

Human Physiology
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Hello everyone, I welcome you again in our next class which is about introduction of cells, structure of various cellular components and their function. So, in this class we will thoroughly discuss about different components of cell and how they function and what is their role in terms of like our overall human physiology. So, what is cell right? Cell is a fundamental unit of life. In the last class also we discussed little bit about cells and tissues, but mostly self is a self replicating structure. What it means? If you remember that as I said for our normal body growth cell division is a very important component. So, as cell divide from like one cells to like two cells to like multiple cells it helps to create like a growth in our body, right.

So, Robert Hooke who discovered cell, Robert Hooke in around 1665, he first observed and coined the term cell from a size slice of cork. What is the average size of human cell? If you can think of it is almost like 1 to 100 micrometer. So, of course, there are some larger cells like ovum, these are like almost like 100 micrometer of size and there are some smaller cells also right like in like sperm, sperm is like about 4 micrometer, but in general the range is about 1 to 100 micrometer in range. Constituent that are part of a cell are commonly called as protoplasm.

What are the constituent mostly like as you know like majority of our body is like contains water. So, same way 70 to 80 percent of our protoplasm is made of water. Then you have carbohydrates, you have lipids, you have proteins and also different type of electrolytes right like sodium, potassium, magnesium, calcium, bicarbonate. So, different important electrolytes they are having very specific roles. We will discuss about their roles in detail in next two classes in ion transport classes and they are very important for overall cellular function.

So, what is the structure of cell, right? So, cell you can see like a basic cell here. What we have? We have like cell membrane to protect like the whole cells, it is to create like a cellular barrier. Then you have like a nucleus component, right? What nucleus have? Nucleus has the genetic material of our cell and then inside you have the cytoplasm and then different organelles. So, mostly three component we will discuss now cell membrane nucleus and then different organelles and cytoplasm. So, these are again you can see such a nice beautiful architecture and structure of a cell contains which contains like cell membrane various organelles right.

It has like nucleus this is the nucleolus where the genetic material is there then we have other kind of ah organelles like ribosomes where protein synthesis happen then we have suicidal bag like a lysosome right different like other part like golgi apparatus where protein packaging happens Also important is to know about microchondria where energy gets produced. So, various like different components, different organelles are present and part of our cell and this class will discuss about those. So, let us start with cell membrane. You see the structure, a nice like a bilayer structure of glycolipids. What it does? It basically protects our cell from unwanted molecules or entities because if lot of pathogens or complex toxins or proteins easily get internalized to our cells, it can damage our cell and if our cells are damaged our human body will not be able to properly function.

So, it is important that our cell membrane protects our cell from unwanted materials that is the main function. It also controls the movement of water because having excess water inside of cells is also not good, it can burst the cell. It also controls the movement of ions like sodium ions, potassium ions. Finally, it controls the movement of various proteins, glucose and so many different other component, right. Interestingly, you see this is a like lipid bilayer structure.

You can see where there is like a hydrophilic head which is like more or less attracted towards the water. You see at the outside and inside part of the cell membrane, you will see this hydrophilic part and then in between a more like non-polar component which is like a hydrophobic tail. These are like long chains of maybe like lipid. So, that is why it is like mostly non-polar and hydrophobic. So, I hope you got some idea and there are lot of like cell membrane proteins you can see like integrin proteins, you can see some important proteins, lot of surface receptors will be there, lot of surface receptor because this receptor also allows like attachment of particular molecules to those receptor and internalization or externalization of those molecules.

So, not all molecules enter or diffuses out passively, there are certain active receptors also that also plays very important part of molecular internalization process. So, I hope there is a very clear idea about cell membrane and in our ion transport class, we will again detail, we will discuss like some component of cell membrane and different type of associated processes. So, what are the functions of cell membrane? Let us one by one discuss. Basically, the cell membrane protects our cell as I said from the outermost toxins or unwanted molecules or even pathogens. It helps in digestion, right.

The cells helps in digestion, it takes food and excretes waste products. Cell membranes are selectively permeable, it is very important they are selectively permeable. The non-polar molecules like gases like oxygen, carbon dioxide, nitrogen, then lipids, steroid hormones, alcohols, they can dissolve in the non-polar region of the membrane and move rapidly across the membrane. Whereas, the polar molecules right like hydrogen, oxygen, soluble molecules, glucose, urea have much lower solubility. Therefore, it penetrates the membrane much more slowly.

Next is cytoplasm. So, the semi-transparent thick gel like fluid cytoplasm that can be found in animal cells is very important constituent of the cells cytoplasm basically holds different type of organelles. These are rich in like water fluid component. It also creates like insulin inclusions like cytoplasmic inclusions cytoplasmic matrix contains many chemical elements also like atoms ions and molecules. Cytosol is the aqueous part of the cytoplasm, almost 70 percent of the total cell volume is cytosol.

It contains filaments, organic molecules, salt and water. The next most important component of the cell which we all know is the nucleus. Why nucleus is so important? Because it holds or it contains the genetic material of our cell and as you know, like from parents to the daughter, we pass our genetic information and it is very important for our overall survival, our overall evolution to our physiological system. So, nucleus is present mostly at the centre of the cell as you can see, it is bound by the nuclear membrane. So, nucleus is also protected by the nuclear membrane and it is only permeable to like very small non-polar molecule because nucleus is so sensitive and important to the whole cell structure that it only permits like few non-polar molecules.

The nucleus contains chromatin, RNA, nuclear protein that move freely in the aqueous solution. So, what are the function of like nucleus mostly like controlling the genetic information and then next is cell organelles. So, what are different type of cell organelles are present in our cell? one by one let's see like we have microchondria which is like the powerhouse it produces the energy in form of ATP then endoplasmic reticulum lysosomes which is like the suicidal bag it helps to remove lot of like bacteria virus if it internalize the cell apart from that it also helps to remove like torn out cells Then Golgi apparatus we have which helps in the protein packaging and then peroxisomes, vacuoles. So, these are few components of cell organelles. Let us discuss one by one.

So, first is the mitochondria which is the powerhouse of the cell. So, why we are calling it as a powerhouse because it produces the energy. So, mitochondria was like first observed by Colliker in 1850 as a granular structure in the striated muscles. The membranes are made up mostly same like phospholipids and protein. This is like primitive prokaryotes are like ancestors of mitochondria and very interestingly, mitochondria has its own DNA and ribosome.

This is very important that mitochondria has its own DNA along with the ribosome also. Functions of mitochondria as we told like it is a powerhouse that means it generates like units of energy. Mitochondria breakdown food molecules to produce like ATP. ATP is basically like the source of our energy. It is important to maintain a proper concentration of calcium ions also.

So, mitochondria has a important role into it. Energy transduction through respiration, mitochondria has a very important role into it also and mitochondria also has important role in thermogenesis. So, these are different functions of mitochondria. You can go through again further if you are interested. Next is endoplasmic reticulum.

So it is basically you can see the structure here. It is a tubular type of structure right network of tubules and flat vesicular structure. It is present in the cytoplasm highly folded membrane used to move like proteins through the cells and very interesting. You can see these dots like in the rough endoplasmic reticulum specially it has like These are like kind of granular right this granular endoplasmic reticulum black dots you can see on the contrary opposite side what you can see these are smooth. Why it is important because this rough endoplasmic reticulum as ribosomes they are the house of the protein synthesis.

But if there is no black dot here that means there is no endoplasmic reticulums here are smooth and no ribosomes are present. So, they will not be able to synthesize any protein here. So, what are various functions of ER? It secretes digestive enzyme in the rough here, in the ribosome it helps in the synthesis of proteins, also it helps in protein segregation, muscle contraction. So, lot of important roles are present for endoplasmic reticulum. Mostly it is either rough or smooth as I said.

Rough endoplasmic reticulum has ribosome and it helps in protein synthesis, processing, packaging. But in case contrary to the in the smooth endoplasmic reticulum, there is no ribosome present. So, they cannot produce any synthesis. But what they can do? They can synthesize various lipids and steroid hormones. So, they also have a very important role to play for cells because steroid hormone has different type of functions, we will discuss later.

Next is Golgi apparatus, it is very important component, you can see the Golgi body or Golgi apparatus inside of our cells. These are a collection of membrane enclosed sacs. What is

important all about Golgi apparatus and what are their function? Mostly it helps in the wrapping and packaging of the protein. Like once a protein gets synthesized by the method of translation inside of ribosomes, there are lot of protein right. So, if we synthesize too much of protein inside of cells, what will happen? Like there is not enough space in present in the protein.

So, it needs to wrap up to make it more compact, more small so that it doesn't require too much of space. So, Golgi apparatus helps into it, right. Apart from that, it produces secretion of granules, which store hormones, enzymes, etc. This is also a site for the formation of lysosomes. So, lysosome is very important because it helps in terms of destruction of various foreign bodies, foreign particles, torn out materials, unwanted particles.

and Golgi apparatus is the site of the formation of lysosome, right. So, you can see lot of important function for Golgi apparatus also. Next as we said like Golgi is the site of synthesis of lysosome. So, lysosome is generally called as suicidal bags. You can see the structure of the lysosome here.

This is so, so important to a cell for its survival, for its purity. Generally lysosome are a little bit acidic in nature compared to the rest of the cytoplasm is very important to remember and then if there is any invasion of like a external bacteria or outer cell component which is not required inside of our cell the lysosome which contains like the digestive enzyme will basically destroy it right. So, lysosome contains like cell hydrolysis and the best perform in the acidic pH, it will destroy all these unwanted bacteria, foreign particle along with like engulfed worn out components of the cell and is important to point out that if lysosomal dysfunction occurred, our human body naturally becomes very vulnerable for many of the diseases And in cases of different genetic disorder, I'll name one like Gaucher disease where lysosomal disorder happens that causes like accumulation of glycolipids inside of the cells and accumulation of glycolipid will cause further fatty liver, fatty spleen situation to our body. So, as you can understand lysosome is very important and any irregularities of lysosome can cause different diseases to our body. Finally, peroxisomes, peroxisome is also an important content component or organelles inside of the cells.

It contains oxidases that produce like H_2O_2 as a byproduct, but oxidase are very important. Why? Because as a whole peroxisome, it helps in the metabolism of produced hydrogen peroxide and detoxification because as you know like if lot of hydrogen peroxide builds up in our body, it creates like a situation called oxidative stress and oxidative stress condition in the body can damages the cell in long run and it can also induce different diseases if it stays for a prolonged situation. So, it is very important. Then it helps in the biosynthesis of the lipid, right, in synthesis of cholesterol also, peroxisome has a role. It also has an important role in terms of like bile acid synthesis.

So, you can see different very important functions are associated with the peroxisome. Finally, the cytoskeleton, cytoskeleton is very important is a system of fibers that maintains the structure of the cell, right. If there is no cytoskeleton, you can see this cytoskeleton network is like holding the cells. So, if there is no cytoskeleton, what will happen? The cells will basically fall apart, all the organelles will come close to each other, creating a hampering process to their normal functions. So, basically it gives, cytoskeleton gives a structural integrity of the cell.

Above all that it helps in the movement of the chromosome, cellular movement, movement of the proteins with the cell membrane. So, cytoskeleton is as you can see is a very important component. So, some fun facts finally. Like our body, in average contains about 37.

2 trillion human cells. You can imagine the huge number, how many cells can be present in our body, right? So, this is a really interesting thing. Another important fun fact, like about 372 times as many cells making just one body than there are stars in our home galaxy and milky way right. So, you can see like that 372 times of different type of cells are present in a in one single body and this many type of stars are not even present in the galaxy. So, you can see the variation of the cells that is important to execute different functions. Why this many type of cells are present? Just because each cell has like a very specific function and one cell cannot perform, mostly cannot perform the other cells function.

Like, neurons are specific, nephrons are specific, alveoli cells are specific and our human body is like really kind of a wonderland where this diversity exists. Finally, for a task. Can you identify like what is this cell on the left side? Can you identify what is this cell on the right side? I will give you couple of seconds. So, the right side you can see a distinct structure of like cell membrane that means and it does not have of course, any cell wall.

You can also see like nice nucleus to it. So, it is an animal cell or human cell. So, basically the right side we have a human cell or animal cell and on the left side what you can see, you can see a thick cell wall right, no obvious like this type of round shape nucleus is present. It is clear that this type of cell which is not having any like cell wall is a plant cell. So, hopefully you identified the right cells and I again thank you everyone for attending my third class. I hope you enjoyed and you were able to now will know about various type of cells and different components of the cells and what are their functions.

So, let us meet again in our next class about the ion transport. Thank you again.