Introduction to Cell Biology
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Lecture 55
Endomembrane system of Cell: Discussion session 4

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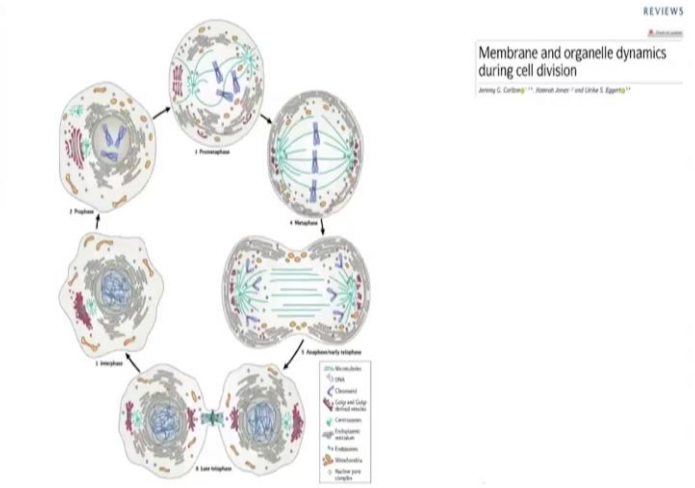

So, what I will do is I will go in and take questions now. Anybody else have any queries.

Professor: Anjali you have put your hand up, please go ahead.

Student Anjali: Sir, what is endosome, in the first slide that you showed.

Professor: So, endosomes are essentially vesicles that are pinched off, that could come from the plasma membrane, there could be they are brought in through endocytosis. And these now will carry not just what is on the membrane, they will carry receptors and the endosomes can get targeted to very specific locations inside the cell.

The endosomes also have receptors which are bound to ligands. And so, as they are brought in, they can be used for many different purposes they can be used to affect the architecture of the lipid membrane, as they keep going in. They could also be used to regulate signaling, they could be used to regulate the availability of receptors on the plasma membrane.

All things that the endosomes are able to do. We did not talk extensively about the process of endocytosis. In this there are different mechanisms of endocytosis as well. And when you come to the advanced cell biology course, we will be talking about clathrin mediated endocytosis, caveolar, endocytosis and such.

Professor: Kishan You have your hand up?

Student Kishan: We are talking about how the stiffness of a cell can affect the gene regulation. So, if the cell shape was able to it was manipulated from the outside, would that mean that we could change how the genes regulate?

Professor: Yeah, so if you take cells, like the endothelial cells, that line our blood vessel, and people have done these experiments, where they put them on dishes on slides. And all you do now is you grow them normally and then they form a nice sheet of cells and then you put them in a chamber where you can flow liquid at the rate at which it flows in your blood vessels. Just having that flow of liquid above the cells so the liquid is flowing over the cells. changes the orientation of the cells.

So, the cells are kind of pointing in all directions, the moment flow starts in this direction, in a couple of hours, all the cells orient in this direction, they are all now pointing this way. in the direction of flow, you change the direction of flow to this. It will take a couple of hours, but they will all orient to this direction. And the moment you apply flow, signaling, gene expression, everything in the cell changes.

So, the mechanoresponsiveness of sets is truly one of the black boxes are just beginning to understand that but it is very very vital to everything that the cells do in our body. They do not do this without the context of a mechanical cue. I mean we miss we may notice it very obviously, sometimes we may not, but what we are discovering is more and more it is the case that the mechanical milieu, the mechanical kind of cues that the cell is it getting is very vital to what the cell, how the cell behaves in your body. Kishen, I took your query.

Professor: Vignesh?

Student Vignesh: yes, I was thinking about how nuclei eventually evolved. Because when we look at the endosymbiotic theory regarding mitochondria and chloroplasts we said that bacteria had engulfed, like archaea had bacteria and that formed mitochondria. So, I read a bit about this. And then there seems to be a sort of similar theory about the nucleus itself.

So, I was thinking about when initially this sort of endosymbiosis happened and a cell needs to undergo cell division. And during that time, you might not have these centrioles that open up the nuclear membrane and then allow that allowed those mitosis or mitosis to occur. So,

like during those times, would it be plausible to think that me maybe the nucleus itself divided usually as a bacteria does and then…

Professor: It could be. It could be. So, it is possible that there existed cells were, or there existed a bag of lipid in which there were multiple quote unquote, nuclei. Because essentially, it was this original cell that had been taken in and now is essentially dividing. And it may have taken a while for the particularly, for example, the genetic content of the nucleus driving the control of the rest of the cell, is again, another huge step in terms of not just having something inside another cell. But now it having a significant say in what happens. So, that is how it could have begun it is highly possible, we do not know for sure. But the speculation.

Student: We also have a parent DNA and the host DNA, and they like sort of competing with each other now and

Professor: That's that's here, you are assuming that there was a parent DNA. Does not have to be. What if this was just the DNA that came in? You, we do not know. We do not know. It could be just a bag of liquid that took up something which then became the master of the that entire bag. And it kind of took over and now eventually drives everything that made the modern cell as we know it. But it is a it is a fascinating area, and there are a lot of questions that remain to be answered. Anandita?

Student Anandita: Yes sir, I wanted to know if euchromatin and heterochromatic are also part of the chromosome territories? Is that?

Professor: Yes, so obviously, they are the eu heterochromatin are, where the DNA is wrapped is present. So, when you talk about chromosome territories it is essentially these structures that are kept in place, and they are kept in place. So, as I said you should go look up some of the work that Kundan's lab is doing because they do very interesting stuff, where they are trying to figure out what exactly is in this group of genes or this DNA that is present here, that allows it to be anchored to this particular site.

Because where it is located, if it is, for example, if and these chromosome territories move around, by the way, so they can be moved around in the cell, in the nucleus itself, depending upon what group of genes you want to express how. So, go look this up there is a lot of information on how chromosome territories are held, where they are, and how this influences gene expression.

Student Anandita: And also, sir, do nuclear pores form dissociat as and when needed, or is it that they are already formed and they are just sit there?

Professor: No, no, though, they form and dissociate, they form and dissociate, I am trying to think whether there is a significant amount of the nuclear pore complex that breaks up in a nucleus regularly. And I am inclined to say that happens. But let me also look this up I am not sure how much of a turnaround happens. But my sense is it does when cell division obviously happens there is the turnaround increases pretty dramatically.

Professor: Sujani, your query?

Student Sujani: Sir, firstly the different stress also mechanical stress can change a gene regulation and it can probably even cause deletions. Does the cell have some sort of protective mechanism to prevent that because otherwise, all physical injuries or even small changes quite cause changes?

Professor: So, I am not sure this all cells want to actually not respond to mechanical cues. See mechanical cues will obviously change expression of genes will affect the behavior of cells. Our cells trying to say let me not be mechanoresponsive, maybe there is there are certain situations where they do not want to be mechanoresponsive, and they may have mechanisms that will prevent mechano-responsiveness at that time, but cells in general to large or small extents, like for example, endothelial cells respond to flow in a way that maybe kidney cells do not.

And the extent of that responsiveness may vary, but it does look like most cells have the ability to react to mechanical cues. And they have been doing this all along in ways that we have just not noticed. So, for example, tissues have a certain stiffness. And because tissues have certain stiffnesses, the cells it is a kind of a circular mechanism or a circular thing where the cells help create the environment that create the environment that drives the stiffness, because the extracellular matrix that is secreted is secreted by cells.

And now that environment comes back and tells the cell how to feel because of the stiffness that is present in that environment. So, there is a feedback loop here. And that constitutes part of the normal homeostasis of the cell. So, for example, in diseases like cancer, this environment and its stiffness does change significantly. And that is thought to contribute to how the cells behave, and what they are now capable of doing.

So, to kind of answer your query, is there a mechanism by which the cell switches off its mechanical responsiveness at a certain time. I am not sure whether it exists in the form that you are asking. But it could possibly have be happening for specific pathways per se that responsiveness could be changed. Almost, yeah.

Student Sujani: I was actually thinking in terms of how there some diseases which get triggered after physical injuries so, what they have.

Professor: Is there a disease that is triggered after physical injury?

Student Sujani: Yes, I know one tells a pain, a chronic pain condition.

Professor: No, no, a chronic pain condition is because of nerves being affected.

Student Sujani: Right but I also heard as I was reading up on this, and also read that they do have a genetic factor involved so, I was wondering.

Professor: No so, see that is what I am saying. So those are actually pain is a completely different mechanism altogether. And you cannot associate a physical injury that happens, for example, you fall down you get hurt, your screen gets scratched that is injury. Obviously, there are there is a mechanical damage that has taken place, but that is not driving the behavior of the cell. Everything that happens as a result of the injury now the cell is reacting to, and that is what drives either recovery or not there off or lack of recovery, as the case may be.