Introduction to Cell Biology
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Cytoskeleton: Discussion Session 1

Professor: And we will go to questions. And before we go to questions, there were two things that, two questions that were raised in earlier classes that somebody was to come back and talk to us about. So let us take a minute or two, and see if they can tell us, and I cannot, I am trying to remember the name of Vaishnavi. I think, right? Vaishnavi, you had something that you will to tell us, right. So, is it possible for you to turn your camera on?

Vaishnavi Reghunath: Yes sir, one minute.

Professor: Then please do. Remind me what the question was. And, and tell us what you found.

Vaishnavi Reghunath: Yes sir, I wanted to know whether anaerobic eukaryotes were in fact, an aerobic. And we could give them that exact definition.

Professor: Okay.

Vaishnavi Reghunath: I looked it up. And I found that we actually cannot, because multi cellular eukaryotes do perform anaerobic respiration. But it is only because they are forced to, because they are found in habitats that lack oxygen, like underneath ice cover or inside the bodies of other organisms. But they can still perform aerobic respiration, if they can come across a situation where oxygen is available.

And most of them do require some level of oxygen, even if it is very small, or be exposed to oxygen at some part of their lifecycle, because they need it for certain important synthesizing processes and for unicellular, eukaryotes, most of them are usually found either in a symbiotic relationship with aerobic organisms like algae, or they are usually found inside the bodies of organisms, like parasites, for example, Entamoeba.

Professor: Right. So that is a very comprehensive answer. And you are right, that they could have existed in a more prominent form. Before oxygen levels climbed up. See, oxygen is an

extremely powerful thing. In terms of energy metabolism. And, and it was a game changer for us.

So, and this might be true for any other planet that we are thinking could have some form of life that resembles ours, remember this, that, all life does not have to be life as we know it. But it is, that is one of the reasons why both water and oxygen is something that, many of these probes that are looking for, for life, are trying to find, because it, it is a, indeed a big game changer for how energy metabolism happens.

And that now allows for, as we understand it allows for the development of complexity as we have seen here. So that is, that is a very good answer. Thanks, again, for going back and looking at, looking for this. There was somebody who asked a question about whether, there was one more question I let me just make sure.

Sneha Borse: Sir, I was that.

Professor: Yes. Could you, could you identify yourse lf?

Sneha Borse: Yes sir, sir Sneha Borse.

Professor: Yes. Sneha, is it possible for you to turn your camera on if so turn, d0. Otherwise, you go ahead. What was the question you raised?

Sneha Borse: Sir, the question I raised was; “Is cytoskeleton present and prokaryotes and eukaryotes?” Sir, for answer, for this question is cytoskeleton is present in eukaryotes, and it is not present in prokaryotes. Because this prokaryotes are not well developed, since they are single bounded. And the second question was; “Is, in cytoskeleton are the microtubules attached to? Where are the microtubules attached?” So, they are attached to the centrioles of the microtubules.

Professor: Right. So, the centrosome is where they begin. And remember, as I said, the tip of the microtubules has something called the tip complex. Because the tip is very important. So, this thing is just wriggling around inside the cell. So if it has to be parked someplace, the way the cell does it, it kind of holds the tip in that place, and this ensures that there is now a proper highway from the center of the cell to that particular point.

So, when it comes to delivering stuff, his becomes very, very useful if you are able to anchor or hold the tip in a particular place. The interesting thing about microtubules also is that, along with being these very dynamic structures that are kind of moving around in the cell, and then also having this tip, tip complex and being anchored at a specific place, they are assembled or put together in other complex structures as well.

And we will look at the Cilia in the next class, where these microtubule strands actually come together, along with motor proteins, which we will discuss later, to create a structure that is very different from what we see in, in in a cell that I just showed you. So, this movie of this microtubule is the, is the same microtubule but it is doing very different things, it is assembled and put together very differently.

In prokaryotes, the interesting thing is, there are versions of or molecules that actually look like and could actually do things that, actins or, or microtubules, could do, but they do not work like microtubules in eukaryotes do, they do not assemble like they do there. Gayatri's lab here in IISER actually studies cytoskeleton components that are in prokaryotes, and she works on molecules like FtsZ, right, and you do not have to remember any of these.

But remember that there are such molecules, that are present in prokaryotes, that could have been the predecessors to the tubulin, that we now know, exists and comes together to form the microtubules strand, or the actins subunits that, that are that are present in eukaryotes. But they are not the same, the same kind of structures do not exist there. Thanks again. So, now we will take a few questions here. Go ahead, Sai.

Sai: Yes, sir. I was just thinking about, if the dynamic structure of the cytoskeleton actually has any significance, like, I know that in, like WBCs, and all that they kind of do not stick to a particular shape. And that might help them to.

Professor: Right. No, it is hugely vital. Remember, cells are very dynamic structures themselves. Everything from just being able to bend the membrane and create a pocket to take up something, requires very rapid remodeling of the cell membrane. And, and the cell membrane is not getting remodeled, the cell membrane is actually tagged to the cytoskeleton that is underneath it.

And that actin cytoskeleton, is what is bending. Simple things like pinching off of the membrane, requires the cytoskeleton, there are proteins that come and bind the membrane, and then that will kind of shrink the membrane to allow it to pinch off. But they are all supported by the cytoskeleton, the cell moving from one place to another, the cell putting out protrusions, to feel and sense its environment, or talk to neighboring cells, everything is dynamic.

And, so a cytoskeleton that is non dynamic in cells would have been, almost useless for the cell. Because the cell is not now trying to limit itself to one place. It is not like it is thinking, I am going to stay here and spend my entire life here. And so I have to do very little, other than sit and process stuff. It is looking to move around, it is looking to kind of create more complex structures. And so, that dynamic nature of the cytoskeleton is very, very vital to why they have become such an important player, and is very vital to what it has allowed the cells to do.

Sai: Also, if a cell is engulfing something, like when it pinches off as like, vacuole or whatever. Does that retain the cytoskeleton component of it?

Professor: So it will retain the cytoskeleton component. And so that is part of the process. So, so that dynamicity is integral, without that there is no going forward as far as cytoskeleton is concerned. And the more you read about cells, the more you will begin to appreciate all the things that you know, that these cells are able to do because of a dynamic cytoskeleton.

And next class I will begin with the intermediate filaments, and we will kind of quickly go through what or intermediate filaments are and how they are different from these two components. So, there is a third component now. So think about that. What is it? One, one question I want to pose to you guys to think about is, you know actin, you know cytoskeleton, microtubules, how they are similar and different.

If you have to put a third cytoskeleton component here, what is it that you want this one to do? That is going to be very different from these two. Does it actually have to be different? Can it be like these two and still be there? We will find out when we talk about the cytoskeleton.