**Electronic Systems for Cancer Diagnosis**

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**Lecture – 01**
**Tissue and Cell Culture Techniques**

Hi welcome to this particular module and we will be learning in this module what are Tissue and Cell Culture Techniques. So, it is very important, because for our course electronic system for cancer diagnosis we need to understand how the cancer occurs in a human body right and what exactly a cancer is. So, when you will understand in detail what exactly cancer is you will find that it is nothing, but a group of cells dividing unevenly and that causes the problem in the human body alright.

So, when we talk about cell dividing unevenly what exactly we mean right and how you are culturing those cells, how to culture within the body? So, what is the environment within the body and how we are how these cells accumulate together to form our tissues, how tissue accumulate together to form an organ right. So, let us see today, what our cell means and then few cell culture techniques or you can say tissue culture techniques. When there is a culturing; that means, that your culturing in the laboratory alright. So, there are several terms that we will be learning today one of those terms is called in - vivo techniques, another one is called ex - vivo techniques and the final one is called in - vitro techniques.

So, we will learn how those techniques are and how we can take advantage of the existing cell and tissue culture to learn about the progression of cancer and to learn about how we can design electronic system if we want to address the problem which are tissue related cancers alright.

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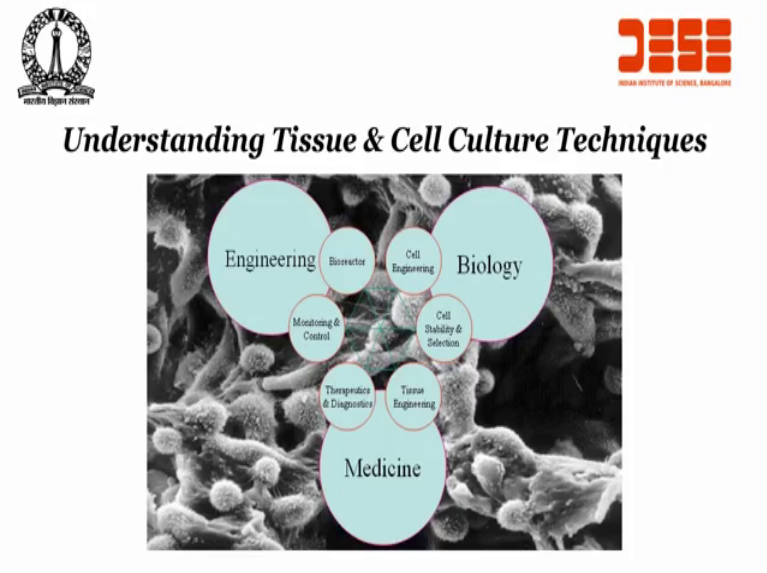


So, with that particular goal let us start our this particular module and like I said we are here interested in understanding tissue and cell culture techniques. So, when you talk about tissue and cell culture techniques it is a combination of engineering, it is combination of biology, it is a combination of medicine.

So, when you talk about engineering and biology and medicine that combination it is very interesting because you can talk about cell engineering, you can talk about bioreactor, you can talk about how to monitor and control, you can understand what is cell stability and selection. You can understand what exactly a tissue engineering means and then you can understand how you can design therapeutics and diagnostics devices, if you know all 3 things if you link all 3 things together all right.

So, finally, understanding about biology and medicine will help us to design a novel electronic systems for curing or for diagnosing cancer that is the idea right, now that is why we are understanding this as a introductory class. So, that we understand how the cell looks like, how the tissue looks like and how can we take, how can we fabricate devices, fabricate microchips, fabricate electronic systems or integrate electronic systems all together to understand the tissue properties.

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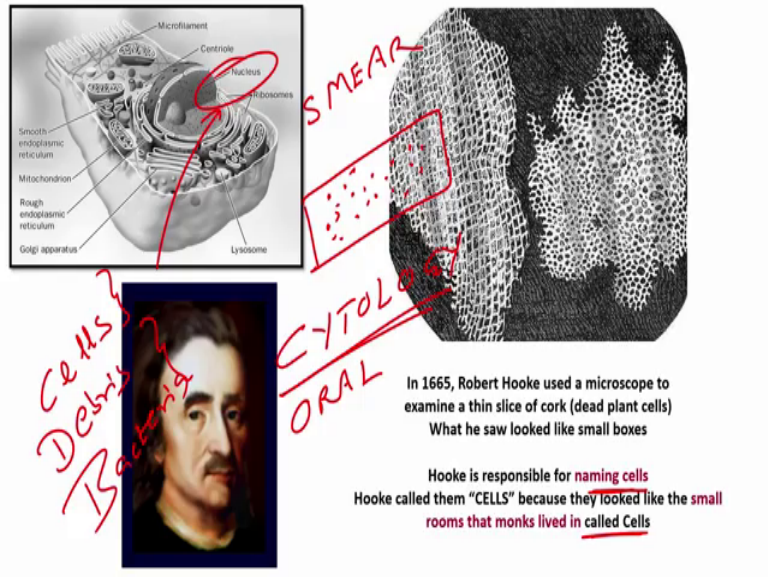


So, if you see the where exactly the cell originated in 1665 a Robert Hooke used a microscope to examine a thin slice of cork dead plant cells and what he saw looked like small boxes. You can see here right in this particular image it looks like small boxes placed together isn't it and at that time the monk used to live in a small area which is very similar to this kind of boxes and they used to call them cells. And that is how Hooke came up with the naming of these small boxes as cells as they look like the small rooms that monks lived alright.

So, that is how the name originated when you look at the details of the single cell, what you will find? You will find a micro filaments inside the cells, you can find centriole, you can find a nucleus, you can understand ribosomes, there are lysosome, there is golgi apparatus, there is endoplasmic reticulum right, there is mitochondria, there is smooth endoplasmic reticulum. So, lot of structure formulates a cell alright. The interesting is the nucleus how we will know if I take the number of cells let us say if I take number of cells and I place on the glass slide.

How do you know whether all these dot looking structures our cells are not right, suppose I take using cytology. So, if you remember the 5 minutes introduction class I told about a word called cytology studying of cells right. So, if you want to study let us say oral cancer then you need to take out cells from the mouth, when you take out the

cells and you smear the cells, what do you do smear, SMEAR when you take out the cells and smears just smear the cells you will see like this ok.

Now the question is how you are sure that all these dots are cells or there are debris or there are bacteria how will delineate the cells from the debris and other things all right, that is where the nuclear staining helps us alright.

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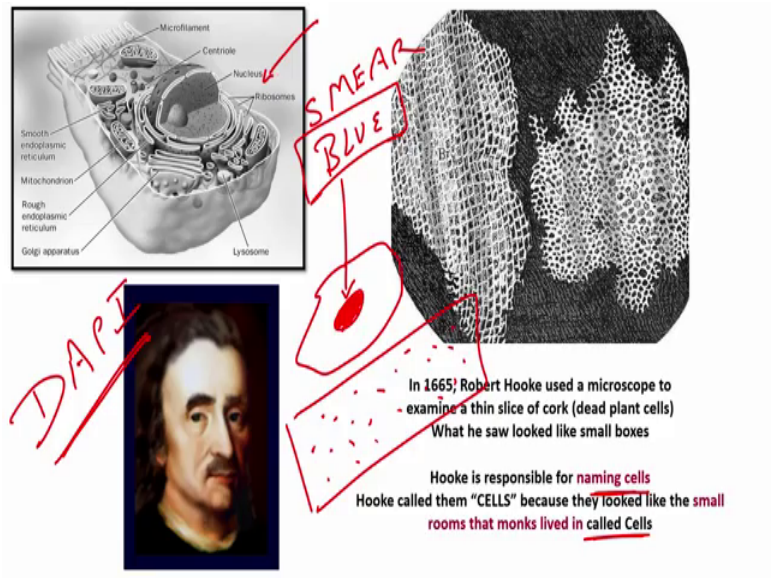


So, you can do a nuclear staining and you will see that when you stain the nucleus of a cell with a marker called Dapi, DAPI you will see that this nucleus within the cell this nucleus will turn blue. You can see a red dot because my pen is red, but when you stain the cell with DAPI you will see that the nucleus turns to blue; that means, that if I have a glass slide with some dots.

And if I stay in these cells with Dapi then I would distinguish or delineate these cells from debris and other organisms right because I can see clearly the cells who amongst these other particles would the nucleus would turn blue in color will turn blue in color ok. So, that is a something that we need to understand when you talk about the cells. Now let us go to the next slide right so, the point is that when you open the cell you can see lot of things within the cell, then the most important thing from engineering perspective is that, What we will do if cell consists of so, complex things right.

What we want to do is, what we are to understand is that yes the cell constitutes of lot of this particular technical names microfilament our nucleus and ribosomes and a lot of the things, but the chemical composition within the cell sodium, potassium, right that if the cell is lysed, lysed is when the cell dies when the cell ruptures right then this chemical comes out and these chemicals are conductive that is what our interest lies. So, let me give an example why it is really important from engineering perspective ok. So, if I have a material and I can measure a impedance right impedance or resistance.

Let us say resistance is inversely inverse of conductivity correct, more conductive material is the less is resistance value right or higher the resistance value less the conductivity. So, what I want to tell you is that, if you have cells alright and if the cell ruptures if the cell lies what will happen the chemical within the cell will come out when the chemical within the cell comes out the conductivity increases so, how can we use it, what is there for us right. So, the interesting thing is if I load a drug on group of cells and if the drug is effective then the cells would lies and the conductivity would increase.

So, if I can design a sensor which can measure the conductivity of cells and when the cell is lysed then I can understand whether the drug is effective or not; that means, I can understand the efficacy of a drug; that means, that I can do a drug screening. So, for drug screening using the conductivity we can design a device right, that we will see as a part of this course and I will tell you how quickly we can design this drug skimming device very easy a simple property of conductivity right. Now you cannot measure resistance in this case because the cells are capped in a drug and if you understand that it is not re assistance now because there is a double layer capacitance involved when designer device on which you are putting the cells. You cannot just rely on dc the current resistance you had to rely on impedance because lot of parasitic effect would come into picture.

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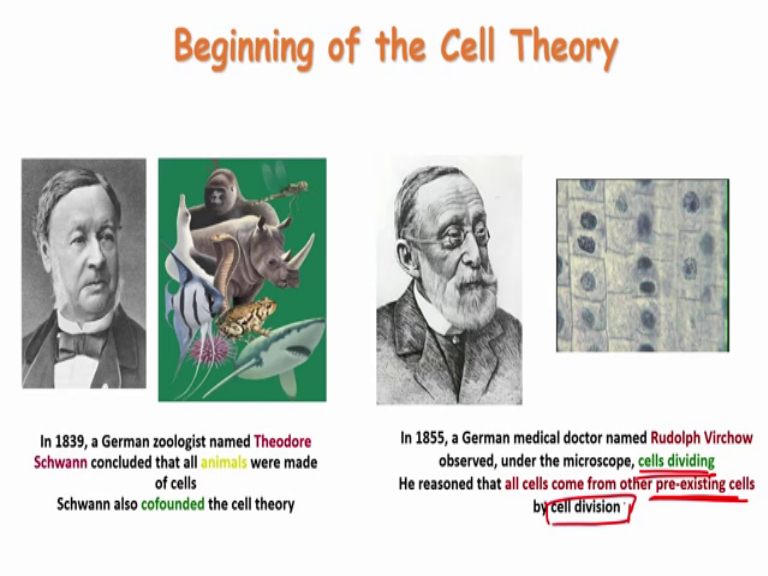


So, we will see coming back to our cell theory. So, the beginning of the cell theory in 1839 a German zoologist named Theodore Schwann concluded that all animals were made up of cells. And he also co founded the cell theory right, what he found that all the animals right you talk from humans, chimpanzees, snake, frog, fish, talk about anything right were made up of cells good. So, what happened in 1855?

In 1855 a German medical doctor right, named Rudolph observed under the microscope cells dividing all right very interesting observation and he reasoned that all cells comes from other pre existing cells by the phenomenon called cell division alright. So, the cell division is responsible for forming other cells. So, from where the cell comes from the pre existing cells alright. So, this was the observation by Rudolph Virchow a German medical doctor in 1855.

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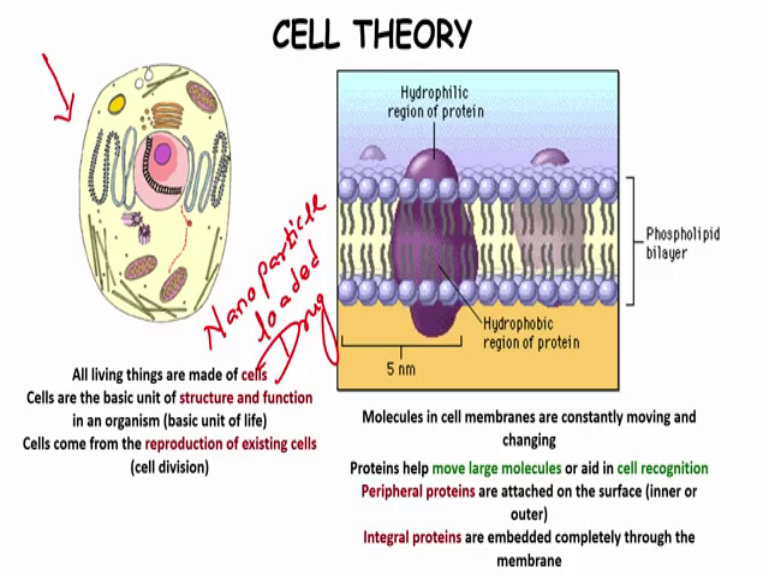


So, if you further understand if you take a cell which is right shown here all living things are made up of cells right cells are the basic unit of structure of a function in an organism and it is the basic unit of life, cells comes from the reproduction of existing cells and that is (Refer Time: 14:10) with the cell division. When you understand within the cell you will see that there are hydrophobic region of protein, there are hydrophilic region of protein, there is a phospholipid bilayer and molecules in the cell membranes are constantly moving and changing. Additionally those proteins also help move larger molecules are aiding cell recognition, now within the proteins we divide proteins into 2 sub divisions, the first one we call peripheral proteins and second one we call integral proteins.

So, what are peripheral proteins and what are integral proteins? Peripheral proteins are attached on the surface inner or outer, while the integral proteins are embedded completely through the membrane. So, recently if you read a research papers you will find that lot of groups are working on introducing the drug within the cell or they say nano particle loaded drug, nano particle loaded drug alright. So, what is the purpose of this? It is very interesting idea and like I said lot of research groups are working on this. So, the point is here.

You see when a drug enters the cell alright how much time a drug can stay within the cell, how much time a drug can stay within the cell is called influx. The time at which

they say the drug is thrown out of the cell is called efflux, influx efflux right. Now, why drug is thrown out of the cell because drug is not the part of a cell right. So, how fast the drug is thrown out now the drug is thrown out quickly. So, the efflux is faster than the effect of the drug onto the cell would be minimal right.

But if I create a drug within a nano particle and then nanoparticle is made up of lipid or phospholipid. So, I cover the phospholipid around the drug and I introduce that nano particle loaded drug into the cell what will happen bilipid or phospholipid is a part of the cell right. So, now, this say the efflux will reduce the time that is thrown out right is now less; that means, that more time a drug can stay within the cell the more time the duct can stay within the cell it will start acting on the cell and it will start rupturing the cell and thus the treatment becomes more effective. That is what I meant by nanoparticle loaded drug see interesting right, same thing very interesting.

Now, in the brain there is something called blood brain barrier. So, the drug cannot pass through lot of the through this barrier and that is why we do reduce the size of the drug to nanoparticles. So, that it can diffuse through the gaps available in this particular blood brain barrier. But the question is how to improve the influx or how to reduce the efflux right? So, very interesting point here is that brain consists of what, it consists of stem cells all the all the things starts from the stem cells right. So, it is a brain stem cells or we can say neural stem cells neurons right so, a group of neurons.

So, neural stem cells neural stem cells causes a new formation of new neurons with an axon and further there are lot of subdivisions within a brain also, there is a different topic of research right. Now what we are talking is, if I can lower the neural stem cells with drug and I introduce those neural stem cells loaded with drug for treating the disease related to brain like brain cancer. Can we improve the influx or can we reduce the efflux; that means, the time that the drug can stay more time within that neural stem neurons question right and that can be a neural stem cells as a novel drug delivery mechanism for treating brain cancer.

Can we use that right and if we can how can we do that? So, anything boils down finally, to what these cells and that is why we need to understand cells and that is why this particular module. So, if you come back to the pbt what we find is we have seen cell theory, we have seen how the beginning of cell theory was, there we have seen the

structure of the cells and we have seen the how the cell and tissue culture can be used right. Now in our next module what we learn, we learn what are the cell culture or what is the cell culture, now we understand basic thing which is what it cells or what are cells right a little bit of cell theory and I told you to 3 different words remember it influx efflux, in -vivo, ex - vivo, in- vitro right.

And we saw that the conductivity of these cells right or the media or would increase if you lys the cell, if the cell dies and that phenomenon we can use for drug screening to understand efficacy of a drug. We also discussed that we can use we can load the drug within a biological sample or against a nanoparticle such that the efflux would decrease all the time that a drug can spend within the cell would increase. In the next module let us see what is the cell culture and what are the techniques or equipment used for cell culture. Till then you take care, have fun see you; bye.