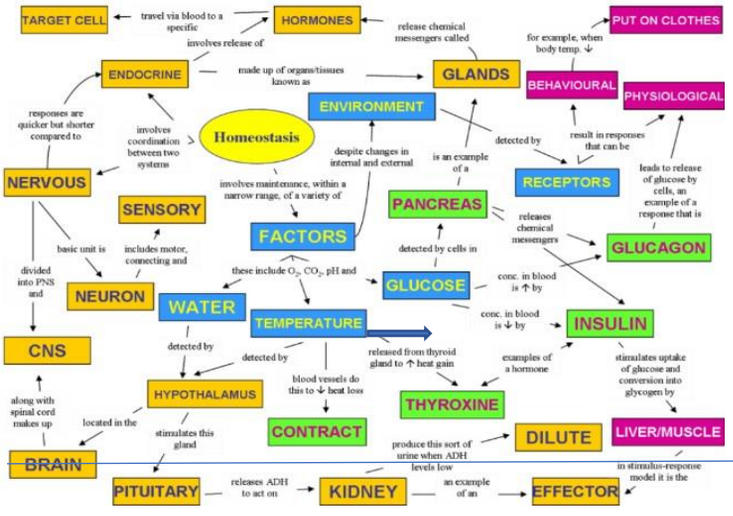
Kind of balance state in our body function if there any change or shift , it will be adjusted or controlled by our body (constancy of substance) .

Cells are found in media called extracellular matrix (ECM). ECM has specified substance such as : sodium ,potassium and glucose must be kept in constant concentrations.

- Homeostasis is not the same as Hemostasis
- Hemostasis is process of blood clotting to stop Blood Bleeding/hemorrhage.
- Homeostasis is dynamic not static and found in any process in our body .

Cells make the body systems → Body systems maintain homeostasis → Homeostasis is essential for survival of cells





الصورة ليست للحفظ
-روابط مهمة

https://youtu.be/7ODgYpdTKaY

https://www.youtube.com/watch?v=LSgEJSlk6W4

Steps of Homeostasis:

-homeostasis is disrupted by any mechanism

1-Receptors sense the disruption and send massages(nerve impulses or chemical signals) to control center , this called input.

Example: Baroreceptors in blood vessels that sense the blood pressure

2-Control center :part of the body that control our organs (e.g. Nervous system)

-input integrated inside control system then sends an output to effectors organs(by nerve impulses or chemical signals).

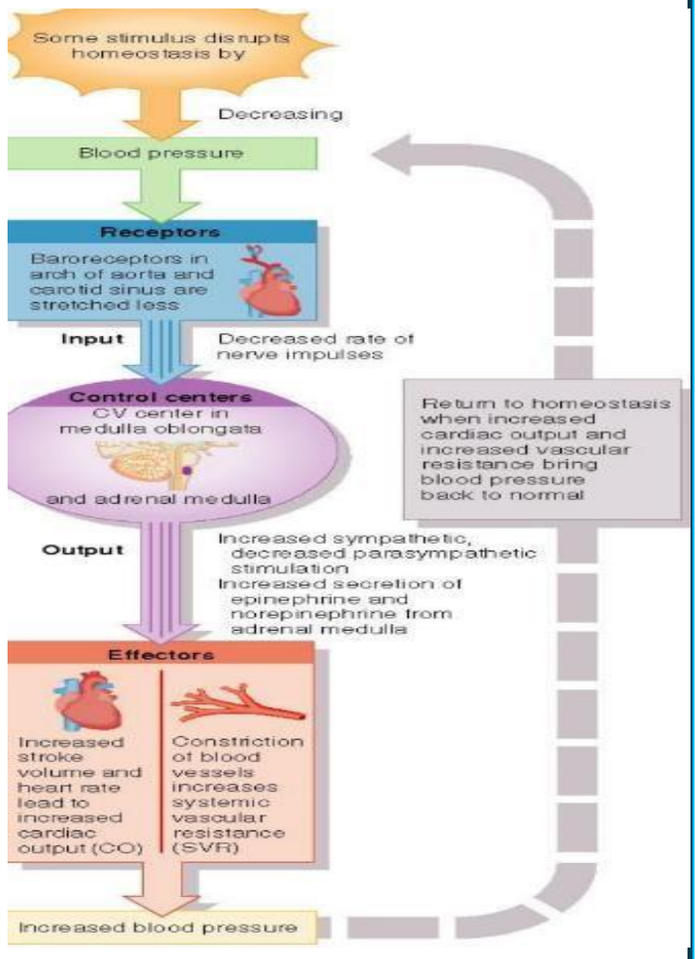
3-Effectors organs receives the output and change the body depending on it.

- Homeostasis is achieved

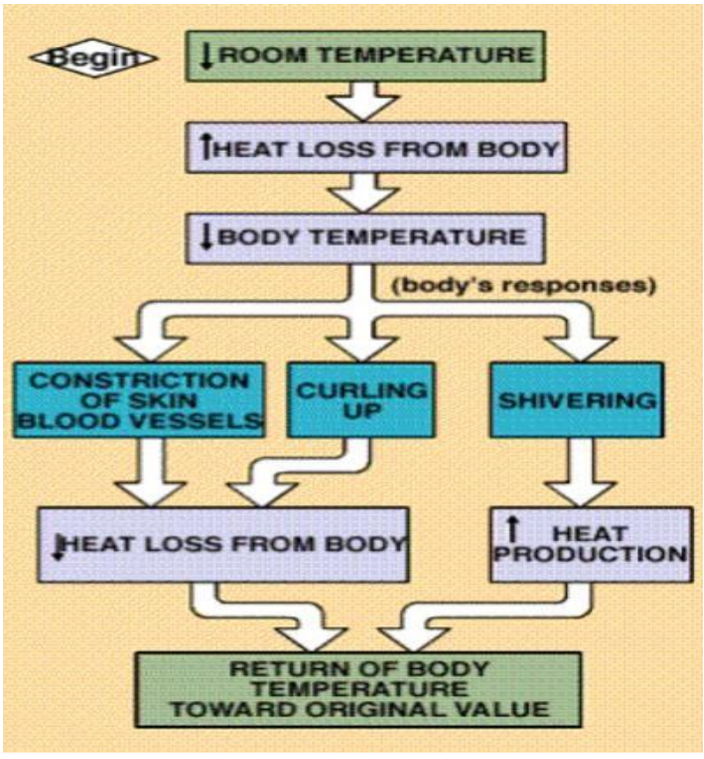
Examples of the homeostasis :

1- Blood pressure
2- Environment temperature
3- Calcium ions

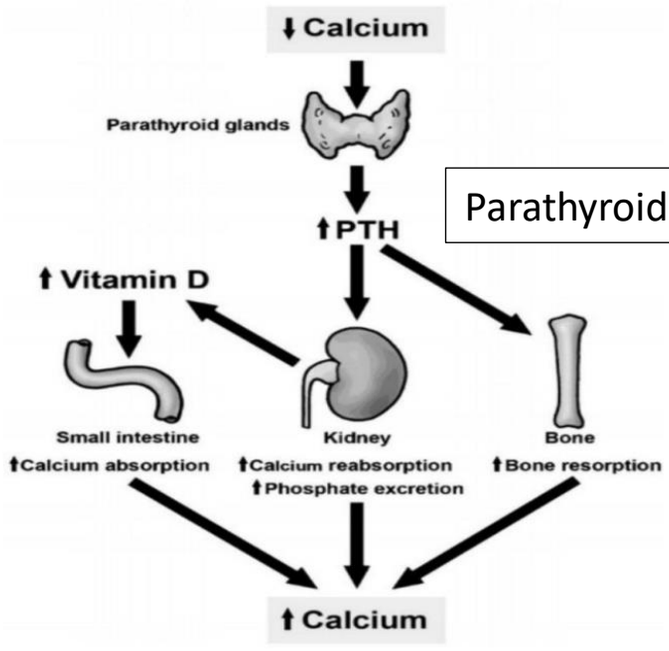
1-Blood pressure:



2-Environment temperature:



3-Calcium level :



Parathyroid hormone

Please go to the first handout of doctor Mohammad then go to the second link in the first page .This link explains the examples of the homeostasis .

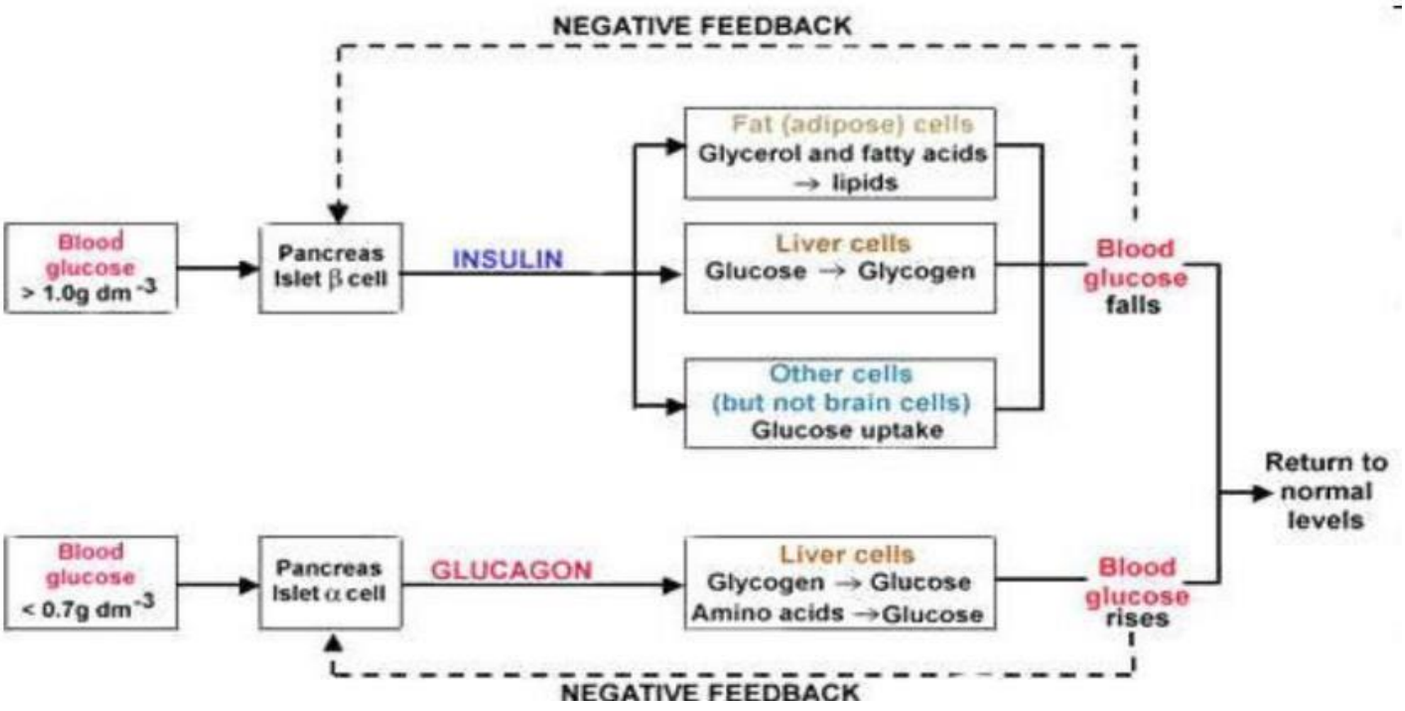
NEGATIVE FEEDACK

When the direction of the stimulus is opposite to the direction of the effect or Reverses a change in a controlled condition
(final event that is a result of the first event and reverse to it).

Example given: hypertension and hypotension (regulation of blood pressure).

Example After Insulin is secreted because of raised blood glucose level, blood glucose falls, this send a message to the pancreas to stop secreting insulin

Another example: After Glucagon is secreted because of decreased blood glucose level, blood glucose rises, this send a message to the pancreas to stop secreting glucagon .

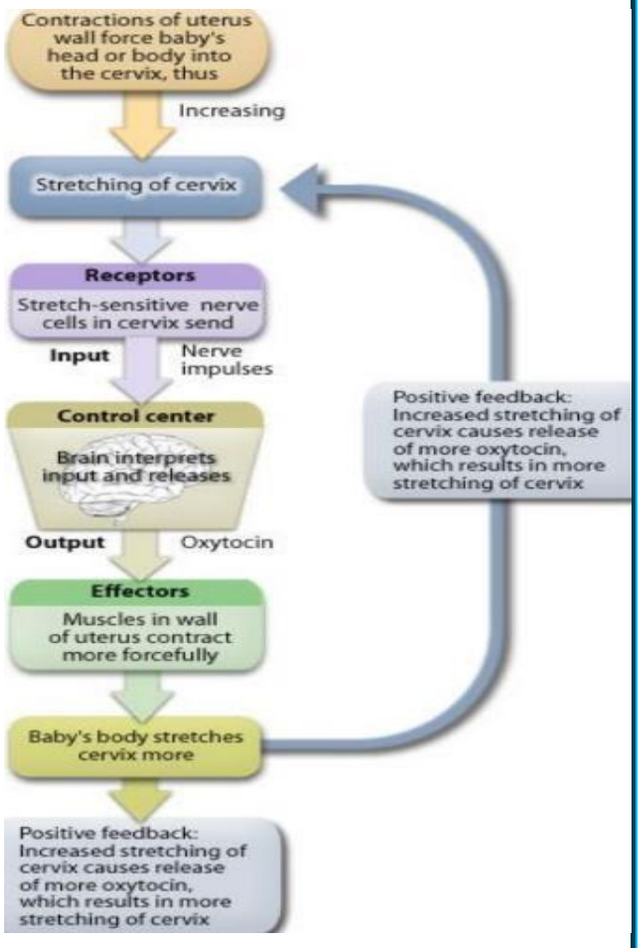


POSITIVE FEEDBACK

When the response is in the same direction with the stimulus in a good or bad way (Final event that is a result of the first event and same to it).

Example: Normal childbirth

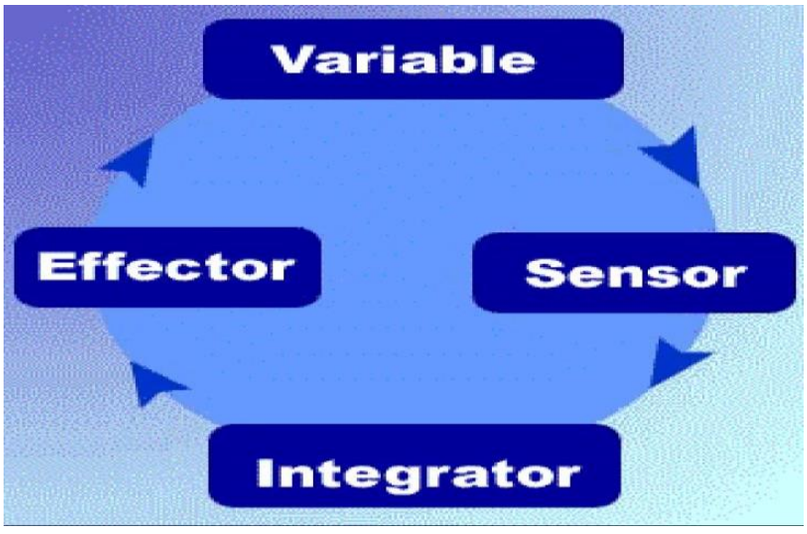
The cervix start stretching when the baby is about to be delivered, stretching is sensed by certain receptors and signal is sent to the control center, which will integrate the input and send an output to the cervix to contract more, contraction is sensed again and the circuit repeats until the baby is born.



The more oxytocin the more stretch.
The more stretch the more stimulation of oxytocin.

Most of feedbacks are negative not positive !

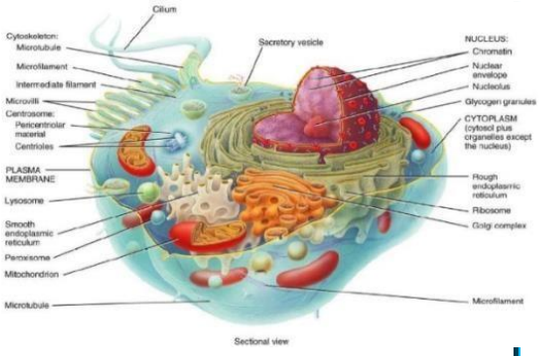
Positive feedback can be harmful !



The Summarizing of Homeostasis

Cells and organelles

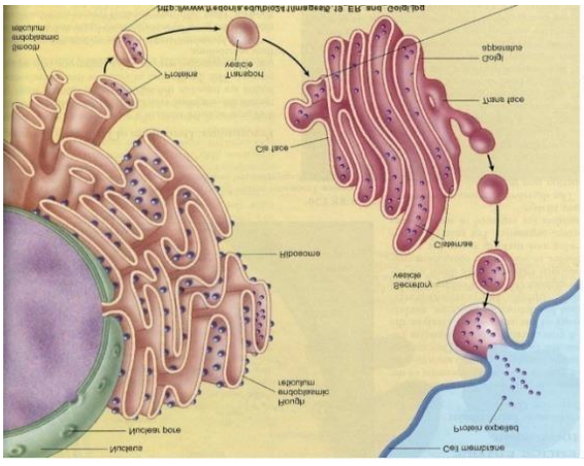
Cell is the smallest functional unit of our body .
We have two types of cells : prokaryotic and eukaryotic cells



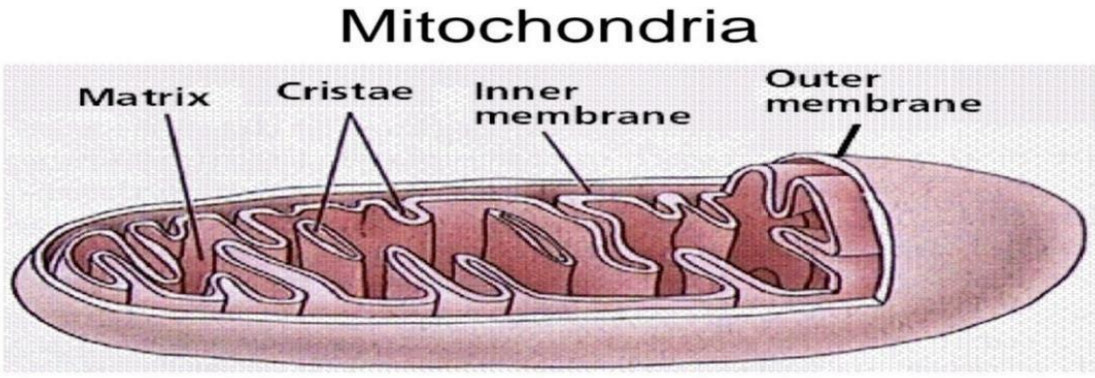
Eukaryotic cell has nucleus and its organelles have membrane that separates them from the cytoplasm and they contain different molecular concentration than cytoplasm, that is important to remain the cell in live.
Its DNA locates in nucleus

Prokaryotic cell doesn't have nucleus and the DNA locates in cytoplasm.

The organelles that have membrane is :
Endoplasmic reticulum: rough and smooth
The function of the rough endoplasmic reticulum is synthesis of protein
Golgi
Lysosomes and peroxisome

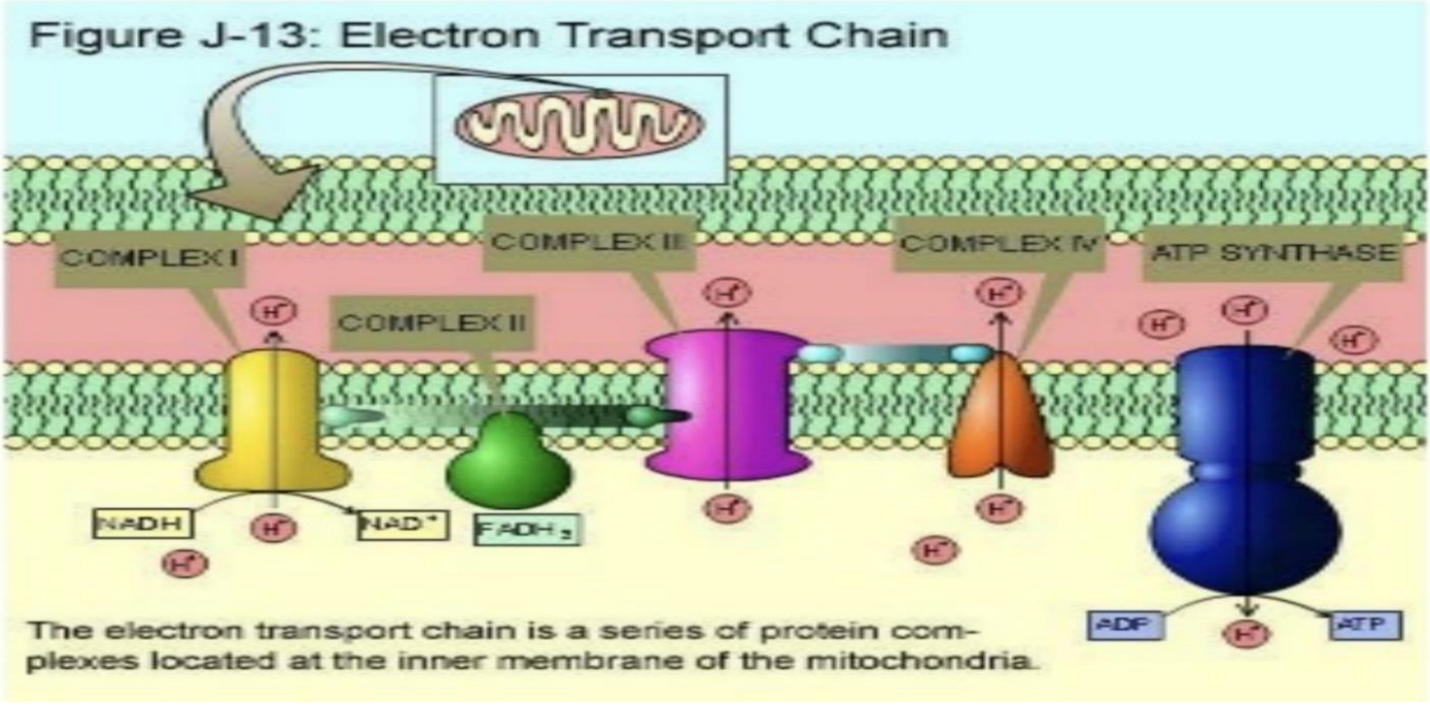


Mitochondria : its function is to produce micro energetic molecule by cellular – respiration that is needed to the activity of cell.
https://www.youtube.com/watch?v=c4JsEBI9u6I



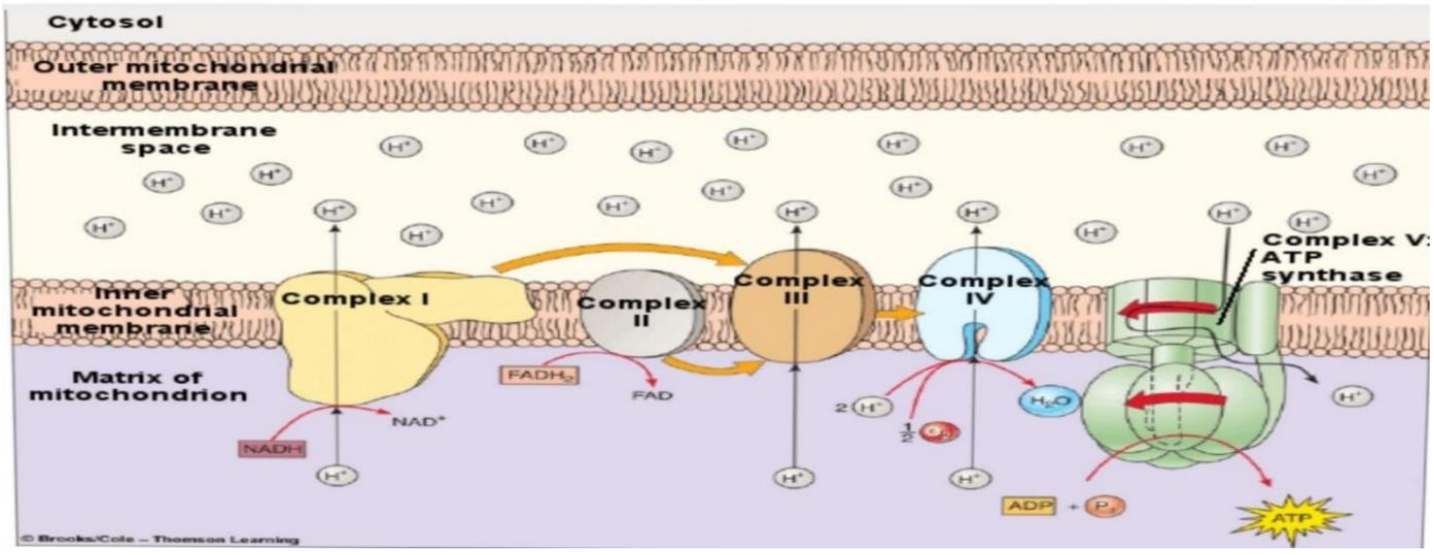
Between the inner and outer membrane of the mitochondria there is inter membranous space .

Electron transport chain is in the inner membrane of the mitochondria, its function is transport protons from the high energy state to low energy state .



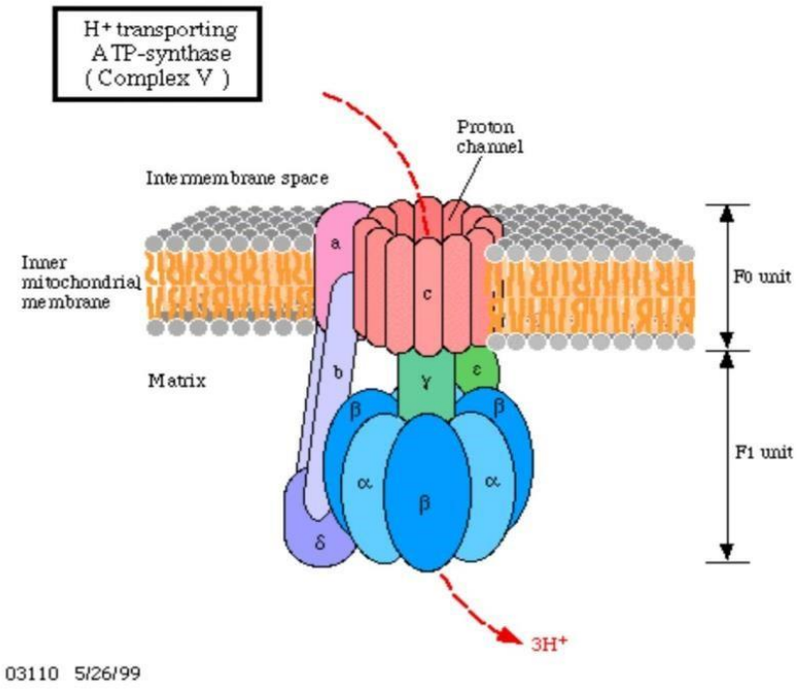
NADH and FADH2 are oxidized ,the produced electrons go to the electron transport chain and move from complex to another until reach to oxygen. During this transportation, electrons give energy to complexes that use it to translate H+ from matrix to inter membranous space, because of that the concentration of H+ in the inter membranous space will be higher.

After that protons are translated into matrix by ATP synthesis enzyme(fifth complex)



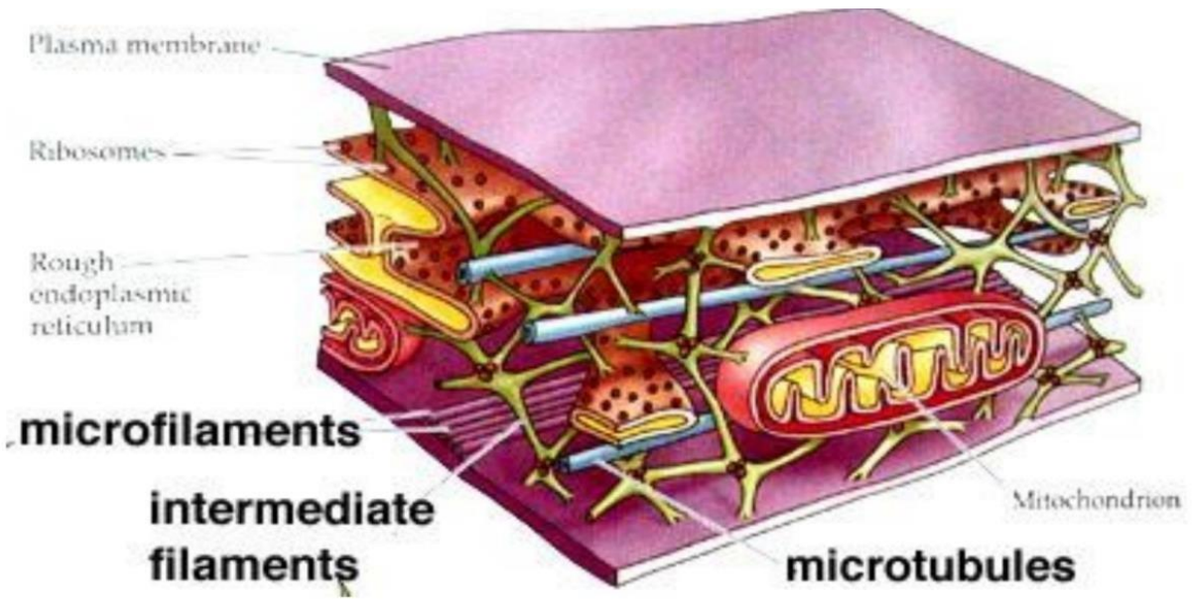
This process called oxidative phosphorylation

Supportive video: https://www.youtube.com/watch?v=fHoL-vcMENw



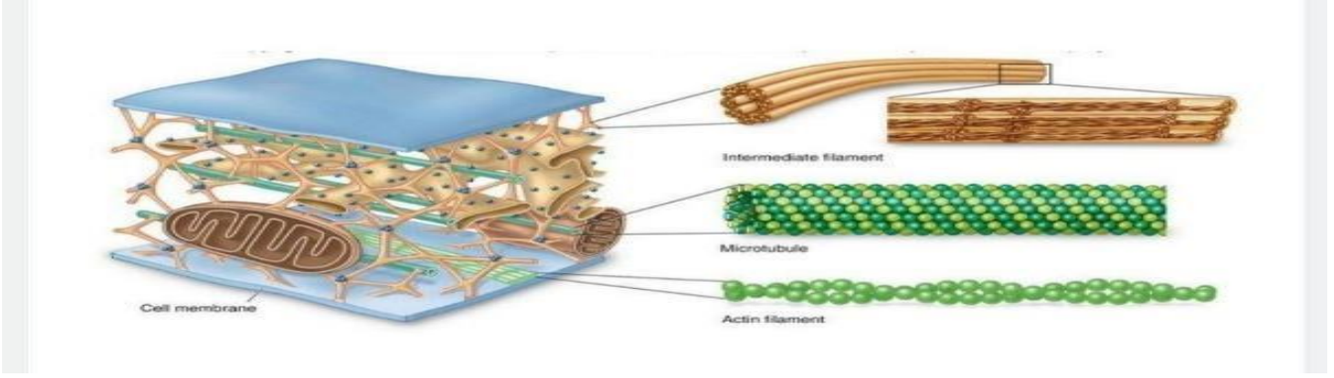
CYTOSKELETONS

skeleton of the cell.



We have three types of the cytoskeletons:

- Microfilaments (smallest in size)
- Intermediate filaments (Intermediate in size)
- Microtubules (largest in size)



Functions of cytoskeleton:

Microtubules:

Formation of cilia

Transporting vesicles

Formation of mitotic spindle

Actin filaments:

Formation of pseudopods

Contraction of muscles

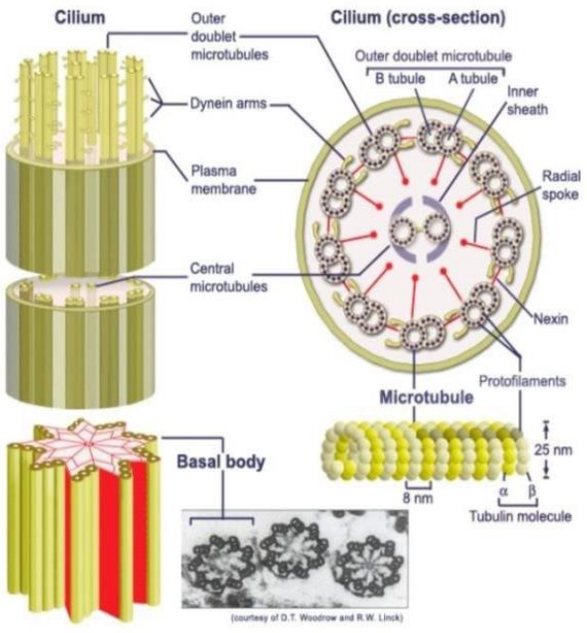
Determination of the shape of cell (Anchoring)

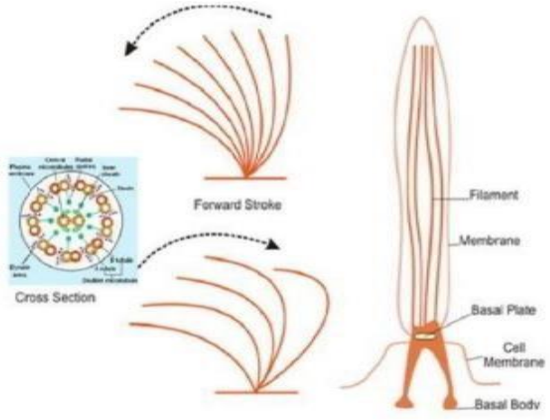
Formation of cilia: -

The respiratory system has cilia that is waving to get the movement of mucus that is secreted to be exited out of the respiratory system.

The structure of the cilia is nine pairs (9 doublets) of microtubules in the form of ring on its tip and one pair in the middle and these are connected with each other by motor proteins.

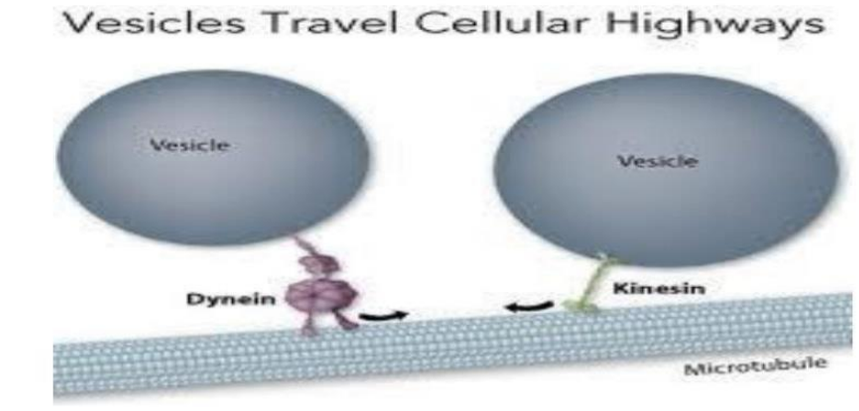
The movement of motor proteins that are connecting microtubules together sliding up and down resulting in waving of the cilia in one direction or another.

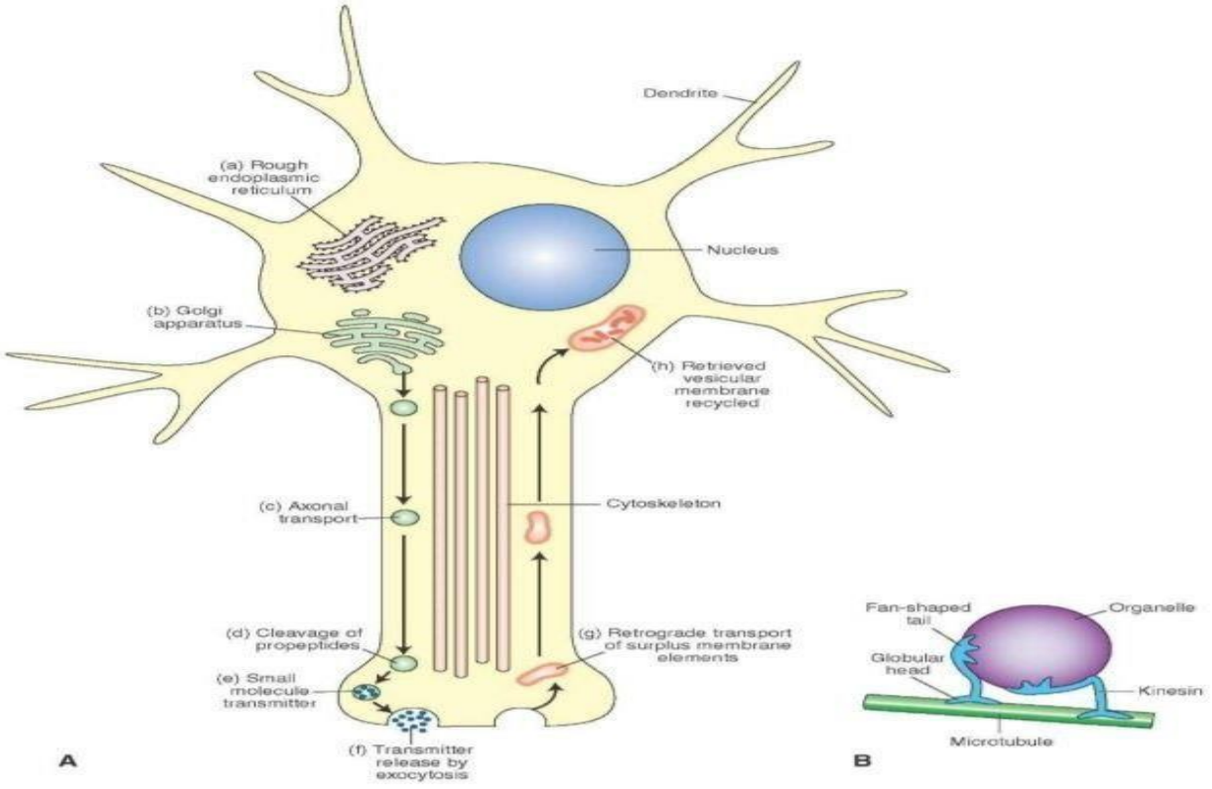




Transporting vesicles: -

Microtubules are very important for vesicles transport. We have a system from microtubules and proteins that does this function. In this system microtubules act as street that certain types of proteins which act as vehicles carry vesicles walk on this street. Each type of protein is specialized to send vesicle to particular destinations. We have plenty of vesicles transport inside the cells which is achieved with the help of the microtubules, vesicles are linked to these microtubules by motor proteins are walking along these microtubules to transport vesicles.





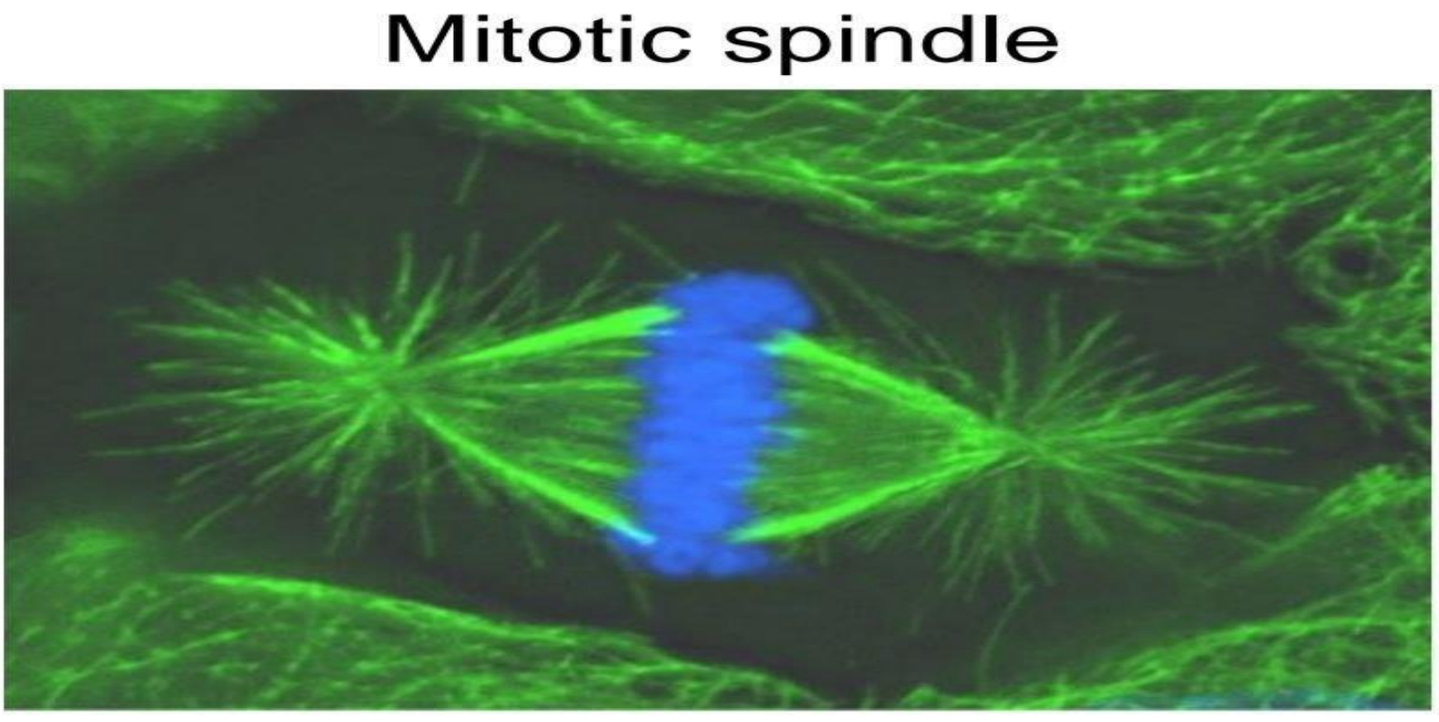
The above structures are not for memorization, just to clarify the example below.

Example of that is neural cell, <u>neurotransmitters are synthesized in the cell body, but their function is at the terminals,</u> and we have very long distance between

the cell body and terminals (0.5-1) meters<u>. How do our bodies transport these neurotransmitters?</u> The answer is by vesicle transport after packing them in vesicles we have along axles of microtubules and these vesicles use these microtubules to get transport of the neurotransmitters from the cell body toward the terminals of the neural cell.

Formation of the mitotic spindle: -

Microtubules function during division of the cell by formation of the mitotic spindles. They can polymerize and connect to chromatids and by their connections they can get separation of these chromatids with the help of mitotic spindles.

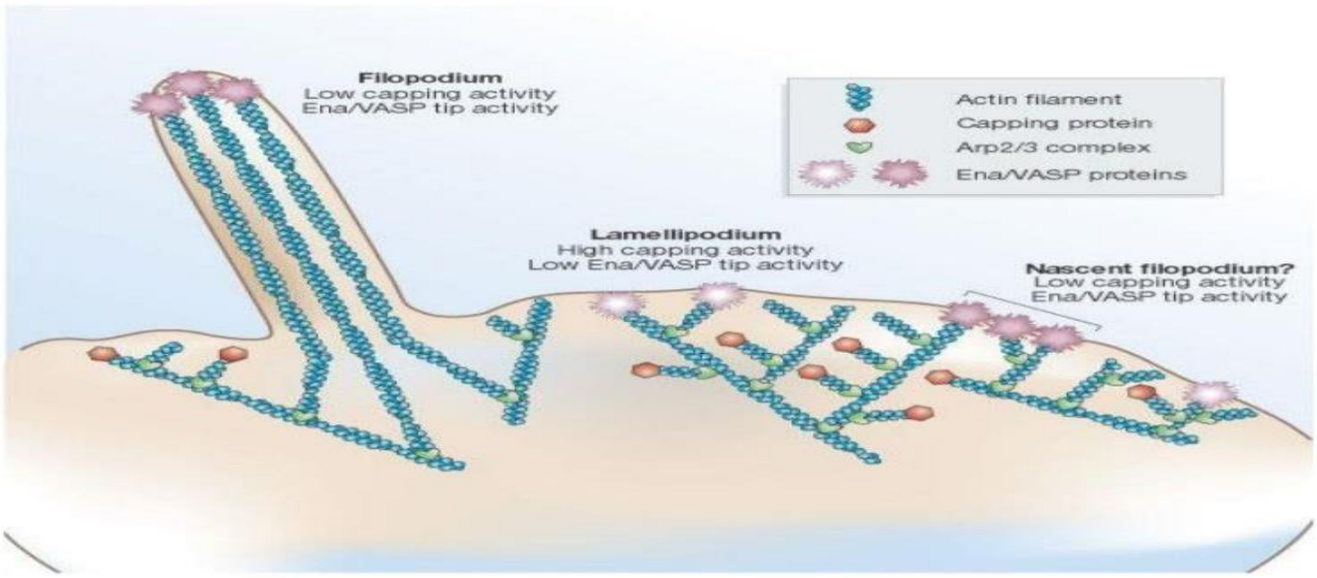


Actin filaments

Formation of the pseudopods: -

Some cells are *moving by process of forming pseudopods* that attached to some points and this process is done by polymerization of actin filaments to get longer actin filaments in that direction after binding of that pseudopods that is trapping the rest of the cell to that location, so it's important for movement of
this cell.

Pseudopods are hidden by depolymerizing.



Contraction of muscles: -

Cardiac muscles are smooth muscles cells and skeletal muscles cells.

We have thin and thick filaments, actually these filaments are different from each other.

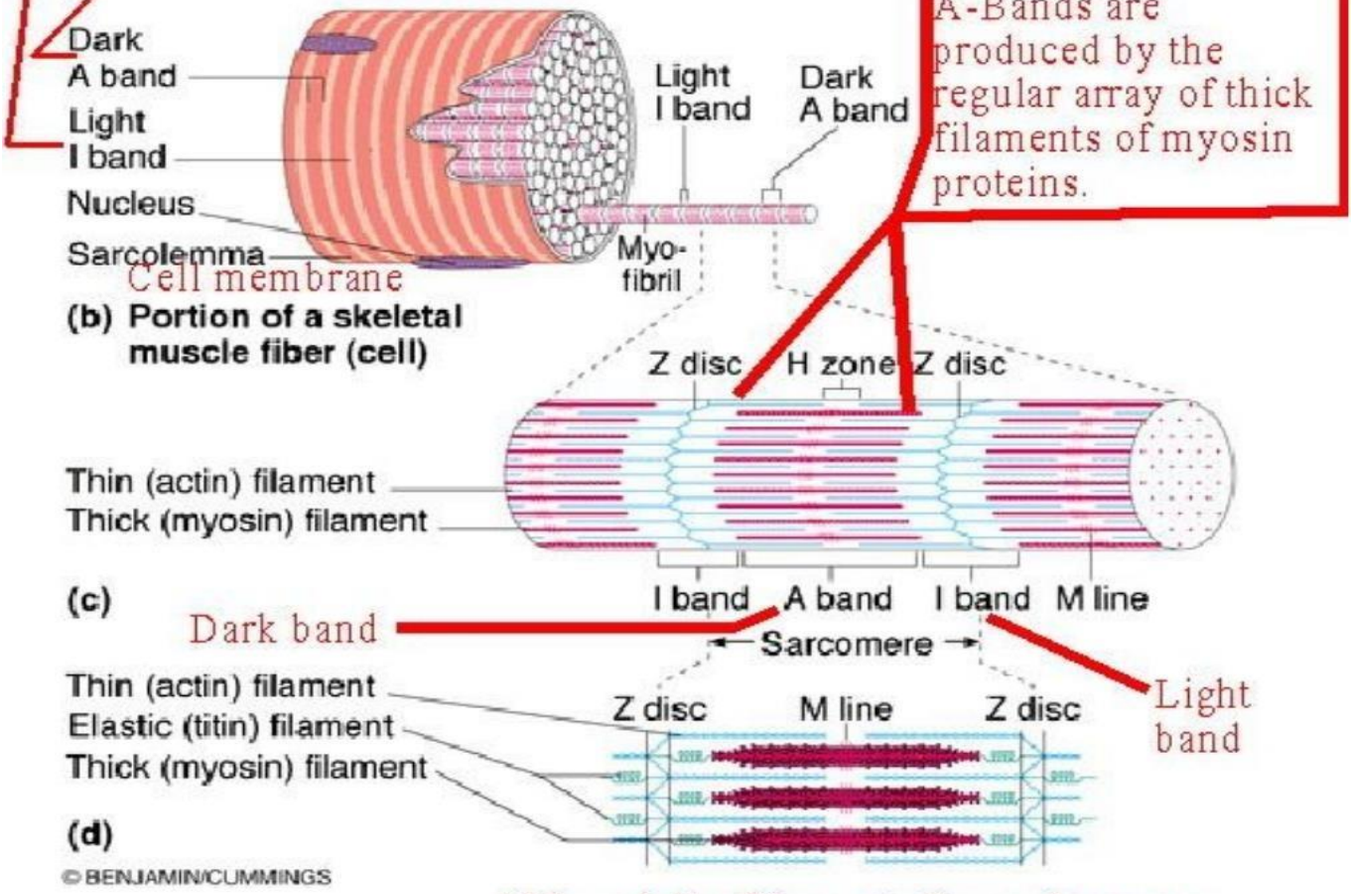
The contraction of muscles is done by sliding thick filaments and thin filaments that causes shorting of them.

Structural Elements of a Muscle Cell

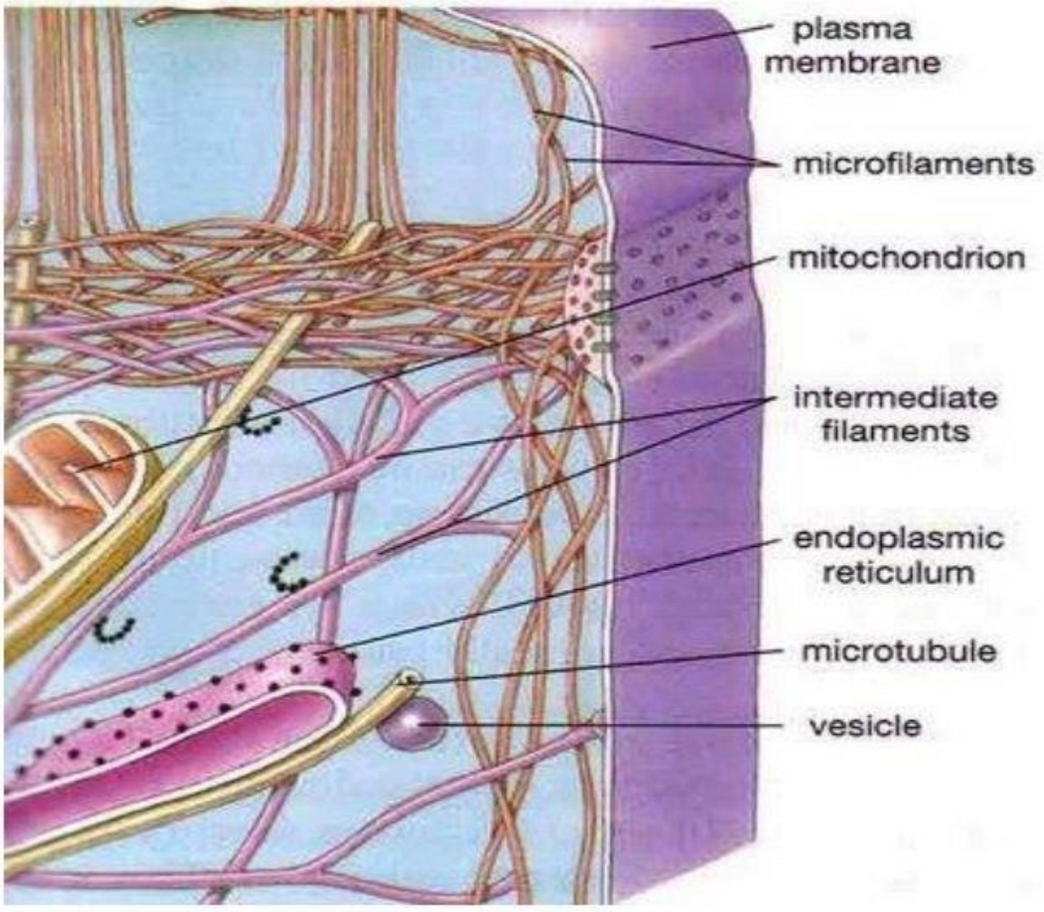
I Band - I stands for isotropic meaning the light passes through this area evenly. These are the light bands between the dark striations.

Striations = A Bands, for anisotropic (not isotropic) meaning the light does not pass evenly, it is refracted. These are the dark striations.

A-Bands are produced by the regular array of thick filaments of myosin proteins.



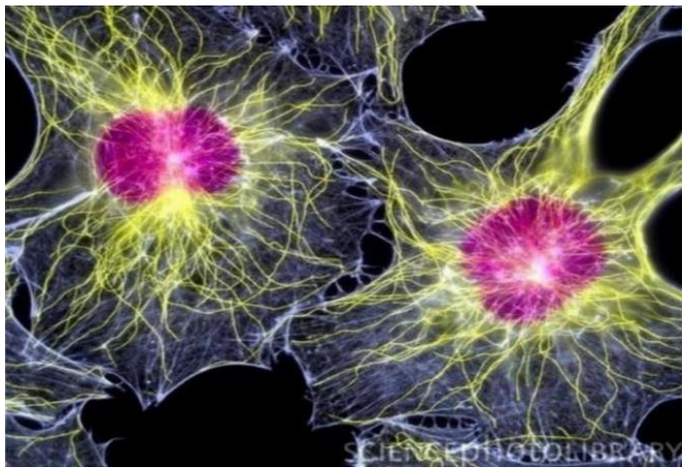
Although the filaments themselves run longitudinally along the myofibril, the A and I bands run perpendicularly to the myofibril, produced by the stacking of the filaments.

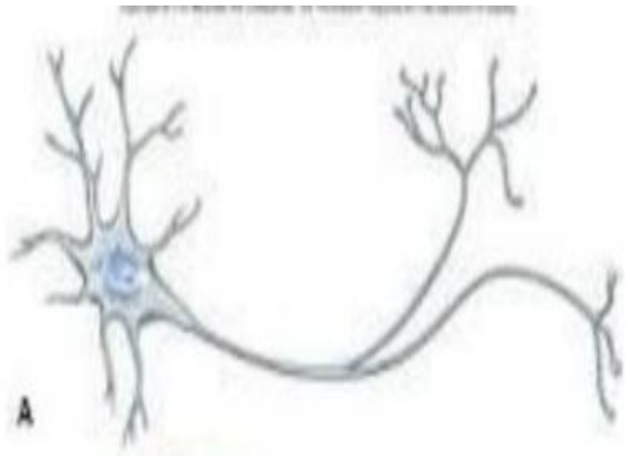


Cytoskeletons are keeping the geometry and shape of cell. (Anchoring of cells)

The importance of the cell shape for its function

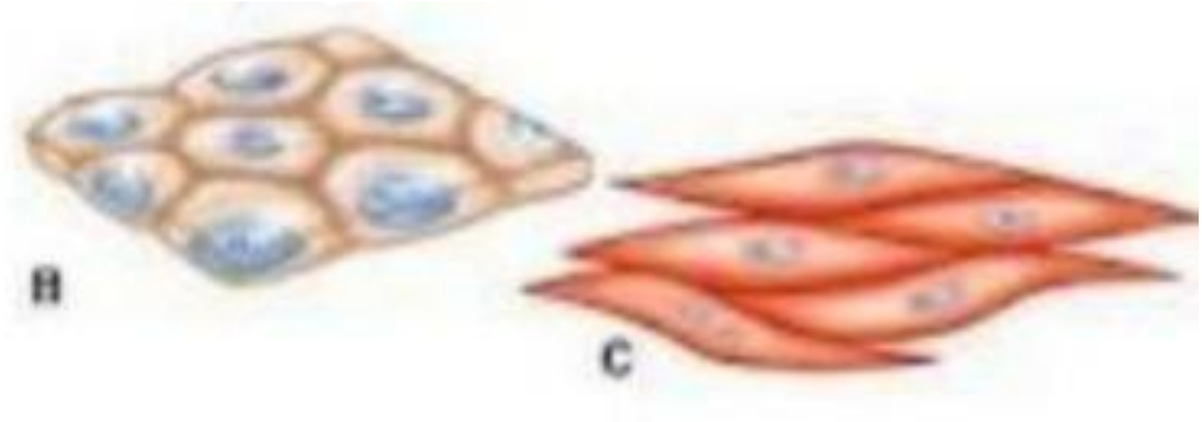
We have different shapes of cells, and these shapes are important for the functions. (**structure determines function)**



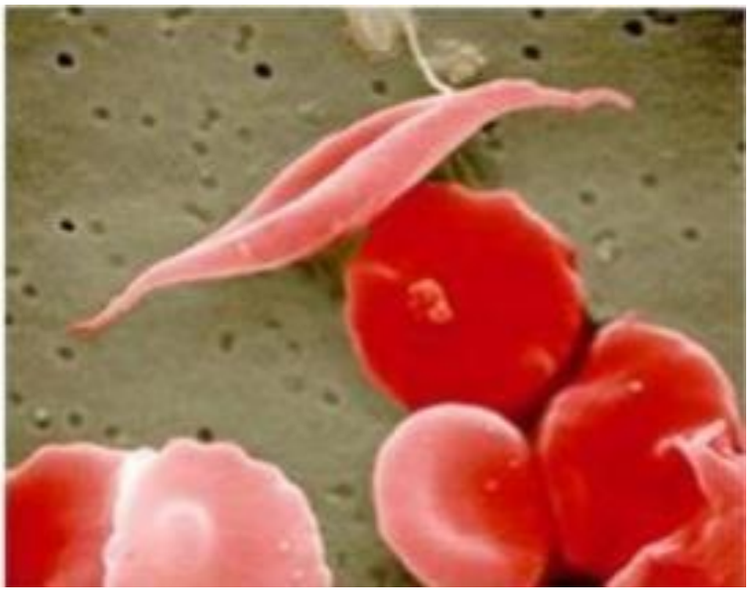


Neurons have a rounded shape that is important for their function. Its shape **increases the surface area** to get some nutrients absorbed well

, in addition, we have a lot of factors called trophic factors that can be released by other cells around the neurons *which are helping the survival of these neurons much better.*



Muscles cells are elongated cells not rounded. If it is rounded, contracting won't be efficient but it is elongated structure. By contraction we are getting good
shortening of that cell to get the job.



Blood cells can transport oxygen well for the highest number of paths in a very short time. They are disk shape (biconcave) to get much better loading for these cells during this short time while they passage in capillaries of the lungs to be
oxygenated and in other body cells to give them the oxygen.

If they are spherical, they can't do their function, and this case is considered disease because this cell will not transport oxygen well.

As we took last semester in biology101 class, sickle cell anemia disease.

NOTE: - GO TO THE FIRST HANDOUT OF DR MOHAMMAD KHATATBAH.
IT'S IMPORTANT. ITS LINK:

https://drive.google.com/file/d/13O9BAIN1I4VOI4f7s58mXBhttps://drive.google.com/file/d/13O9BAIN1I4VOI4f7s58mXB-xo1I1kUxP/view?usp=drivesdkxo1I1kUxP/view?usp=drivesdk

Good luck for all