



Physiology | Lecture 1

Introduction Homeostasis and organelles

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Amal Al-khatib**

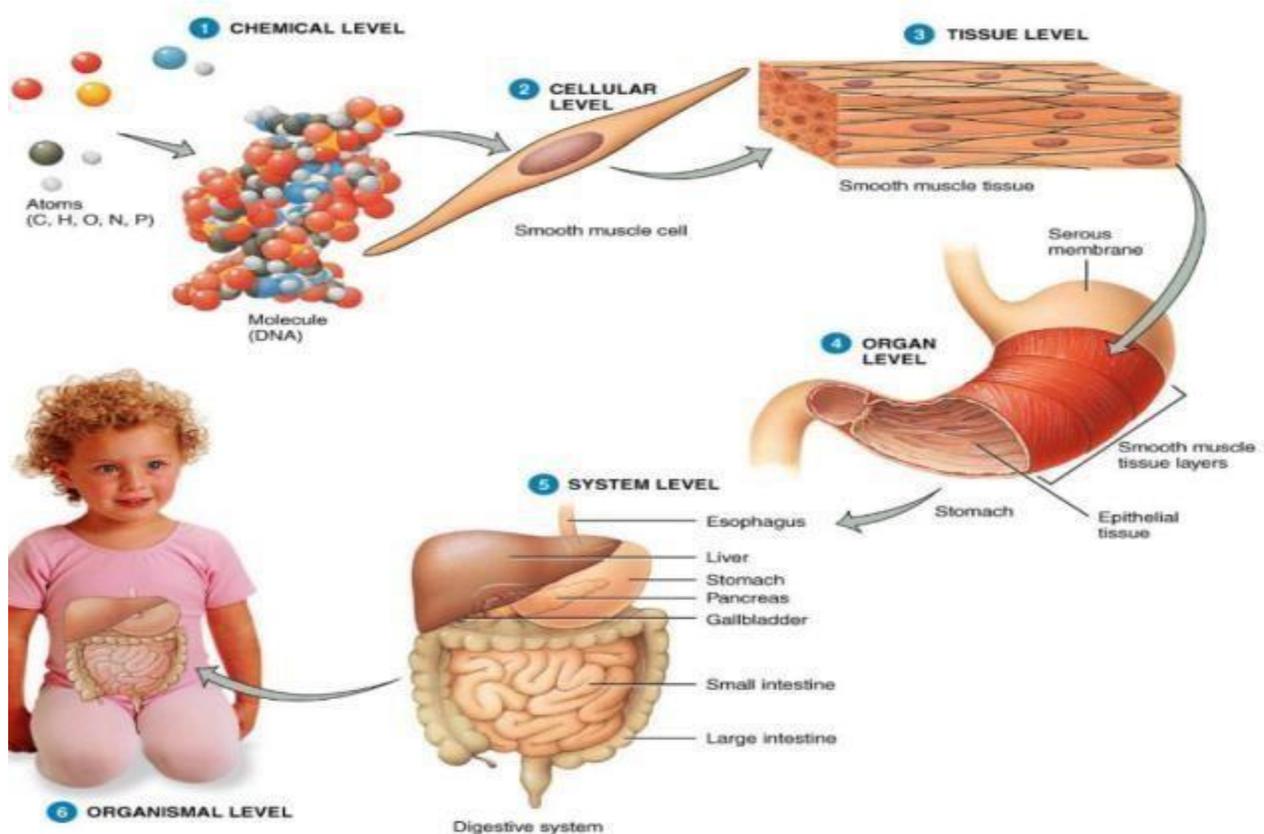
Introduction

■ 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**) .

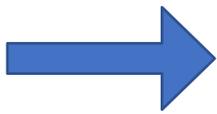
Body system are working to maintain optimal (best) conditions for their survival by keeping **constancy** of internal environment.

For ex fixed temperature and constant concentration of nutrients.

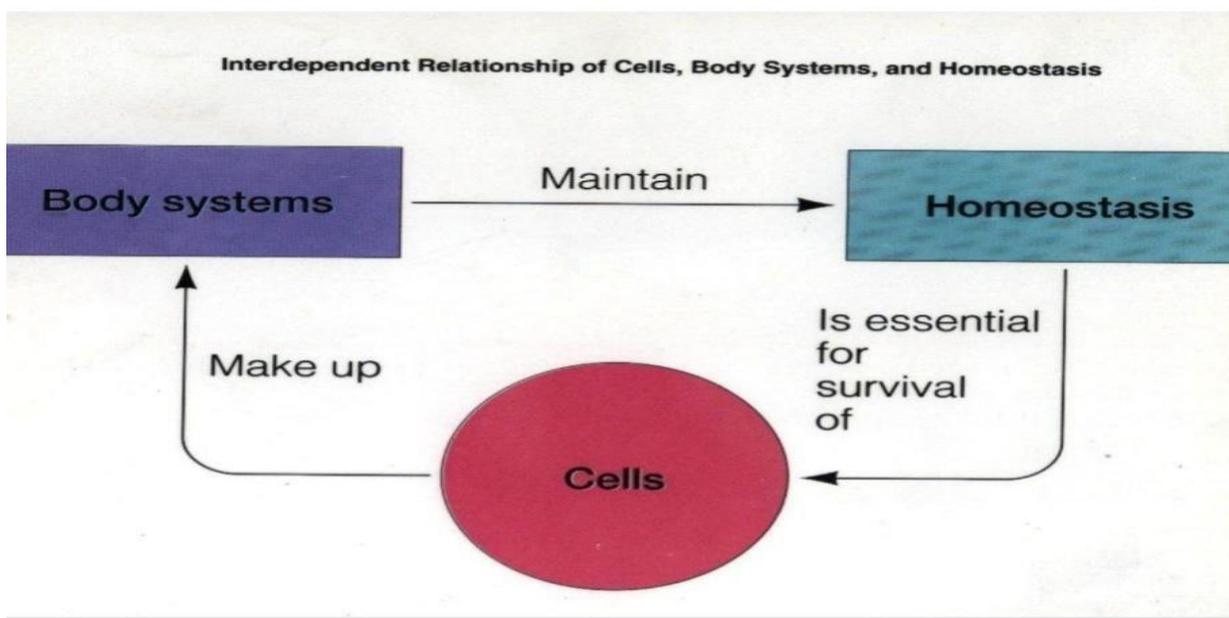
Cells are found in media called **extracellular matrix (ECM)**. ECM has specified substance such as : sodium ,potassium and glucose must be kept in **constant concentrations**.

- Homeostasis **is not the same as Hemostasis** *Blood Bleeding/hemorrhage*
- Hemostasis is process of blood clotting to stop **bleeding**.
- 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



Important links to view :

<https://www.phdnest.com/homeostasis-definition-types-and-examples/>

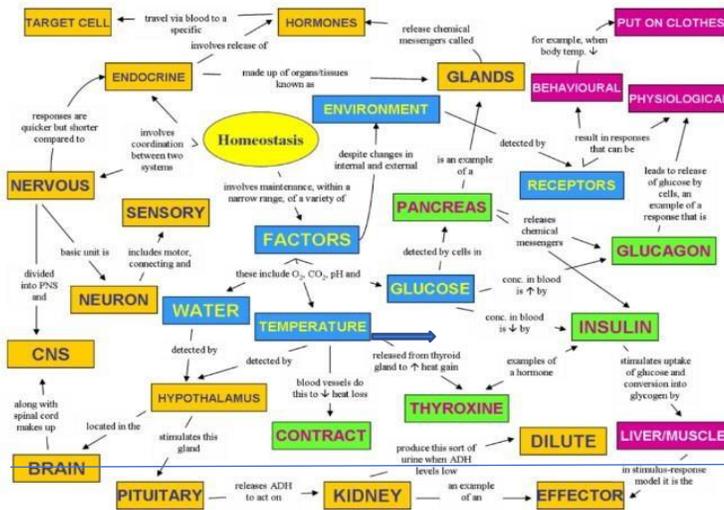
• https://www.youtube.com/watch?v=Rgpj__C2jCc

• <https://www.youtube.com/watch?v=LSgEJSIk6W4>

الصورة ليست للا حفظ
روابط مهمة

<https://youtu.be/7ODgYpdTKaY>

<https://www.youtube.com/watch?v=LSgEJSIk6W4>



Steps of Homeostasis:

-homeostasis is **disrupted** by any mechanism

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

Example: Baroreceptors in blood vessels that sense the blood pressure, Chemoreceptors ,osmoreceptors

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

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

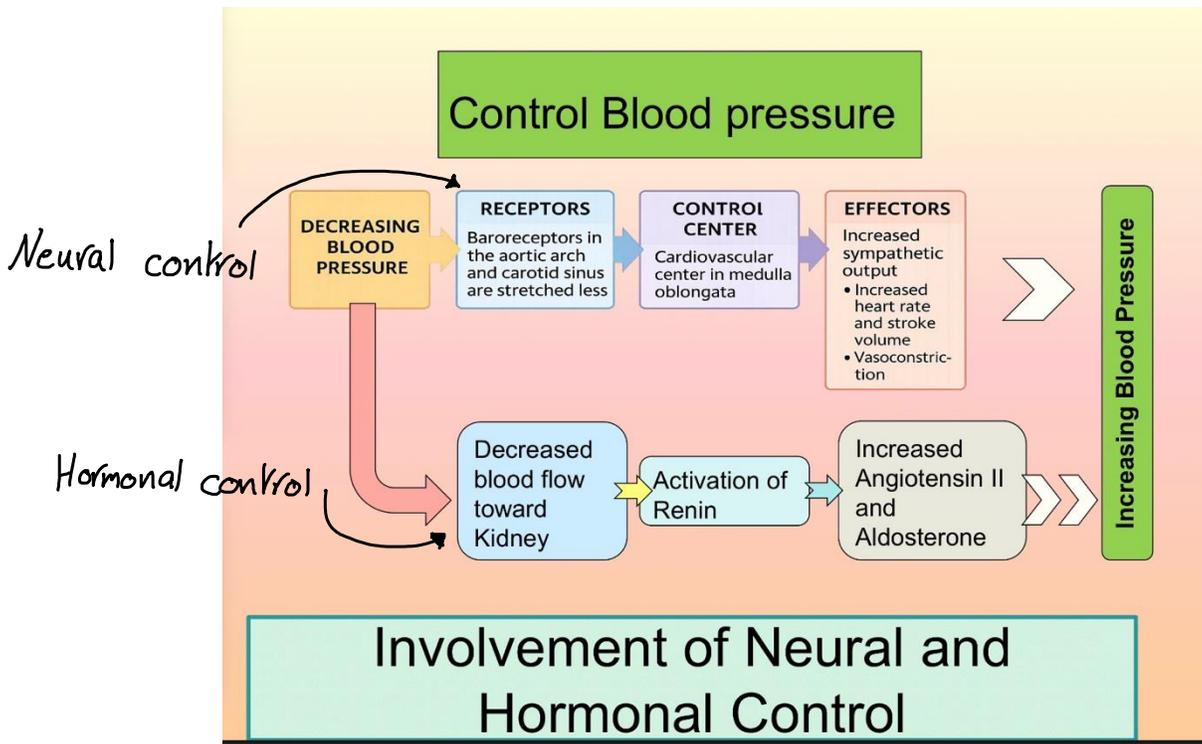
3-Effectors organs receives the output and change the body depending on it.

•Homeostasis is **achieved**

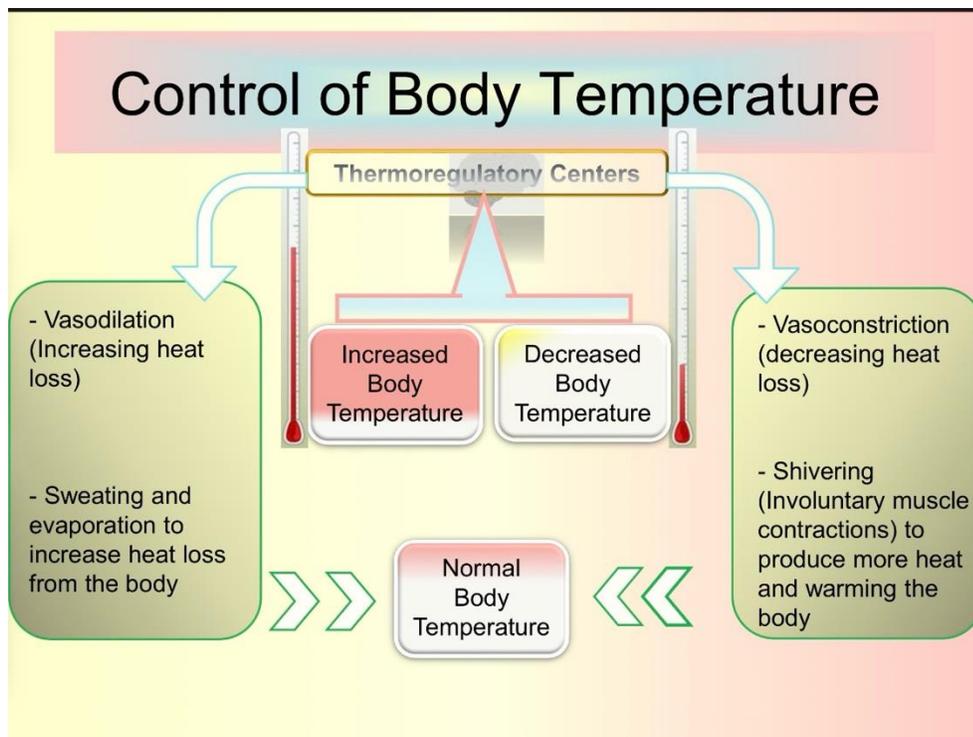
Examples of the homeostasis :

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

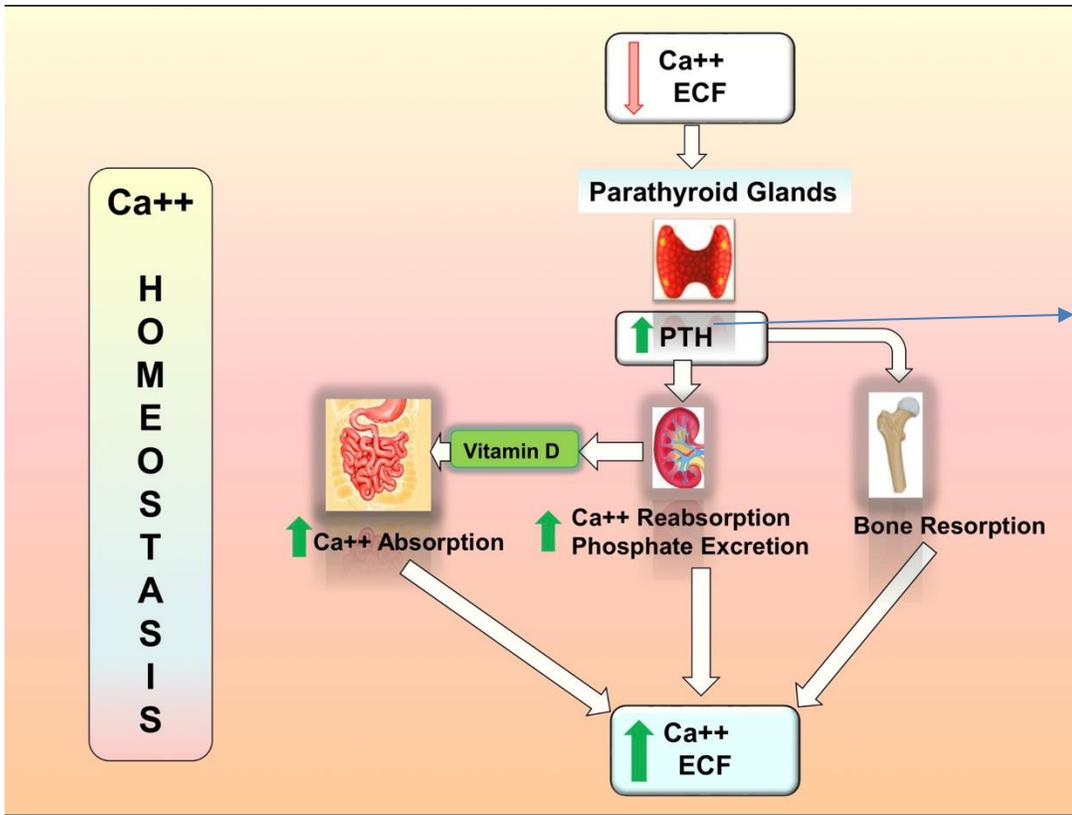
1-Blood pressure: 



2 – Control of body temperature (to maintain fluidity)



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 FEEDBACK

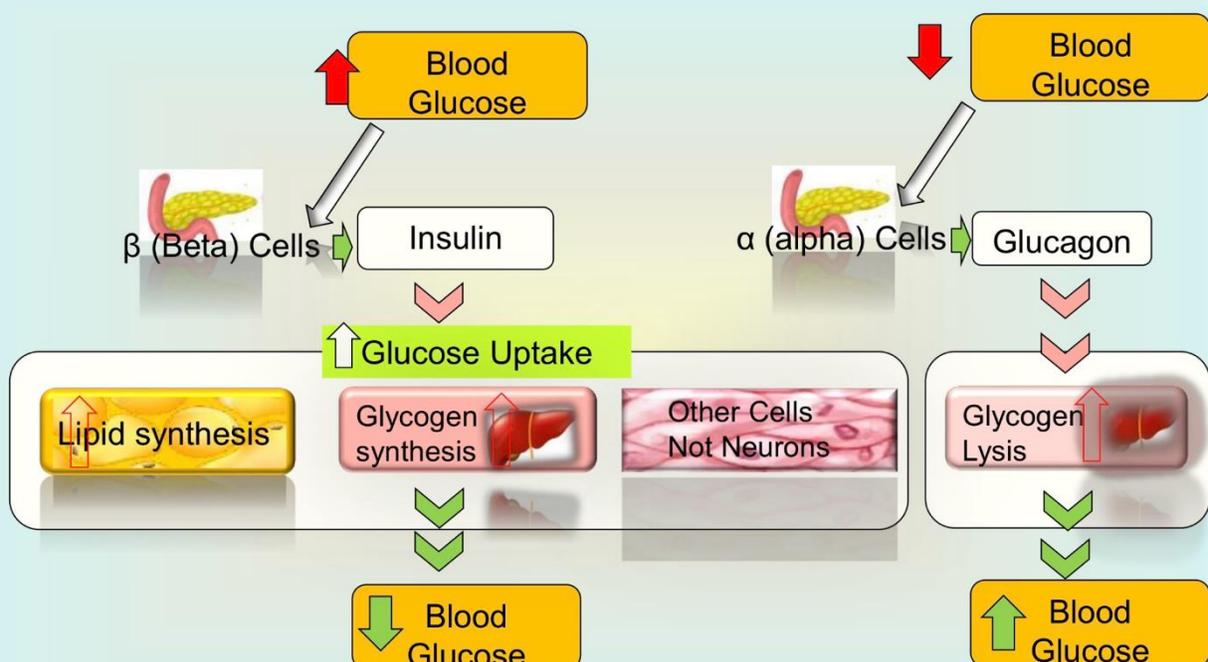
When the direction of the stimulus is opposite to the direction of the effect or Reverses a change in a controlled condition (**mechanisms maintain stability**, keeping physiological variables within healthy limits) (final event that is a result of the first event and reverse to it).

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 .

Negative Feedback

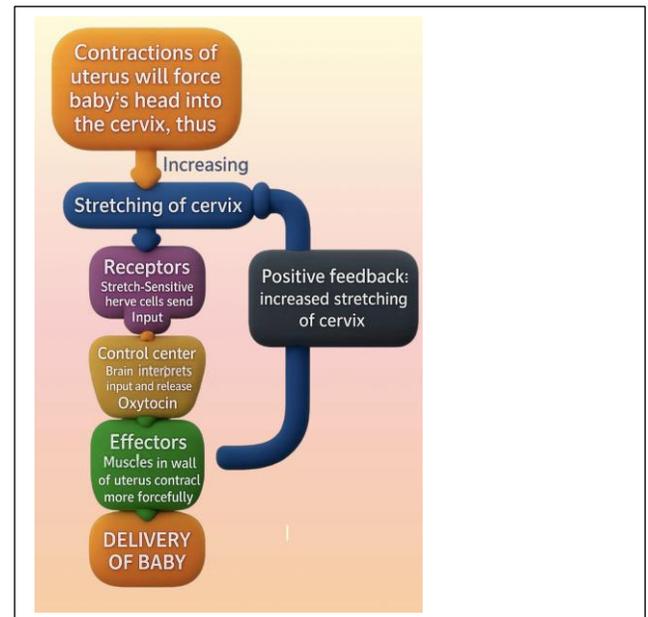


POSITIVE FEEDBACK

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

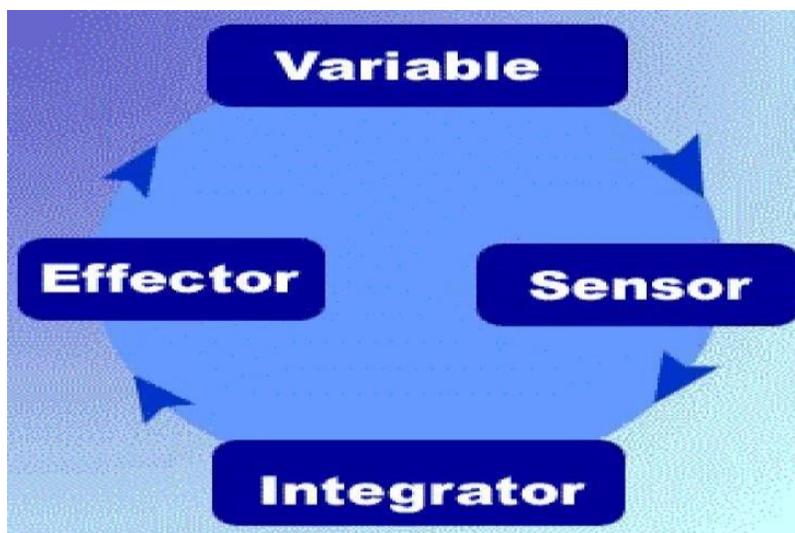
There will be contraction of the uterus, there will be pressure over the cervix causing it to start stretching when the baby is about to be delivered, stretching is sensed by certain receptors and signal is sent to the control center, which will integrate the input and cause the release of a hormone called oxytocin, which is the output sent to the cervix to contract more, contraction is sensed again and the circuit repeats until the baby is born.



Mechanisms intensify responses to achieve specific outcomes.

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 !



Positive Feedbacks are not involved in the control of homeostasis

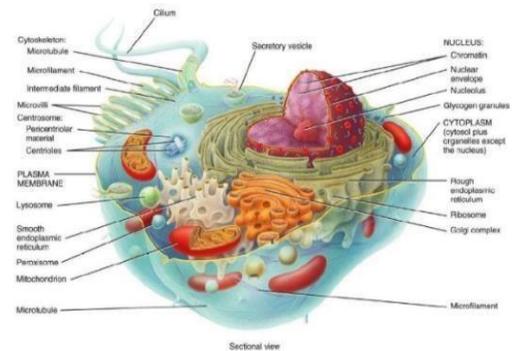
Cells and organelles

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

Its DNA locates in nucleus (nucleus function is the transfer of genetic material)

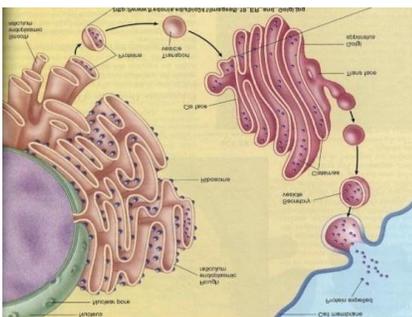
Prokaryotic cell doesn't have nucleus and the DNA locates in cytoplasm



The organelles that have membrane are :

The Endoplasmic Reticulum (ER) : rough and smooth

The function of the Endoplasmic reticulum is synthesis of proteins , the ER creates a distinct separated compartment that allows for a unique chemical environment which is separated from the cytosol (a gel-like aqueous fluid matrix which is inside the cells that surround organelles)

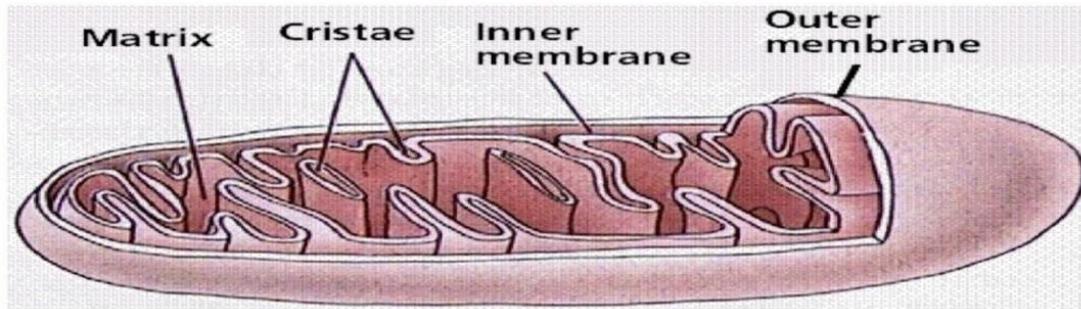


Golgi : is responsible for transporting, modifying and packaging proteins and lipids into vesicles for delivery to targeted destinations.

Lysosomes and Peroxisome : responsible for intracellular digestion, recycling and waste removal

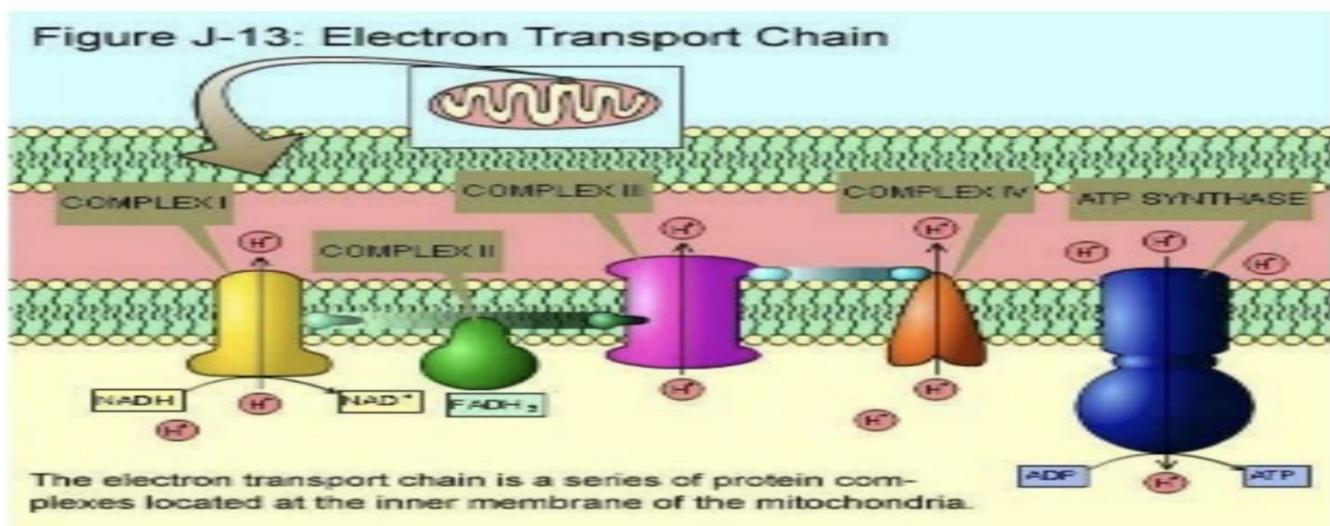
Mitochondria : its function is to produce micro energetic molecule by cellular-respiration that is needed to the activity of the cell

Mitochondria



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

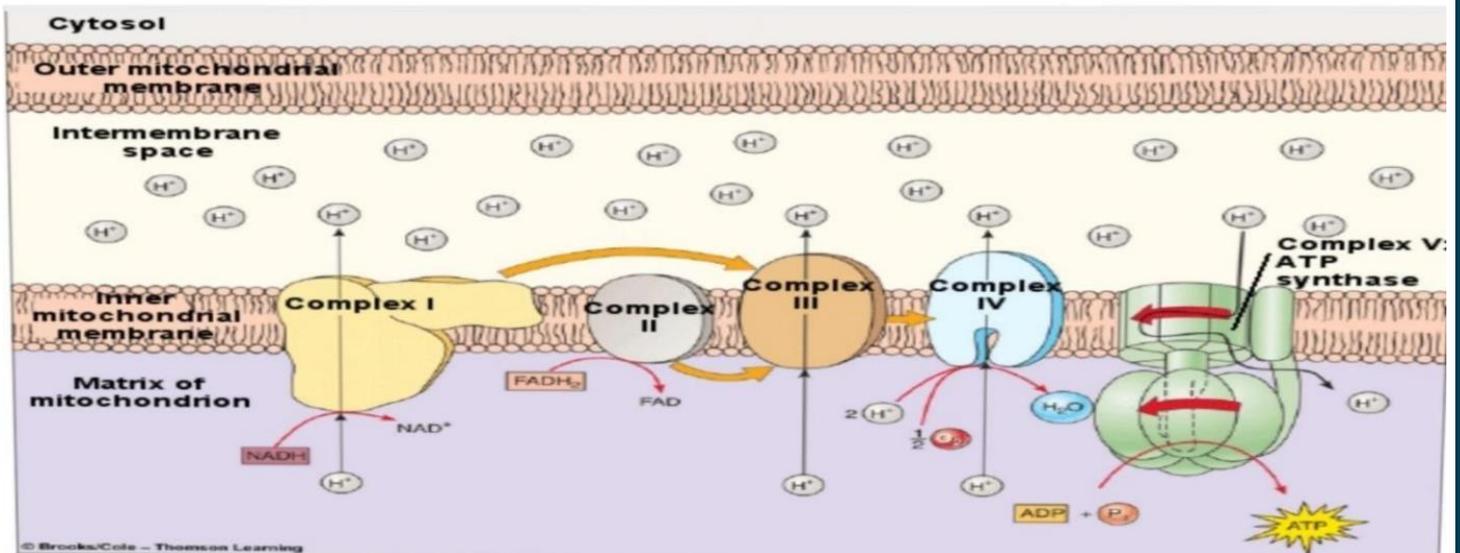
Electron transport chain is in the inner membrane of the mitochondria, its function is transport protons from the high energy state to low energy state .



NADH and FADH₂ (which are reduced electron carriers) are oxidized now ,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.

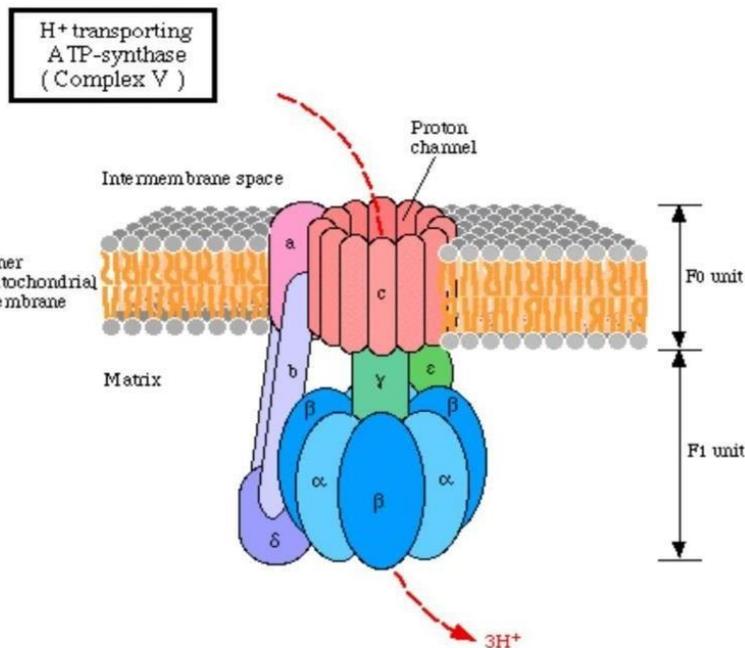
After that protons are translated into matrix by ATP synthesis enzyme(fifth complex)

There is no need to focus on NADH and FADH₂, as the professor didn't emphasize them, All you need to know is that oxidative phosphorylation is the final stage of cellular respiration in the mitochondria , where electrons move through the electron transport chain to reduce oxygen to water, creating a proton gradient that drives ATP synthase to produce ATP



This process which is discussed in the slide before is called **oxidative phosphorylation**

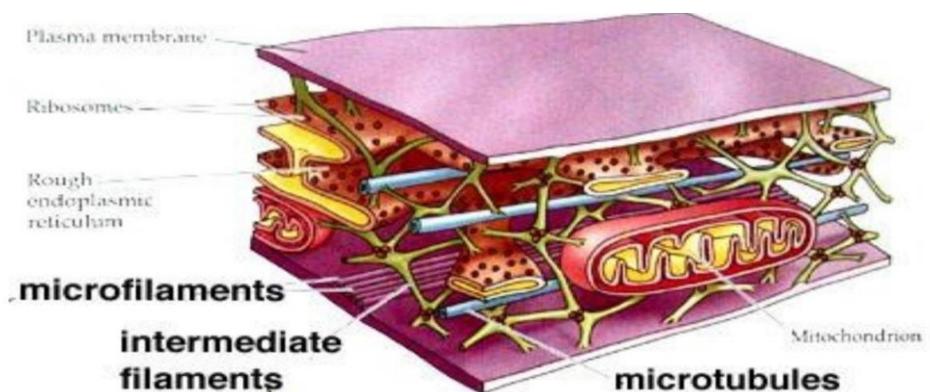
Supportive video: <https://www.youtube.com/watch?v=fHoL-vcMENw>



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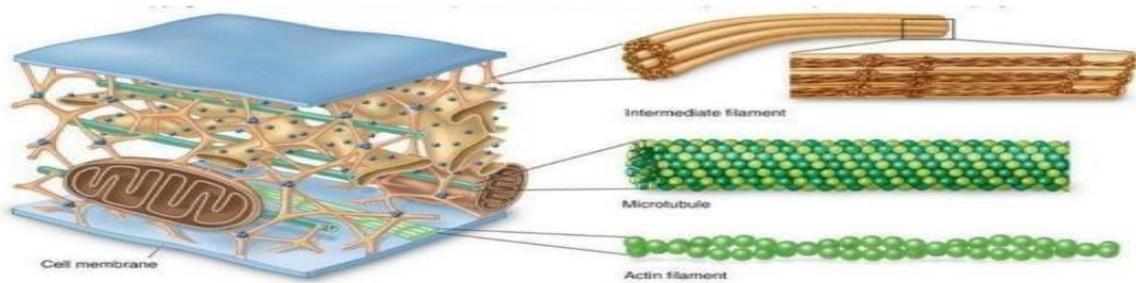
CYTOSKELETONS

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:

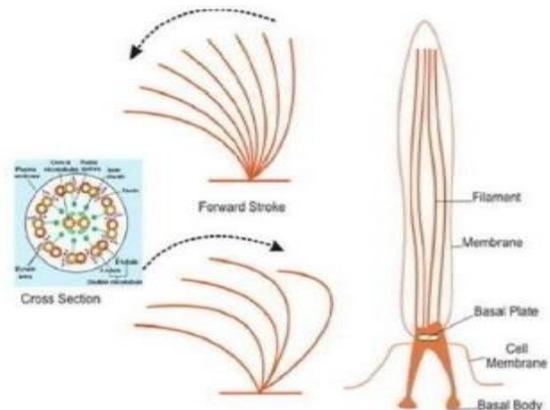
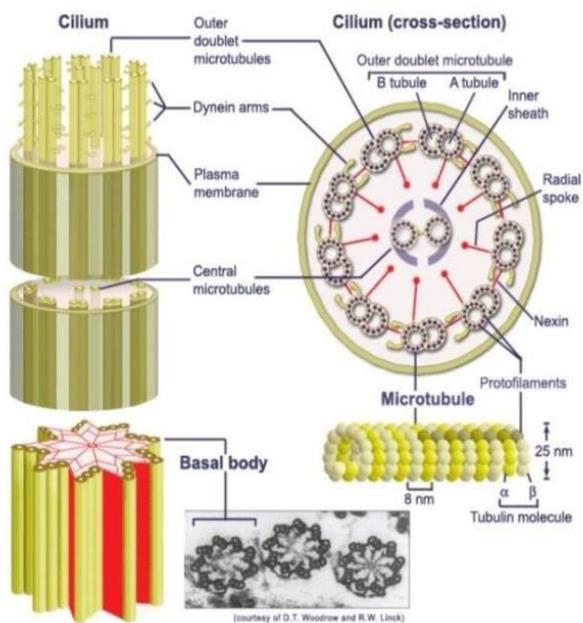
- Formation of pseudopods
- Contraction of muscles
- Determination of the shape of cell (Anchoring)

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.

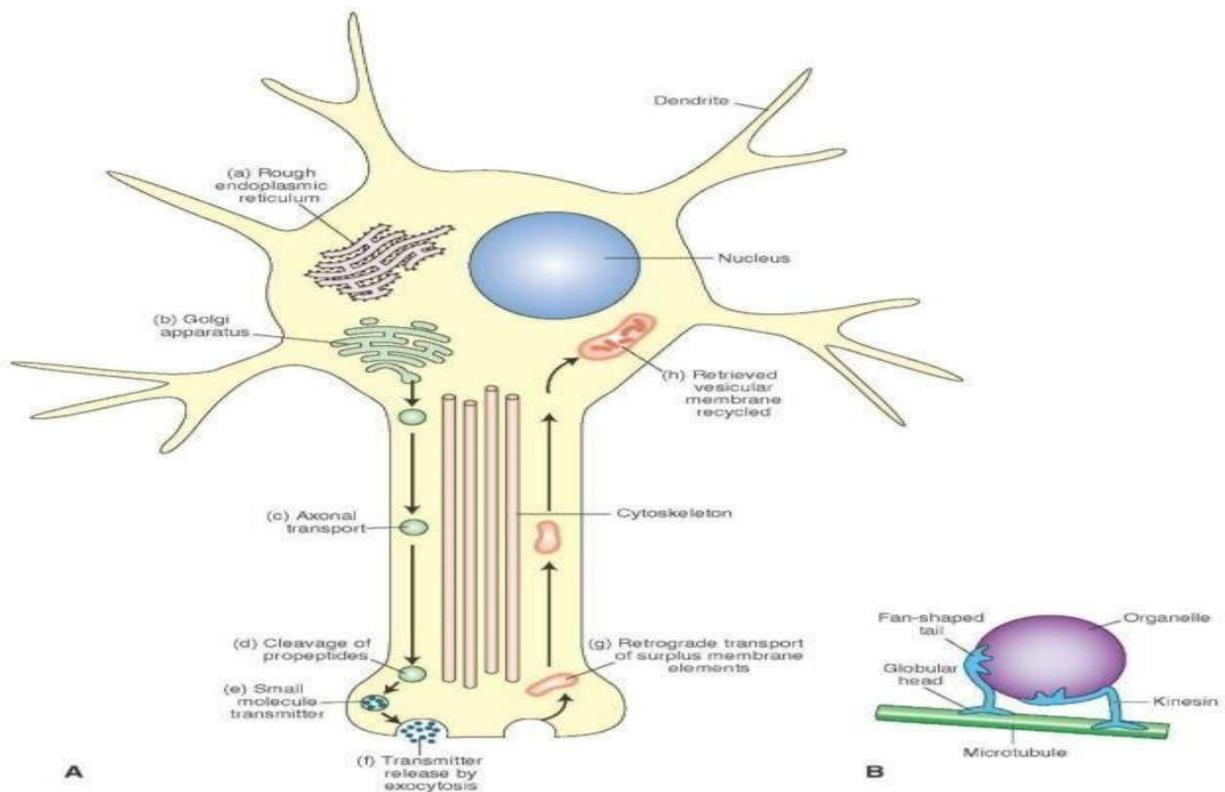
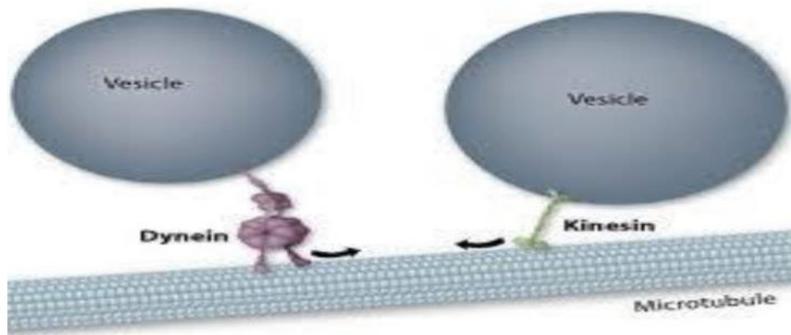
The **movement** of motor proteins that are connecting microtubules together **sliding up and down** resulting in **waving** of the cilia in one direction or another.



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.

Vesicles Travel Cellular Highways



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

Example of that is neural cell, neurotransmitters are synthesized in the cell body, but their function is at the terminals (the end points of the neural cell), and we have very long distance between the cell body of the neural cell and the terminals of the neural cells

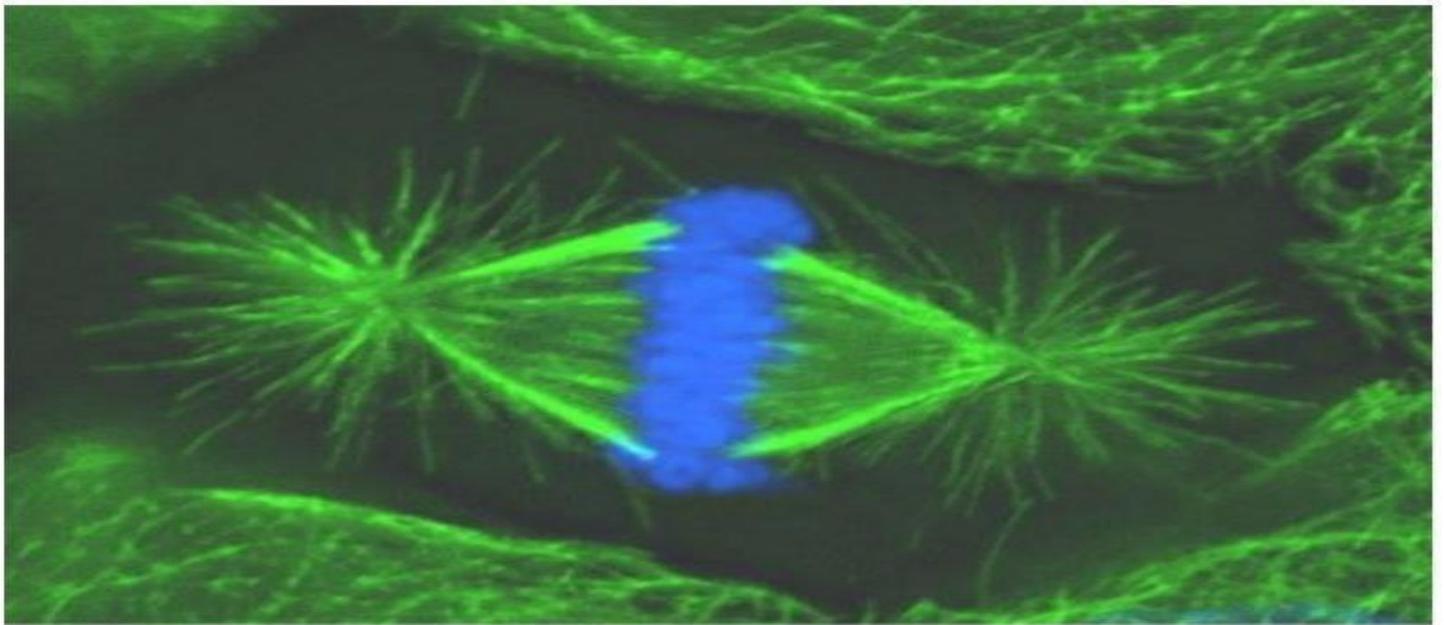
How do our bodies transport these neurotransmitters? The answer is by **vesicle transport** after packing them in vesicles we have along axes of microtubules and these vesicles use these microtubules to get transport of the neurotransmitters from the cell body toward the terminals of the neural cell.



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.

Mitotic spindle



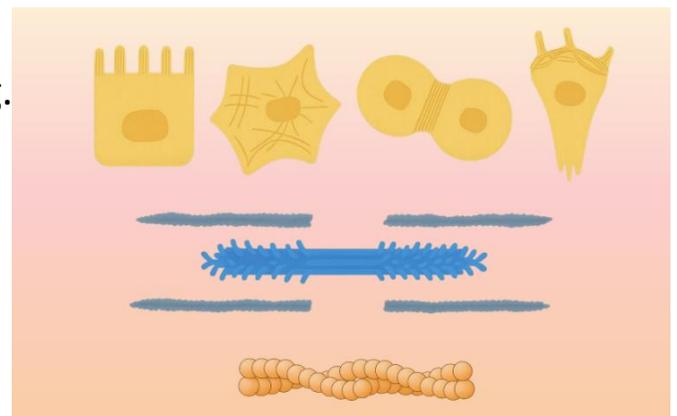
Actin filaments

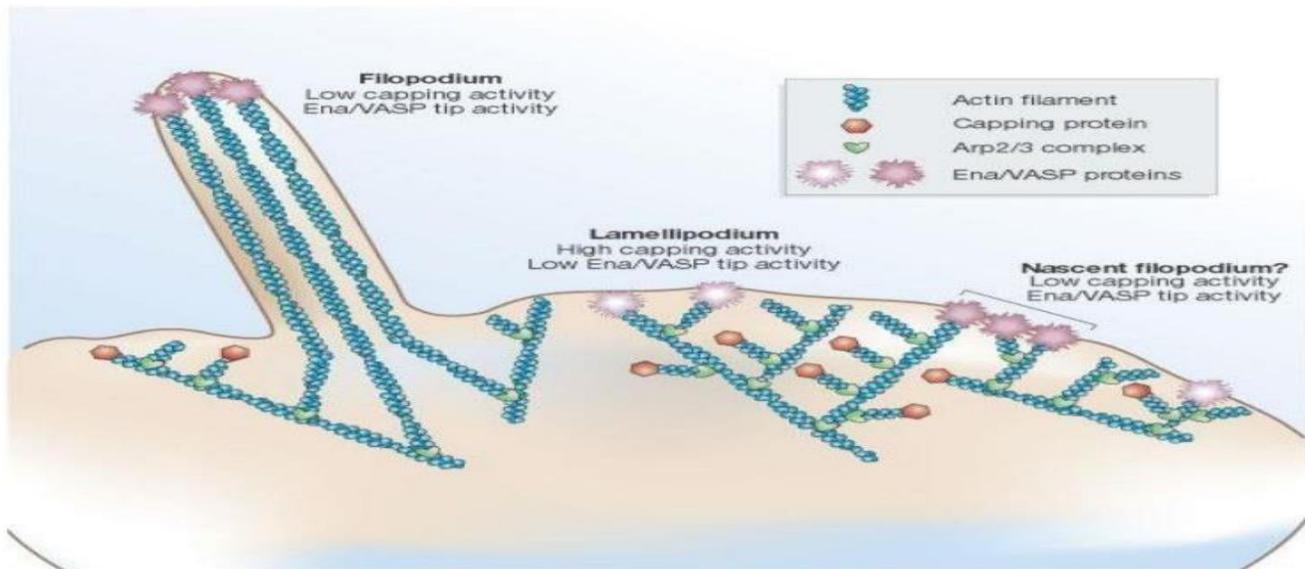
Formation of the pseudopods: -

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.

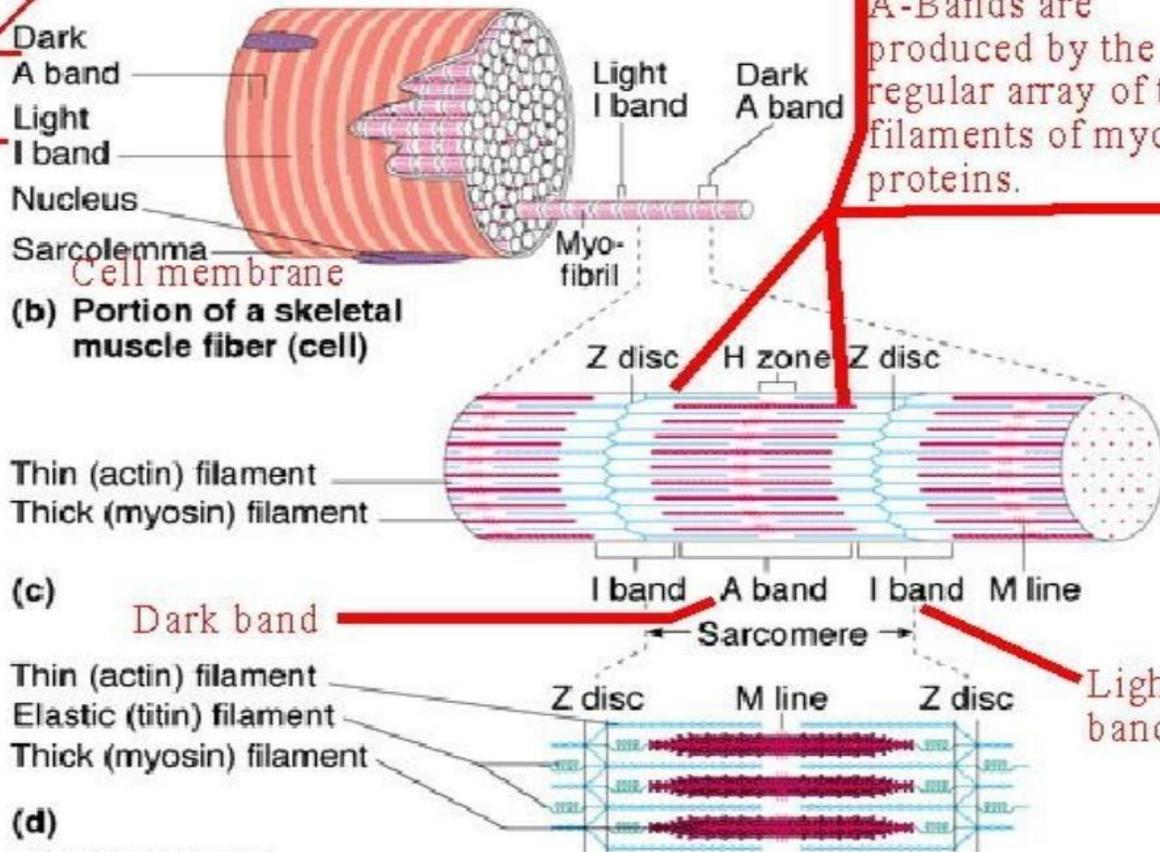
The contraction of muscles is done by sliding thick filaments and thin filaments that causes shorting of them.

Structural Elements of a Muscle Cell

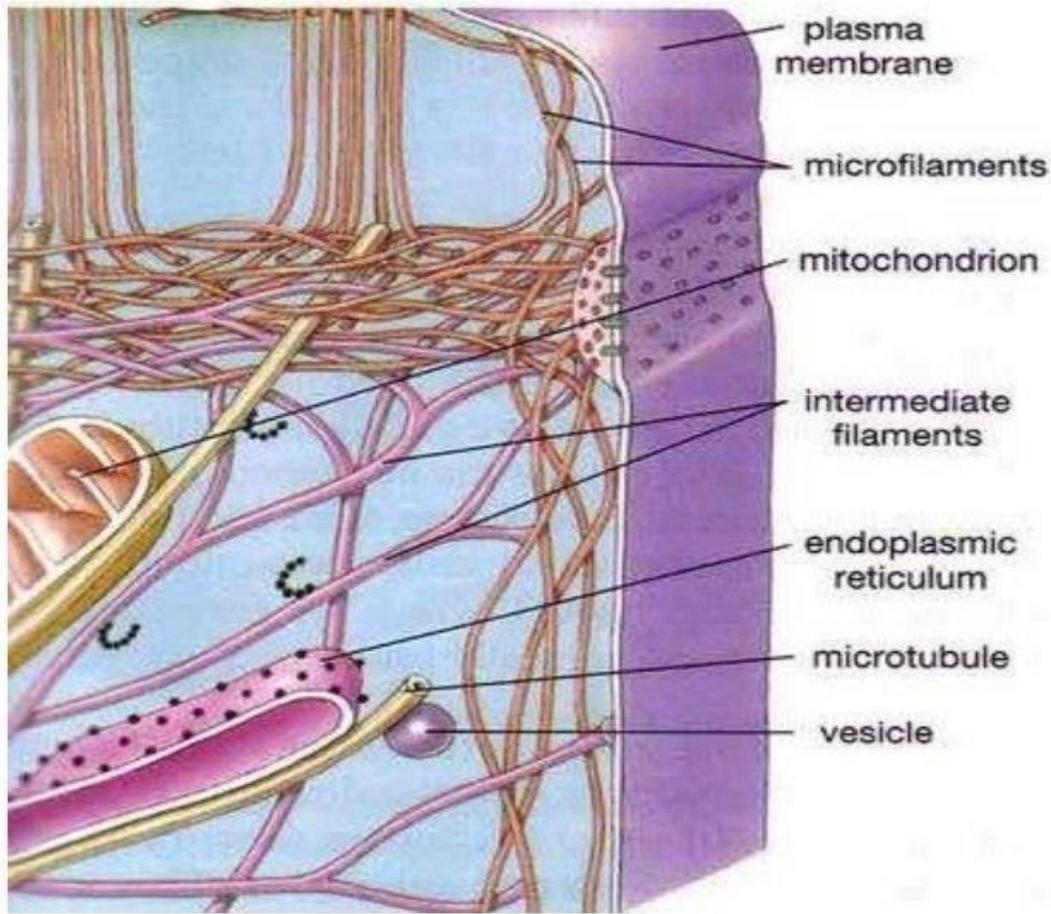
I Band - I stands for isotropic meaning the light passes through this area evenly. These are the light bands between the dark striations.

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.



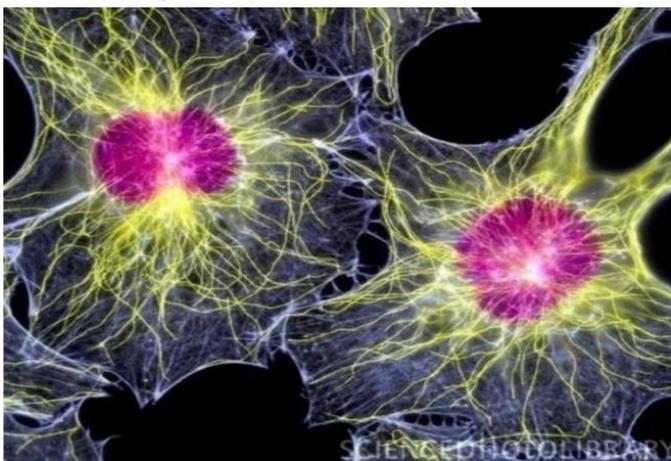
Although the filaments themselves run longitudinally along the myofibril, the A and I bands run perpendicularly to the myofibril, produced by the stacking of the filaments.



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

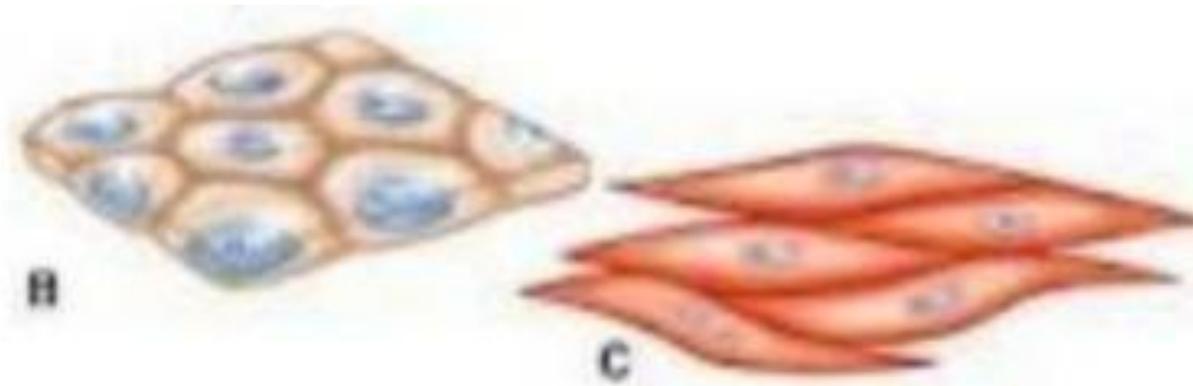
The importance of the cell shape for its function

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

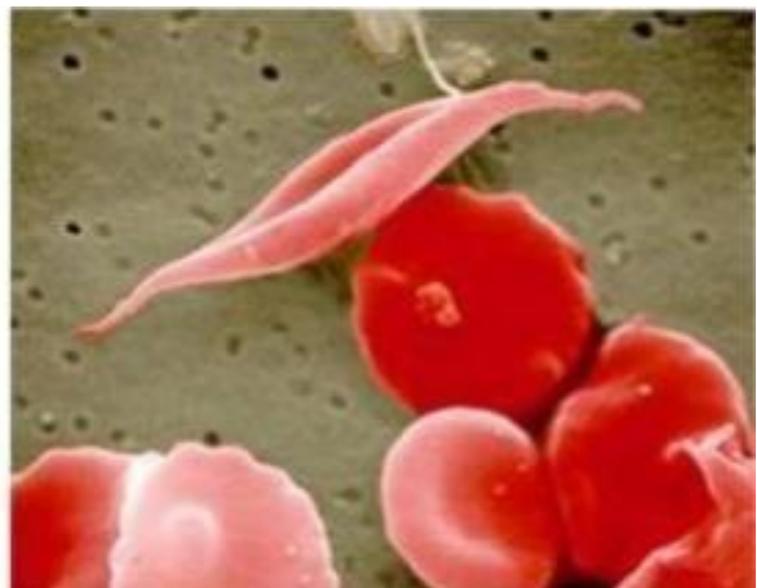


Neurons have a rounded shape that is important for their function. Its shape **increases the surface area** to get some nutrients absorbed well

, in addition, we have a lot of factors called trophic factors(are specialized proteins secreted by cells that promote survival, growth, differentiation and regeneration of target cells) 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-xo111kUxP/view?usp=drivesdkxo111kUxP/view?usp=drivesdk>

Good luck for all

Additional Resources:

رسالة من الفريق العلمي:

اللهم إنا نستودعك ما تعلمناه، فردّه إلينا عن حاجتنا إليه، اللهم لا تحرمنا فرحة النجاح وكلل تعبنا بالتوفيق

For any feedback, click the code.



Versions	Slide#	Before	After
V0 → V1			
V1 → V2			