Biochemical Engineering

Prof. Dr. Rintu Banerjee

Department of Agricultural and Food Engineering

Assistant Prof. Dr. Saikat Chakraborty

Department of Chemical Engineering

Indian Institute of Technology, Kharagpur

Module No. # 01

Lecture No. # 03

Virus and Cell Organelles

Good morning students. In continuation of my last class, today I will be talking about viruses.

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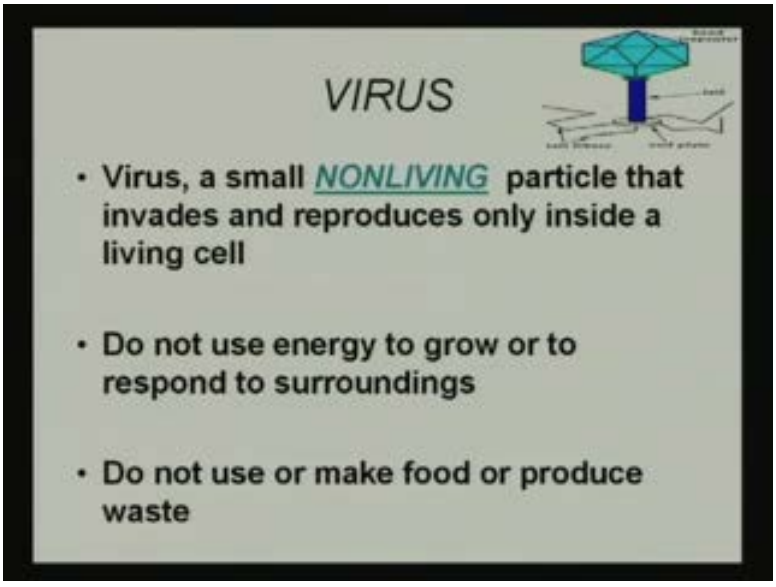

As I have told you earlier that viruses are the controversial creature in this universe and as long as they are outside of the living cell they are considered as nonliving. And will when they come in contact with the host cell they do certain activities for which the scientists are compelled to believe that virus is a living particle. So, viruses are very small tiny particles that invade and reproduce only when they come in contact with the living cell. They do not use any energy to grow or respond to the surroundings. They do

not use or make food or produce any waste which makes us to think that virus is nonliving.

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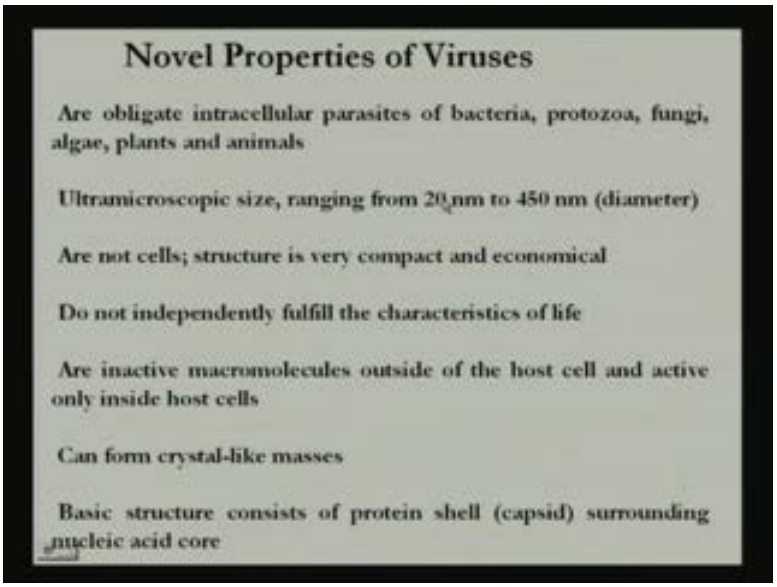

Now, if you see some novel properties of the viruses, we will find that they are obligate intracellular parasite and when they come in contact with any living cell like bacteria, protozoa, fungi, algae, plant and animal this do their certain activities and we consider that and these viruses are living. They are ultramicroscopic in size. Their size ranges from 20 nanometer to 450 nanometer. Now, when in my last class I was talking to you about the prokaryotic organism and bacteria was one of such example I told you that the sizes of bacteria vary from, in in the tune of micrometer level.

But, here the viruses are so tiny that their structure their sizes vary in the tune of nanometer. They are very simple in structure. They do not independently full fill the characteristics of life. They are inactive macromolecules outside of the host cell and only active when it comes in contact with the host cell. They can form crystal like masses and basic structure consists of a protein cell which is called the capsid which is surrounded by the nucleic acid core. So what we can say that, this viruses are a very tiny particles and they are very simple in structure.

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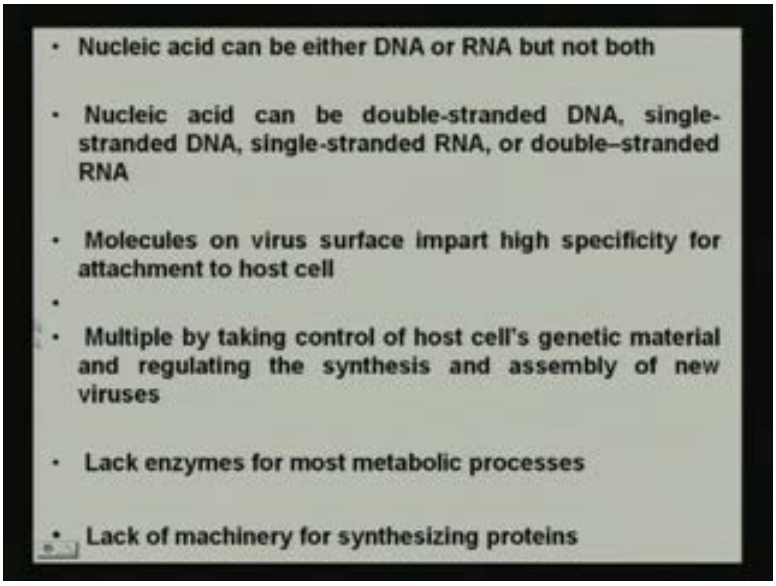

This nucleic acid are either DNA or RNA molecules. Nucleic acid can be double stranded, DNA single standard, DNA single stranded, RNA or double stranded RNA. But, both RNA and DNA are not present in any virus particle. The molecules on virus surface impart high specificity for attachment to the host cell. They are multiple by taking control of the host cells genetic material and regulate the synthesis and assembly of the new virus particle inside the host. In reality, they lack the machineries for synthesizing the protein molecule and they also lack the enzymes for most of the metabolic processes.

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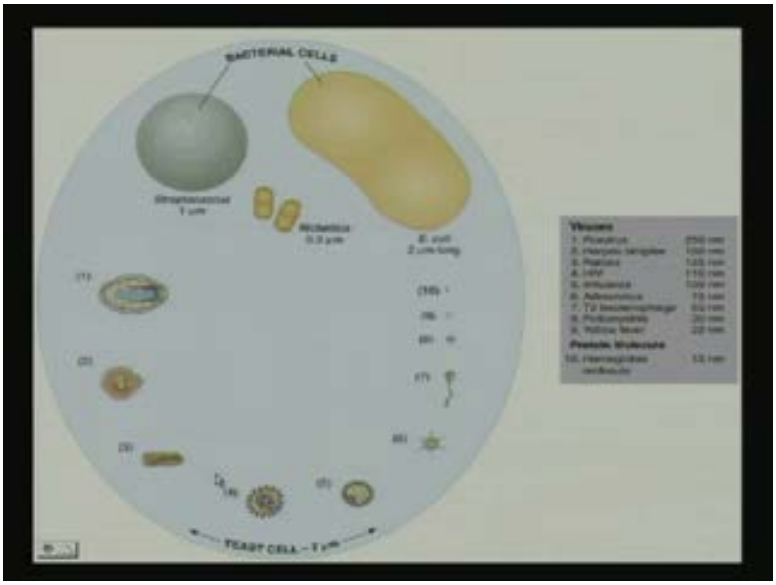

So, if you see the sizes of viruses then we can find that the biggest virus till date reported is the poxvirus and the smallest one is the yellow fever virus. The size of the poxvirus is in the range of 250 nanometer where as yellow fever virus is 22 nanometer.

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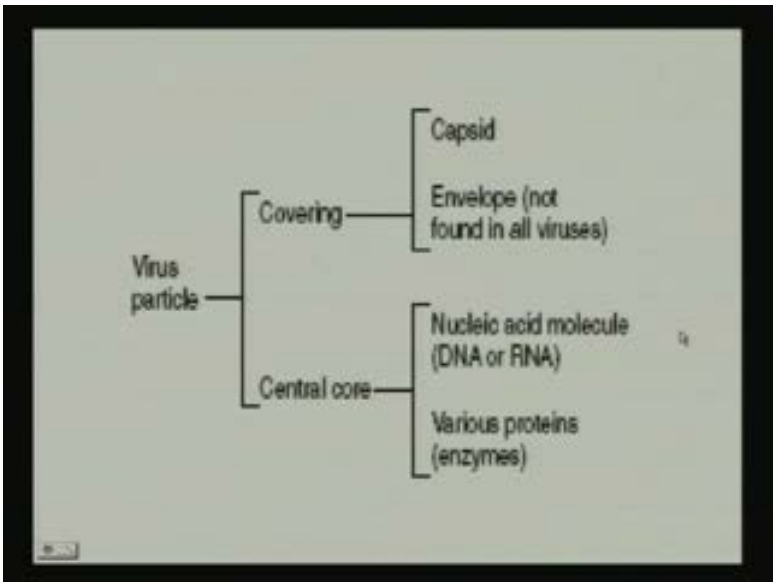

Now, as I have told that they are very tiny small organism and if you see its architecture then, we can find that this viruses has two major part; one is the covering part, another is the central core. This covering part can be once again divided into two; one is called the capsid and another is the envelop. And this envelop is also not present in every viruses. It is found in some of the viruses. If you see the central core, we can find that this is the nucleic acid molecule either DNA or RNA which is covered by this capsid and this virus protein are also present along with this nucleic acid.

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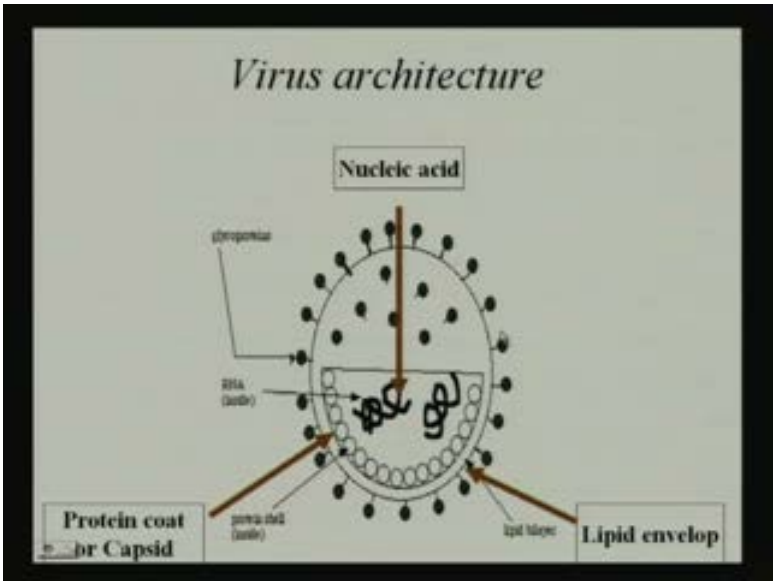

And now, let us see the architecture of viral cell. Now, if we see this virus particle we can find that the inside the cell this nucleic acids are present which is covered by the protein core which is called the capsid or protein core. Sometime in some viruses, some lipid envelop are present which are bilayer in nature and sometimes some glycoprotein receptors are present on the cell surface of the viruses which helps the virus to recognize the host cell.

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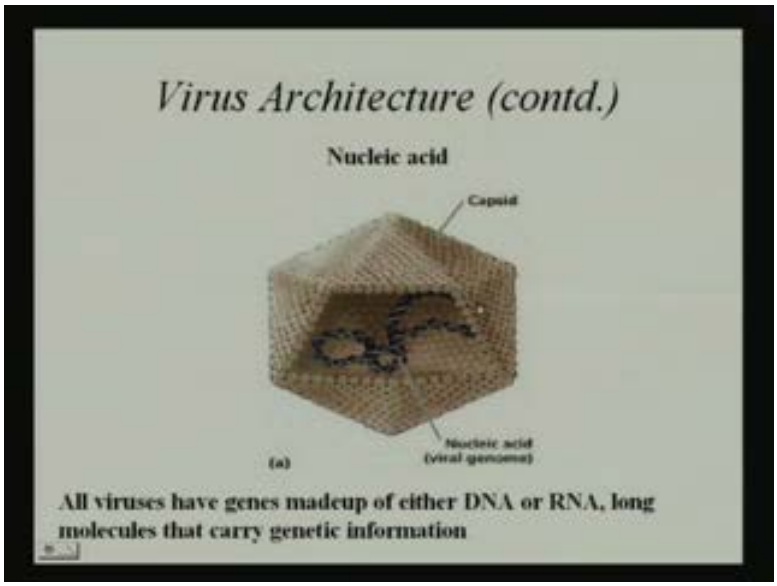

These are the different architecture of bacteria virus sorry.

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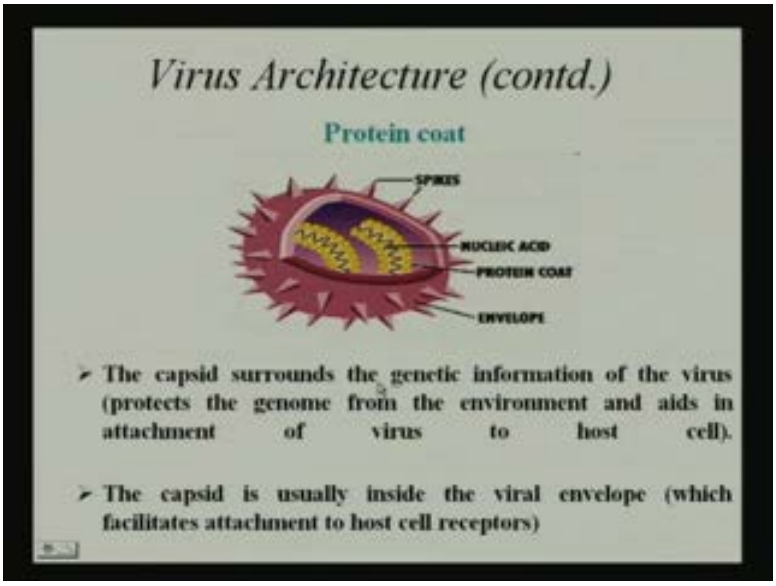

And this virus architecture if you see in some of the viruses, this protein coat is there beside this protein coat and nucleic acid there are certain envelops are present to which some spike like structures are present. And this spike like structure, it helps the virus to go and sit on the cell surface of the bacteria or the host cell.

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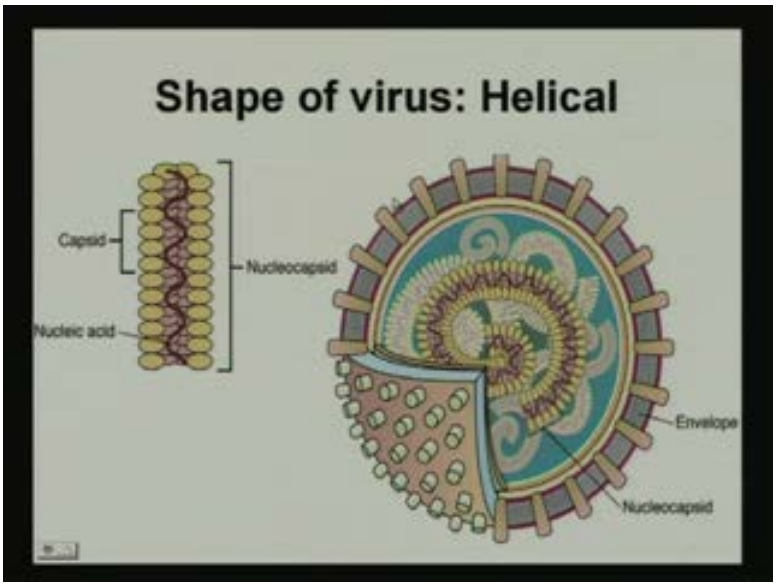

Now, if we see the shape of virus particle then based on the shape, viruses can be categorized into different grades; one is called the helical type of helical shaped virus. Now, in this helical shape the structure itself indicates that it is helix like structure. Here

this nucleic acid is present as the genetic material which is covered by the protein coat which is called the capsid. And all together this is called the nucleocapsid. This nucleocapsid is present inside the virus and it is covered by a layer which is called the envelop. And this particle this as its shape is helical like this is called helical shaped viruses.

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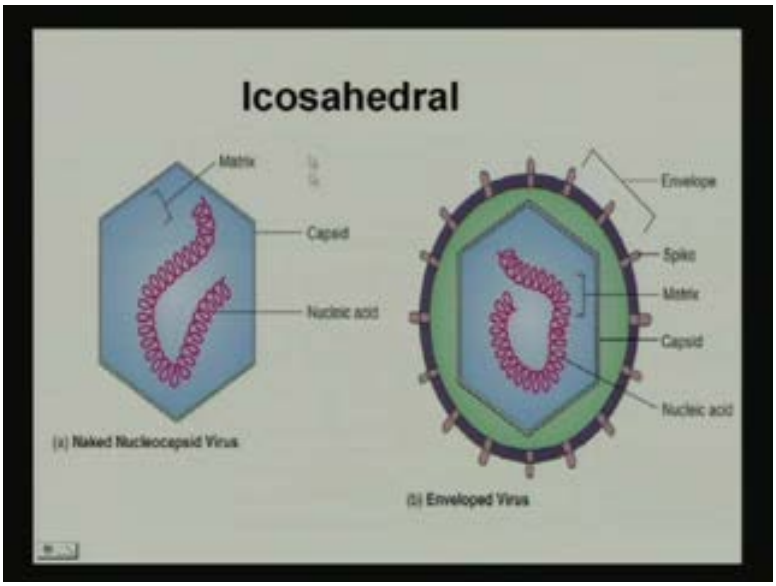

Another group of virus is called icosahedral. Now here, this this type of viruses under low magnification looks like spherical but, when under proper magnification it looks like icosahedral. Here also inside this nucleic acid maltase are there which is covered by the capsid or the protein coat. And some matrix molecule is there inside and sometimes it is enveloped and this envelop has also in in this envelope some spikes are present. So, this is the icosahedral enveloped virus.

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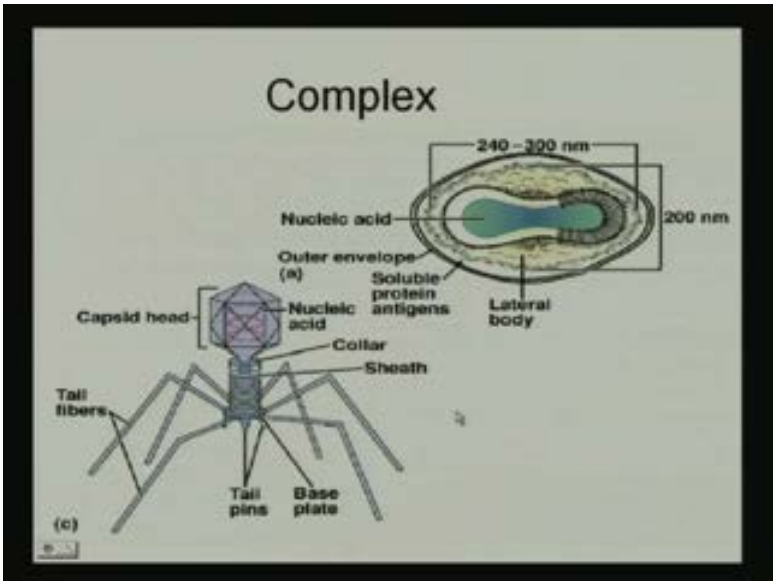

Another group of virus is called the complex virus. Now here, poxvirus and bacteriophage are the example of such type of viruses. In case of complex viruses, this nucleic acid maltase are present, along with that the outer envelope is present in which the soluble protein and antigens are present. Lateral body is also there and the size of this virus is 250 nanometer to 300 nanometer which is considered to be the biggest virus. Now, if we come to the another complex virus then we can divide the entire structure of such type of viruses into two major group; one is called the head, another is the tail. Now, in this head portion, this head is covered with a capsid that means protein coat in which the nucleic acid is present. Now, this head is attached to the tail with the collar and sheath and in this tail portion there is a base plate to which some tail fibers are present along with the tail pins. This tail pins they help and this fibers they help the virus to go and sit on the cell wall of any bacteria or host cell host cell.

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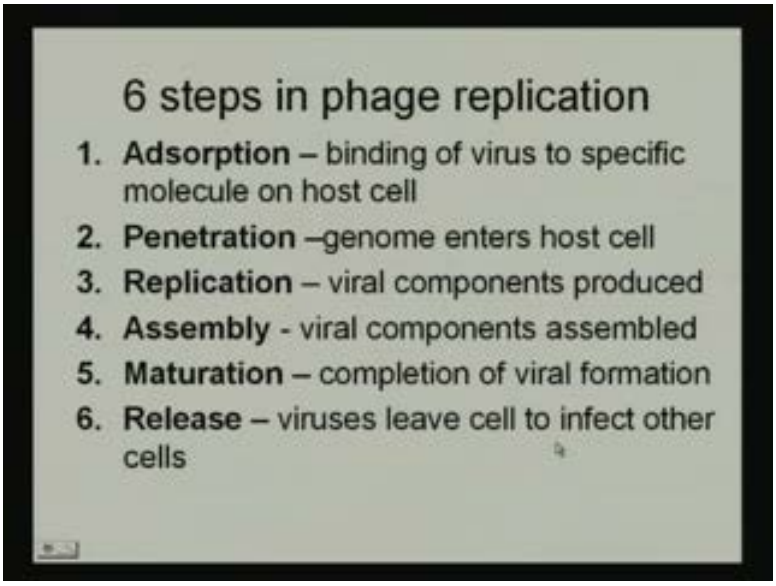

Now this is the architecture of bacteria virus and if you see the life pattern or the nature of replication of such viruses the entire activities can be divided into six major group; one is called the adsorption, where the this is the phenomena where binding of virus to the specific host cell surface is taking place followed by penetration, then replication, assembly, maturation followed by release. Now, how these activities are going on inside any host cell let us take some example and let us study that.

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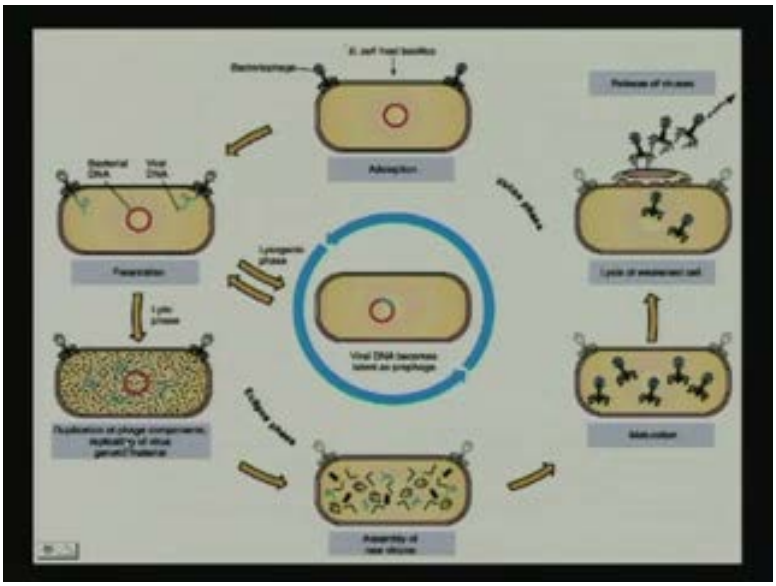

Now, bacteriophage as I have told you that it is a complex virus and it has got one head,

another tail. And tail has got some tail pins which help the virus particle to sit on the wall of the bacteria. Now, when we are just considering e coli as the bacteria and this e coli or the bacteria is getting infected, getting killed by this virus infection. Now, when the first virus particle is coming and sitting on the wall cell wall of these bacteria, then first is the adsorption. So, it is coming and getting adsorb on the cell wall of the bacteria outside wall of the bacteria. As soon as it sits on the wall of these bacteria, the next step is that it injects the genetic material, that is the nucleic acid which is present in the head portion which is covered by the capsid and they inject that nucleic acid material inside the bacterial cell so this nucleic acid is inserted in the bacterial cell. The other portion of this virus particle is staying outside. Now, as soon as this nucleic acid enters to this bacterial cell, it is called penetration. Now, once it penetrated to the bacterial cell it starts its replication. Now, this virus particle is inserted in the bacterial cell and by mistake this bacterial genetic material starts recognizing this virus nucleic acid as part of them. And then the replication starts and they starts synthesizing the different body parts of the virus molecule. And here they synthesize the different part it is the replication followed by the assembly. In the next step, they start assembling the different parts of their body and they take the complete shape of a virus particle. And this is called the maturation phase. Now, after assembly, the maturation takes place. When a million and millions of this virus particles are matured inside the cell they put pressure on the cell surface from inside and ultimately it got burst and all the virus particles are going out of the cell resulting the killing of the bacterial cell. And this is called the lytic cycle of virus.

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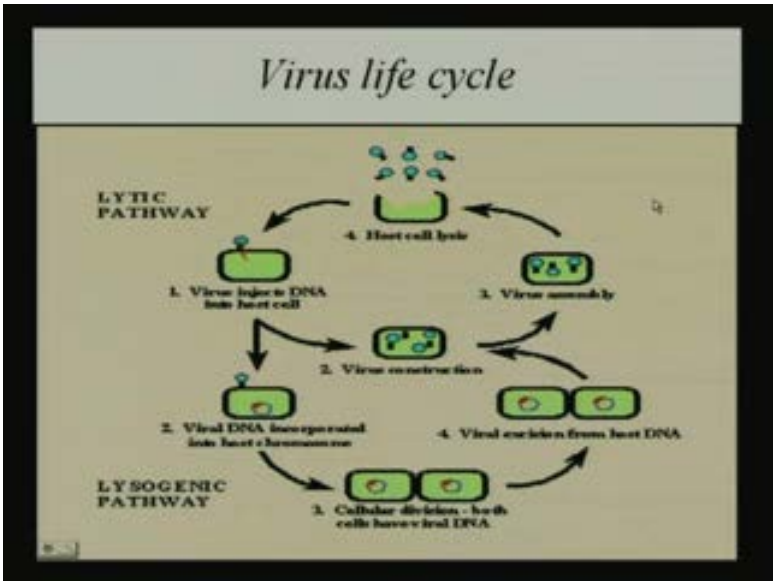

Now, this is one type of life cycle what viruses did do they perform. Another type of life cycle the virus particle which is observed is the Lysogenic pathway. In this Lysogenic pathway unlike these two steps up to penetration, this virus genetic material enters to the bacterial cell. And then this bacterial genetic material which is present they start recognizing the virus nucleic acid as part of their genetic material. And it gets assembled within the bacterial genetic material. Now here, when they undergo the normal cell cycle cell division or reproduction, this virus nucleic acid is also getting divided into the daughter cell and in this way the life cycle goes on in the bacteria. Now, in this way few generations can be taken place and it is remaining as part of the genetic material of the bacterial cell but, under any certain environment. Suppose, exposure of u v light or any drastic condition, once this particular genetic material starts getting expressed then the virus nucleic acid there was again starts their construction. That means they start synthesizing, their replication process starts and they synthesize the different part of the virus particle and then they get assembled and once they mature they release resulting the death of the bacterial cell. And this type of life cycle is called the Lysogenic pathway. And these are the two major life cycles which are followed by the virus particle.

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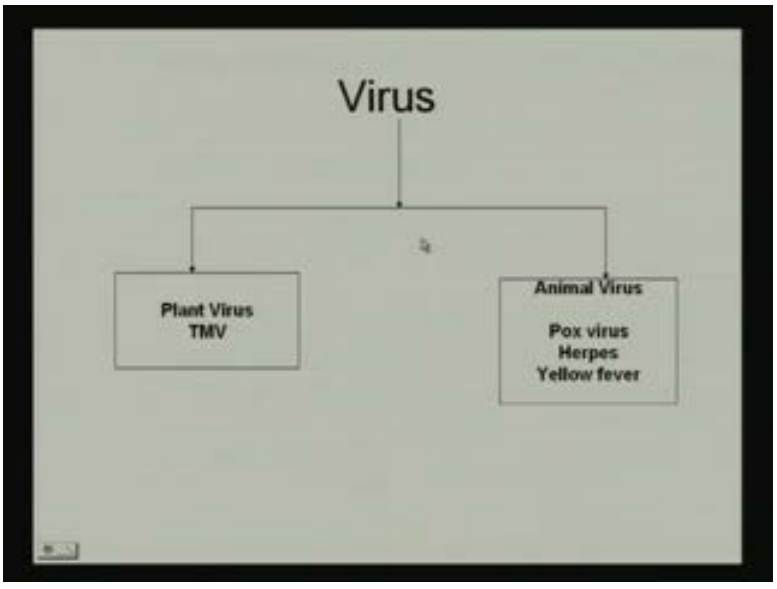

Now, if you see if we classify these viruses; we can divide these virus particles into two major groups; one is called the plant virus and another is called the animal virus. The tobacco mosaic virus is one of such example of plant viruses and animal viruses are the

poxvirus, herpes, yellow fever and so on, HIV and so on. Those viruses are the animal viruses.

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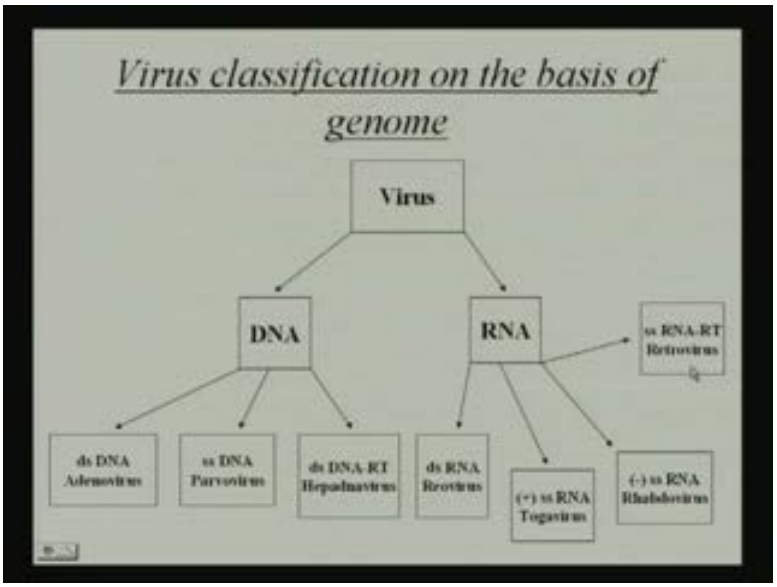

Now, whatever may be the virus particle, these viruses are the smallest creatures which are mostly pathogenic in nature. Now, if we classify these viruses based on its genome structure then, I have already mentioned that DNA either this is the DNA based viruses or RNA based viruses. Now, when it is DNA based viruses; either it is the double stranded DNA or the single stranded DNA. It is double stranded reverse transcriptase DNA or double stranded RNA. That reovirus is of such example. Polar single stranded RNA that is togavirus. Negatively polar single stranded RNA that is the rhabdovirus and single stranded RNA reverse transcriptase is the retrovirus. So, these are all about this viruses. So, these viruses are the tiny and the smallest creature in this universe. And with this I am just concluding my this prokaryotic and this organism.

And now, let me switch over to the eukaryotic organism and eukaryotic cell structure and its cell organelles. Now here, in this particular cell organelles I will be mainly concentrating to the cell theory. Now, as I have already talked to you about the microbial cell, prokaryotic, eukaryotic cell. I have also mentioned you the discovery of microscope and existence of this micro creature in this universe.

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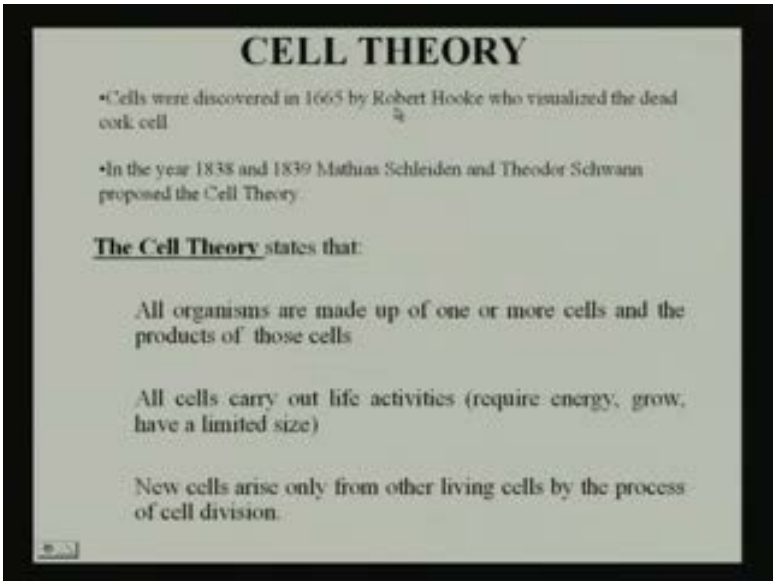

Now, first in sixteen hundred sixty five, the scientist Robert Hooke first visualized the dead cork cell on at a microscope and from there the studies or the existence of the cell in this living creature came into picture. In the year 1838 and 1839 two different scientist Matthias Schleiden and Theodor Schwann they proposed the cell theory. Now, what the cell theory states? The cell theory states that, all organisms are made up of one or more cells and the products of those cells. All cells carryout live activities, it requires energy to grow and have a limited size. New cells arise only after other living cells by the process of cell division. That means cell division is one of the living activities of the cell.

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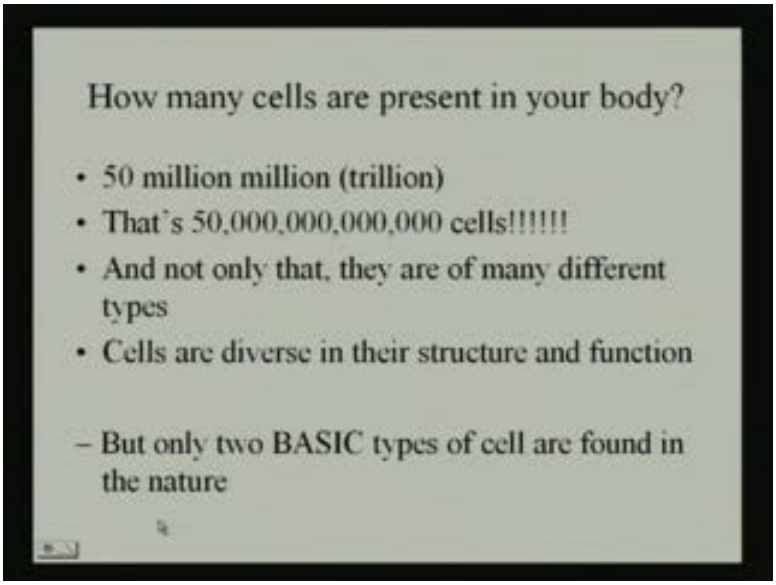

And obviously the question comes that in our body; in your body how many cells are present? Obviously we are eukaryotic and multicellular organism, so obviously how many cells are there in our system? In our body it is 50 million million that means it is in a tune of trillions of cells. And not only that, they are of different types. The cells are diverse in structure as well as in function. But, if you see the basic type of cell then we can find that the entire cell can be divided into two broad categories; one is the prokaryotic or primitive nucleus cell or eukaryotic or the true nucleus cell.

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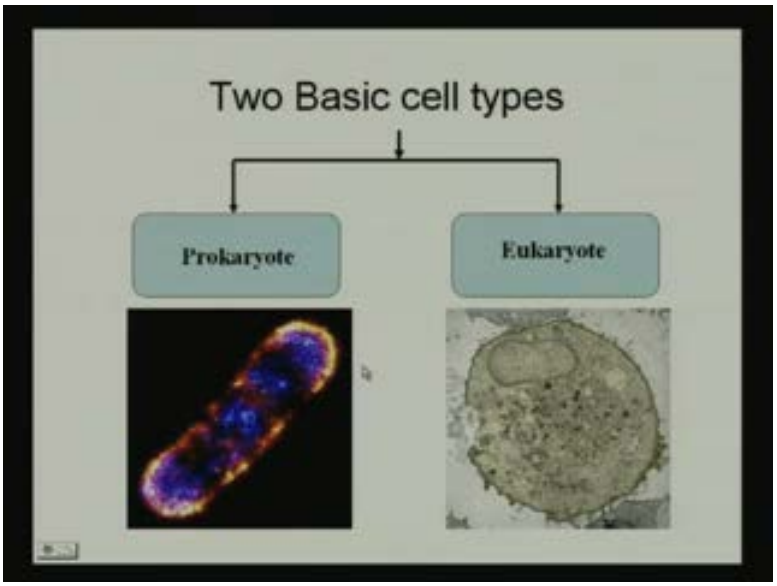

Now, I have already talked to you about the prokaryotic cell in detail. Now, let me tell about the eukaryotic cell in this particular class.

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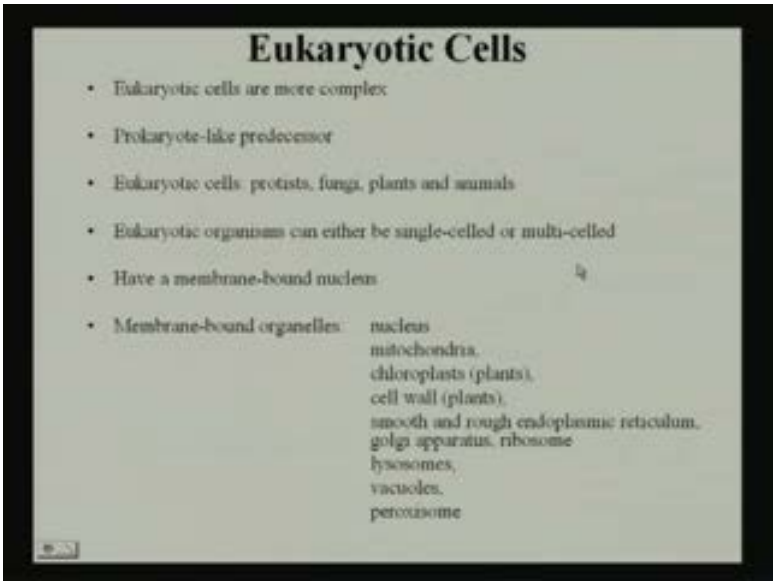

Now, as I have already mentioned that eukaryotic cells are the developed cell, obviously when we are talking about the development. At the same time, we are talking about the complexity. Now, when we are talking about this complexity and if you see the prokaryotic cells are the predecessor of the eukaryotic cell. Eukaryotic cells as in my first class, lecture I have told the five kingdom classification. And then we started the eukaryotes from protists, then fungi plant and animal. So, these all belongs to this eukaryotic cell. Today I will try to cover the cell and its structure in different organelles present in this eukaryotic system. Eukaryotic organism can either be single cell or multicell depending upon its development. It have, this eukaryotic cells have a membrane bound nucleus and different organelles which are present in this eukaryotic system, is the nucleus, mitochondria, chloroplast, smooth and rough endoplasmic reticulum, golgi, apparatus, ribosome, lysosomes, vacuole peroxisome and so on.

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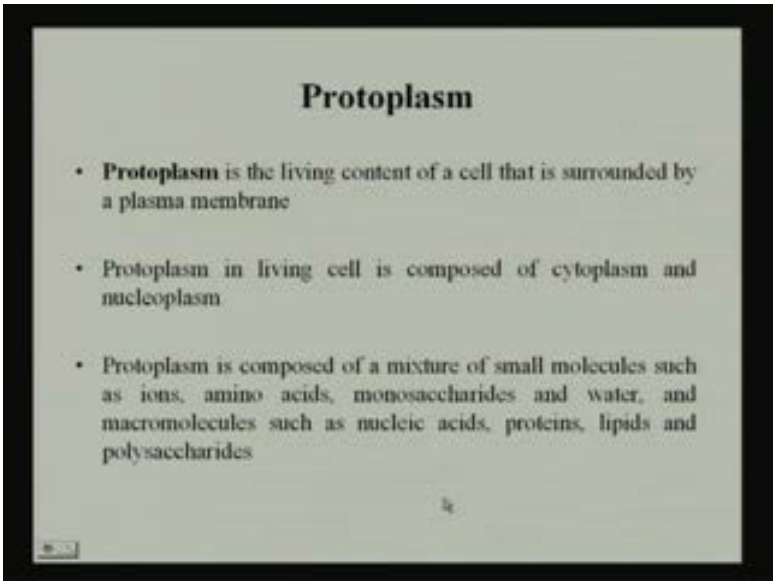

So, let us start the different cell organelles. Now, when we are talking about the different cell organelles, let me start with the protoplasm. This is the fluid which is present in all living system. Now, protoplasm is the living content of the cell that is surrounded by a plasma membrane. Now, protoplasm in living system is composed of cytoplasm and nucleoplasm. Now, when we are talking about the protoplasm, it is the liquid or the fluid and you know in each living cell, more than seventy percent cell contains this type of fluid. That means, three fourth part of the cell contains the fluid. It is essential for any system.

Now, when we are talking about this protoplasm; this protoplasm is the fluid where all the cell organelles are present. When we are talking about the only fluid minus the organelles are the cytoplasm. And when we are talking about the fluid which is present inside the nucleus is called the nucleoplasm. And when we are talking about the cell sap including all the organelles present inside the cell is the protoplasm. Protoplasm is also composed of a mixture of small molecules such as ions, amino acids, monosaccharide and water and the macromolecules such as nucleic acid, protein lipid and polysaccharides. They are the macromolecules. This nucleic acid, protein, lipid and polysaccharides, I will be talking to you in details about each of this macromolecules and their function. But, these particular macromolecules are also present along with some micro molecules in in in the protoplasmic fluid.

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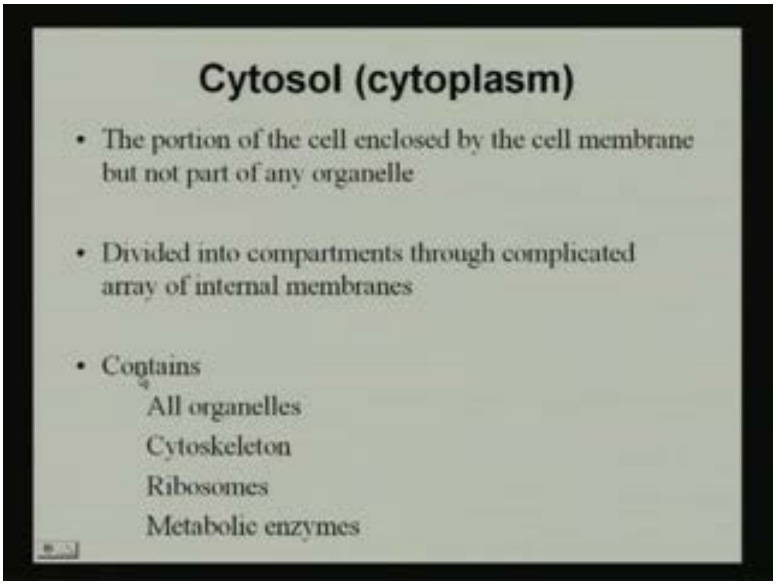

Now, let me come to the cytoplasm. As I have already told, that the portion of cell enclosed by the cell membrane but, not any organelles of the cell is the cytoplasmic fluid or the cytosol. It can be divided into compartment through complicated array of internal membrane. This cytoplasm, in this cytoplasm there are different organelles are present; cytoskeleton, ribosome, metabolic enzymes etc are present in this cytoplasmic fluid.

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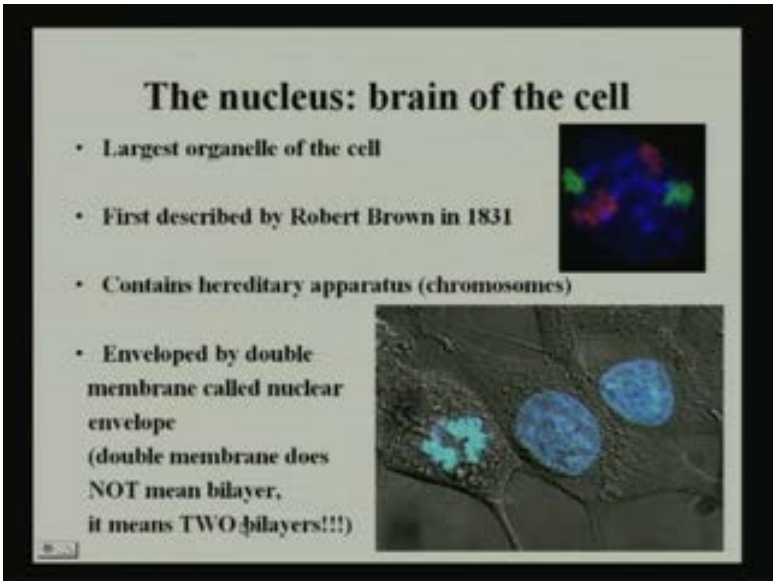

Next, let me come to the most important organelle in the cell. This is the nucleus which is considered to be the brain of the cell. It is the largest organelle of the cell. Robert

Brown in the year of 1831 first discovered the cell. The cell contains the hereditary apparatus which is called the chromosome. It has got the envelop which is bi bilayer. That means two bilayer membranes are there.

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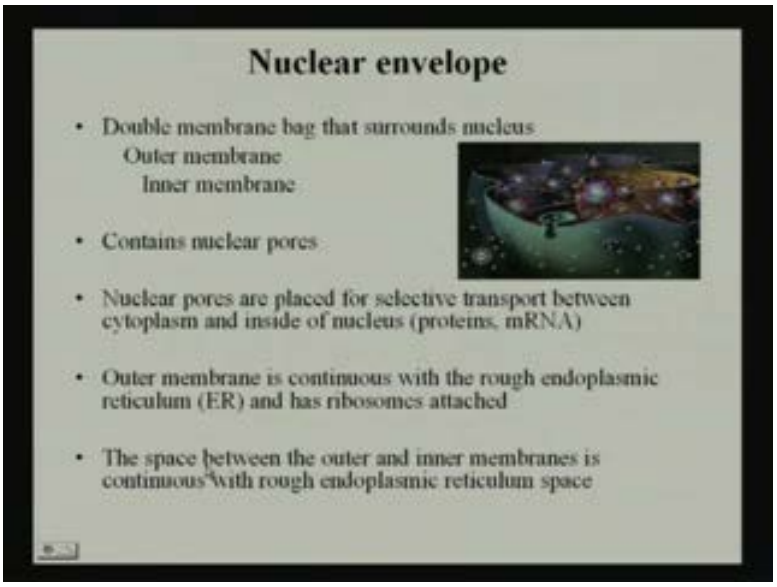

Now, if you see the function of two bi bilayer; membrane we can find that double membrane bag of the nucleus has got outer membrane and inner membrane. And it contains the nuclear pore which is not there in prokaryotic organism. In prokaryotes, there is no cell membrane that nuclear membrane which is covering in in the the genetic material which is present. Nuclear pores in case of eukaryotic cell are placed for selective transport between the cytoplasm and inside the nucleus that is protein and messenger RNA. The outer membrane is continuous with the rough endoplasmic reticulum and has ribosome attached to this. Now, if this is the nucleus, nucleus has got one membrane and it is the outer membrane. The outer membrane is attached to the endoplasmic reticulum. And here, this is two layer of your, this nuclear membrane. The space between the outer and the inner membrane is continuous with the rough endoplasmic reticulum. So, if some ribosomes are attached to it are called the rough endoplasmic reticulum. So, it is present in the nucleus.

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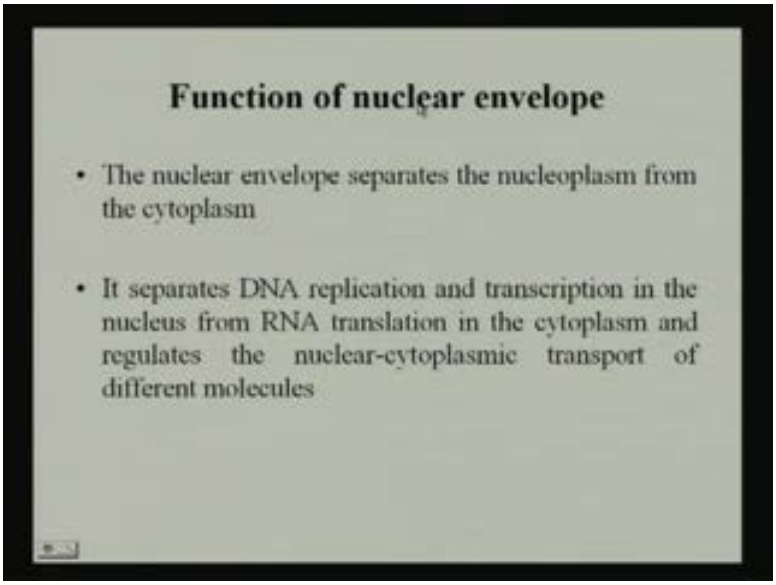

The function of the nuclear envelop is that the nuclear envelop separates the nucleoplasm from the cytoplasm. Now, here the outside of this liquid is the cytoplasm. And here this this barrier, it separates the inside liquid from the outside cytoplasmic liquid. So, inside whatever liquid is there is the nucleoplasm and and here whatever liquid is there it is the cytoplasm. And if this is the total cell structure, it separates DNA replication and transcription in the nucleus from RNA translation in the cytoplasmic fluid. Here, RNA translation is taking place and here DNA replication is taking place. So, this is the main difference in the activities of the nucleus.

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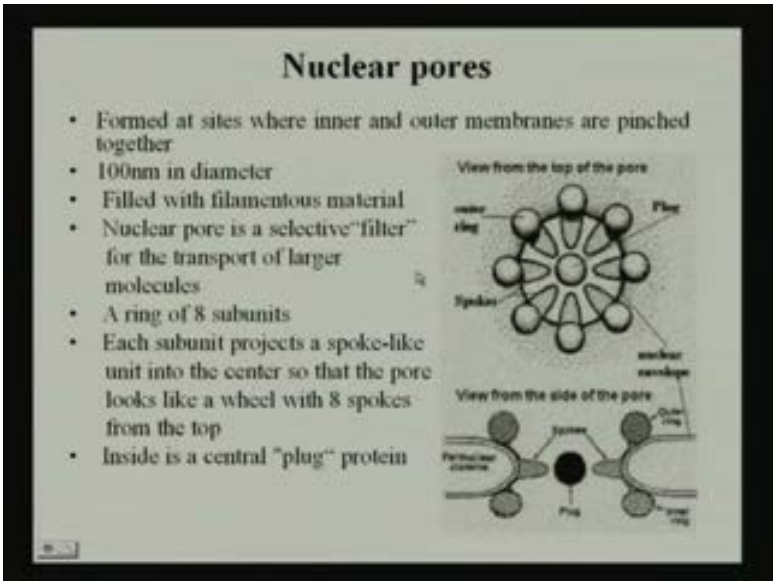

Now, this nucleus has got some nuclear pore. This nuclear pore is formed at the site where inner and outer membranes are pinched together. So, this inner and outer membrane are pinched together is the nuclear pore. So, it is 100 nanometer in diameter, this is 100 nanometer in diameter. It is filled with the filamentous material. The nuclear pore is a selective filter for the transport of larger molecule. A ring of eight subunits are present in this particular nuclear pore. And each subunit projects like a spoke-like unit into the centre so that, the pore look looks like a wheel with eight spokes from the top. So, from the top view view it it looks like a wheel of a cycle and inside the central plug is there which is made up of a protein. So, this is the function. This is the structure of nuclear pore.

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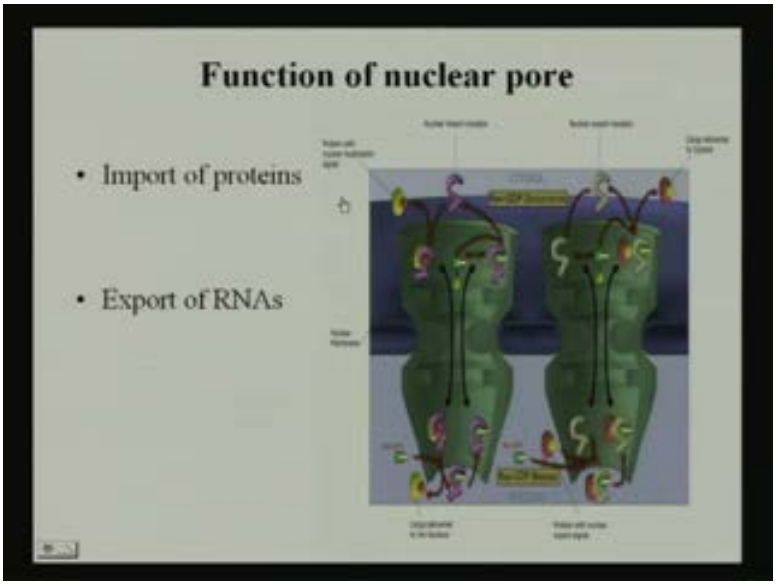

So obviously, what is the function of nuclear pore? This nuclear pore is mainly import the protein and exports the RNA for RNA translation.

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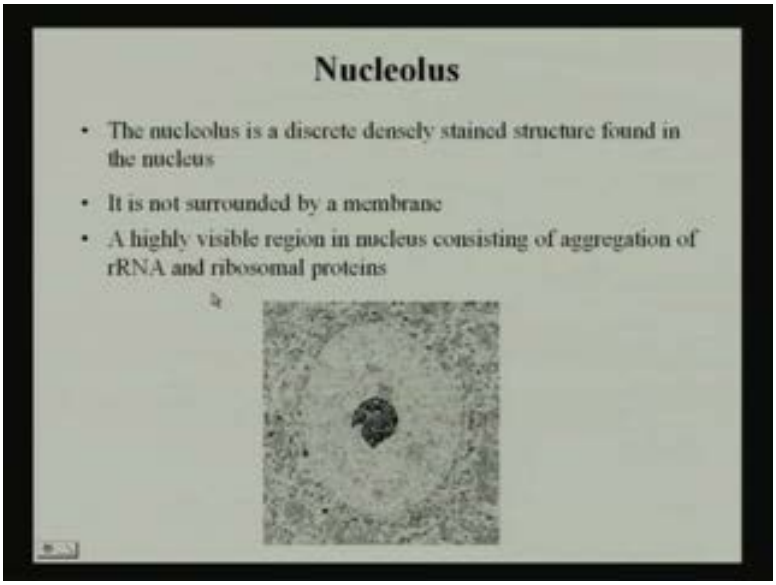

If you see the structure of nucleolus, we will find that the nucleolus is a diverse densely stained structure found in the nucleus. It is not surrounded by a membrane and it is highly visible region in the nucleus consisting of the aggregation of ribosomal RNA and ribosomal protein.

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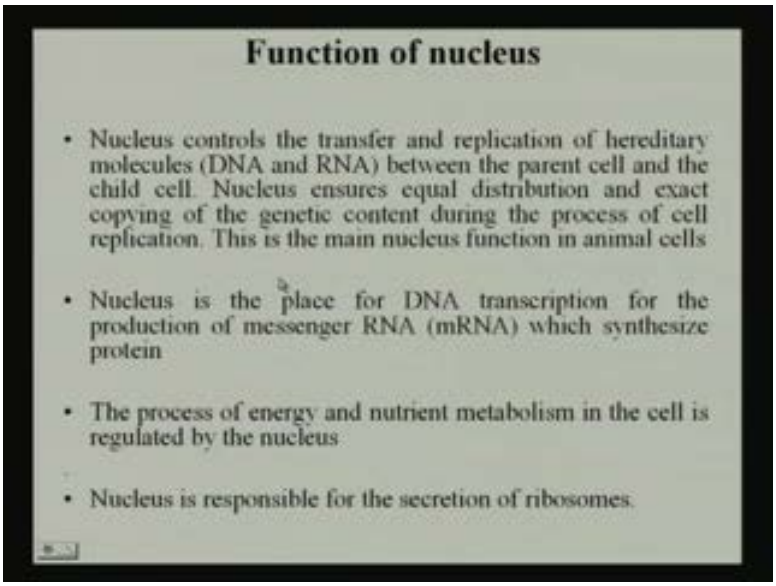

The function of nucleus: It is a very, very, It plays a very important role. Nucleus controls the transfer and replication of hereditary molecules that is DNA and RNA between the parent cell and the child cell. That means during the cell division, the

distribution of genetic material from the parent cell to the daughter cell is controlled by the nucleus. Nucleus ensures equal distribution of exact copying of the genetic content during the process of cell replication and it is the this is the main function of nucleus in the animal system. Nucleus is the place for DNA transcription for the production of messenger RNA which synthesizes the protein. The process of energy and nutrient metabolism in the cell is regulated by the nucleus. Nucleus is responsible for the secretion of ribosome.

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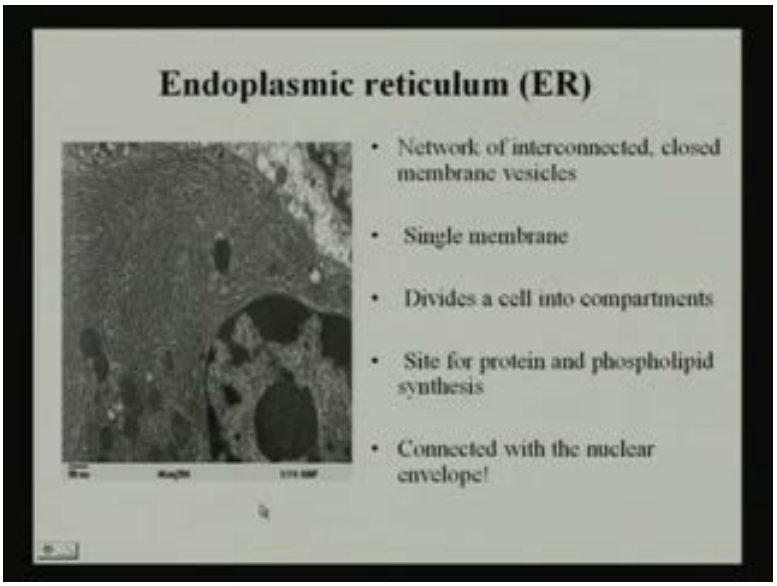

Now, immediately which is connected organelle to the cell? This nucleus is the endoplasmic reticulum. Endoplasmic reticulum is a network of interconnected closed membrane vesicle. It is a single membrane organelle. It divides the cell into compartment and it is the site for protein and phospholipid synthesis. It is connected with the nuclear envelope.

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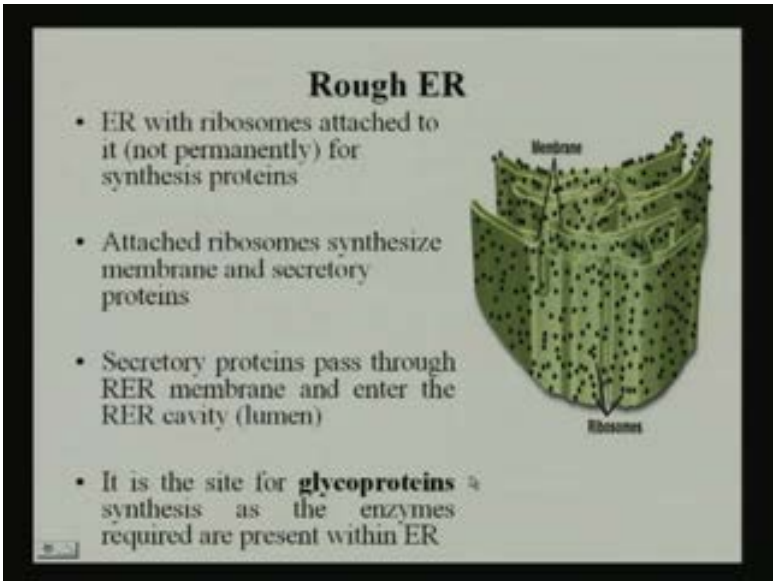

Now, this endoplasmic reticulum can be of two types; one is called rough endoplasmic reticulum and other is the smooth endoplasmic reticulum. Rough endoplasmic reticulum so where ribosome is attached to the surface of the of the endoplasmic reticulum for the synthesis of protein. It may not be permanently attached to the endoplasmic reticulum. Attached to this ribosome is is synthesize the membrane and the secretory protein. Secretory protein passes through the rough endoplasmic reticulum membrane and enters the rough endoplasmic reticulum cavity. That is called the lumen and it is the site for glycoprotein synthesis as the enzyme requires the presence of endoplasmic reticulum.

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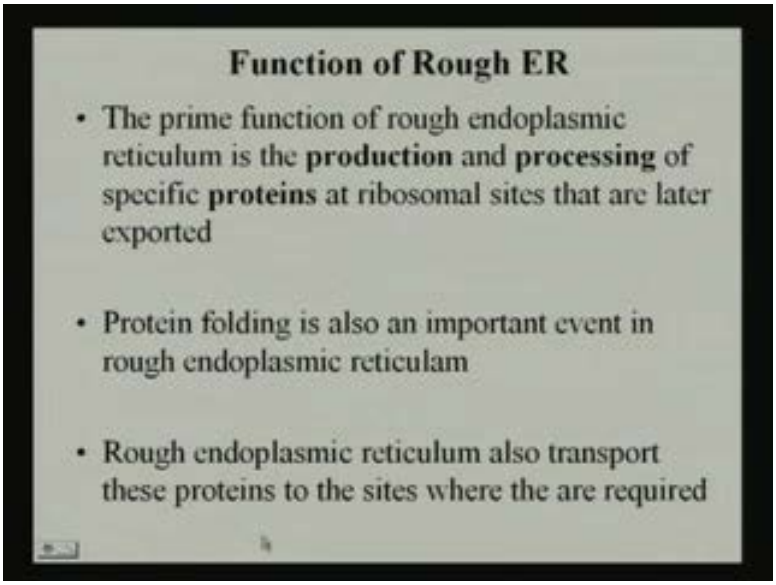

The function of rough endoplasmic reticulum is that, it is the main organelle for the production and processing of specific protein at ribosomal site that are later exported. The protein folding is an also important event of rough endoplasmic reticulum. Rough endoplasmic reticulum is also transport this protein to the site where they required. As an when it is required the transport those protein to that particular site.

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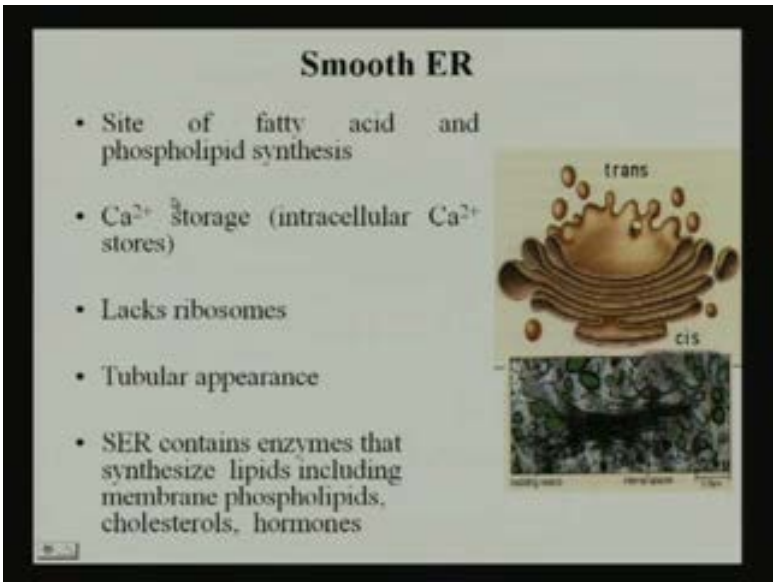

When we are talking about the smooth endoplasmic reticulum, this is the site for fatty acid and phospholipid synthesis. Calcium storage is also another activity of the smooth endoplasmic reticulum. It lacks ribosome. It is tubular in appearance. And smooth endoplasmic reticulum contains enzymes that synthesize lipids including membrane phospholipids, cholesterol and hormones.

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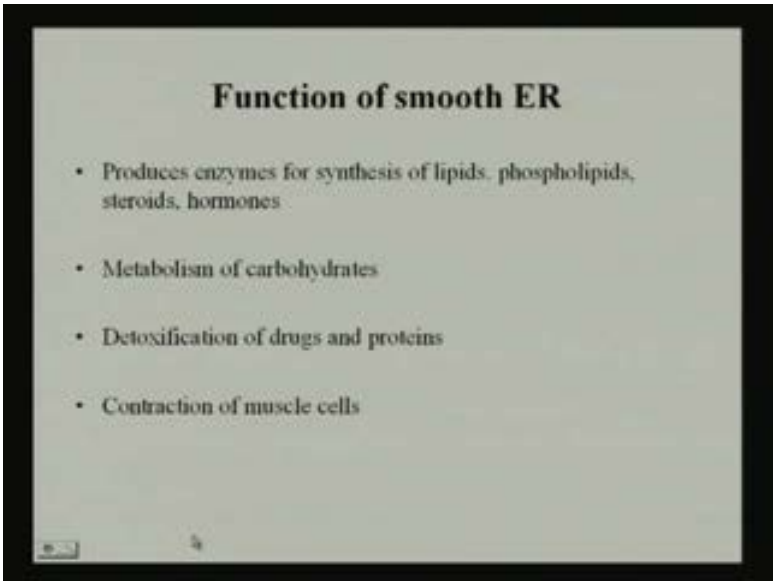

The function of smooth endoplasmic reticulum is the that, it produces enzymes for the synthesis of lipids, phospholipid, steroids and hormones. It is the site for metabolism of carbohydrate. It detoxifies the drugs and proteins and contraction of muscle cell.

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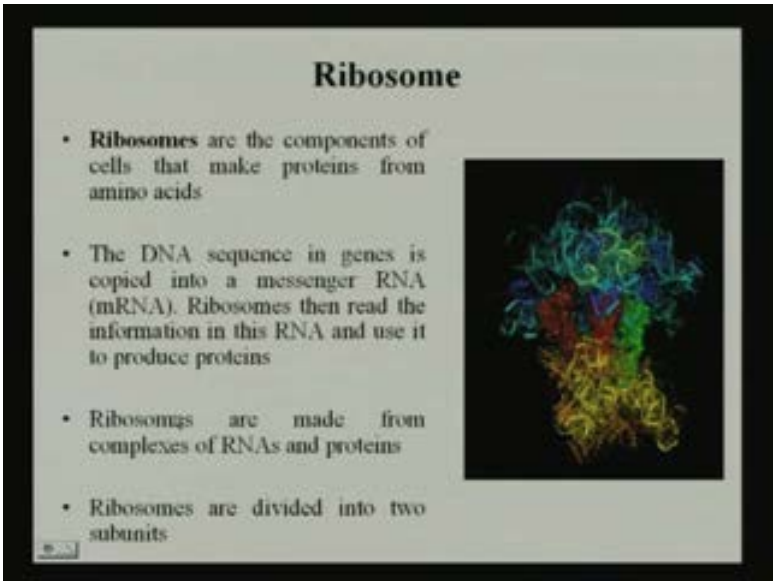

Now, coming to the next organelle is the ribosome. Ribosome are the component of cell that makes the protein from the amino acids. The DNA sequences in genes is copied into the messenger RNA that is the m RNA and ribosome then read those information in this RNA and use it for the production of protein. That means three coded nucleotide are read

by this messenger RNA and they synthesize this protein. Ribosome are made from the complex RNA and protein. And it has got two major subunits.

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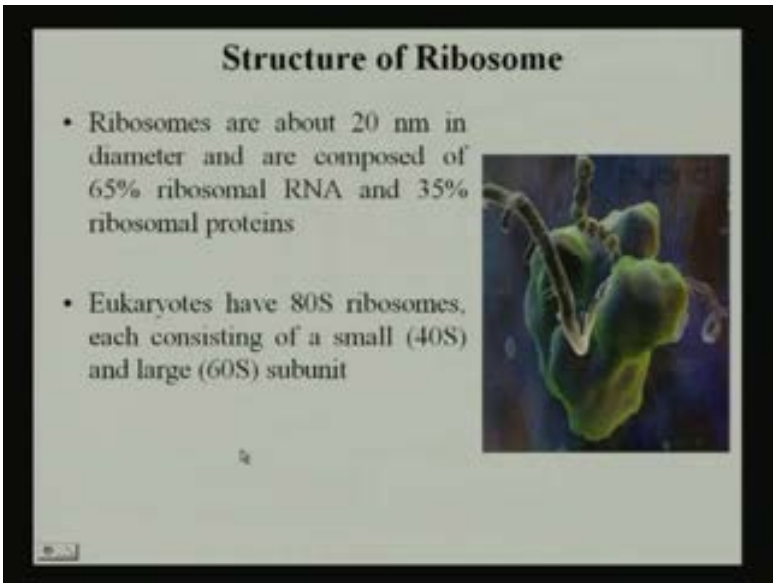

If you see the composition 65 percent, it is composed of sixty five percent of ribosomal RNA and 35 percent of ribosomal protein. And its size varies from twenty. It is the ribosome is of 20 nanometre in diameter, eukaryotes have 80S ribosome where the small unit is the 40S and larger unit is the 60S. It is different from that of the prokaryotic system where we have the seventyS ribosome. The smaller unit is the thirtyS and larger unit is the fiftyS in case of prokaryotic. But, here in case of eukaryote the smaller one is fortyS and larger one is sixtyS subunit.

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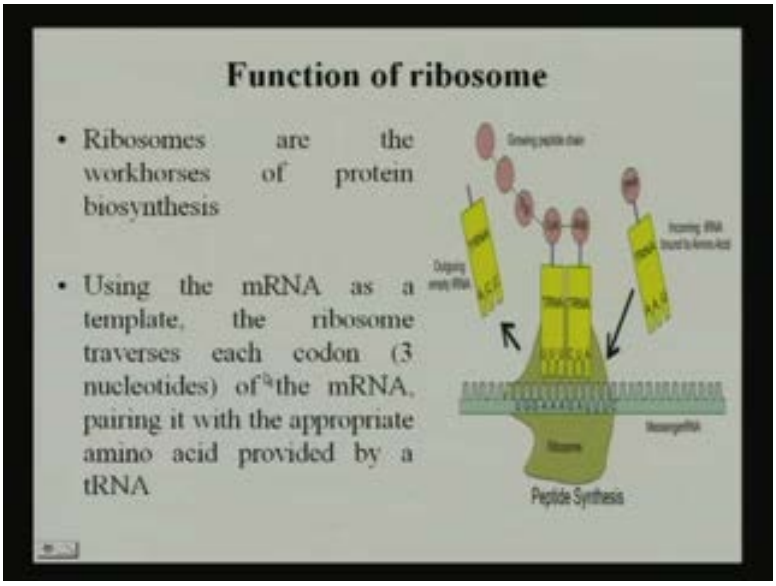

Now, if you see the function of ribosome we can find that ribosome is the workhorses of protein biosynthesis. It is, it uses the messenger RNA as a template and the ribosome transverse, each code on that three nucleotide of the m RNA pairing it with the appropriate amino acid provided by the transverse RNA. And its main function is the protein synthesis.

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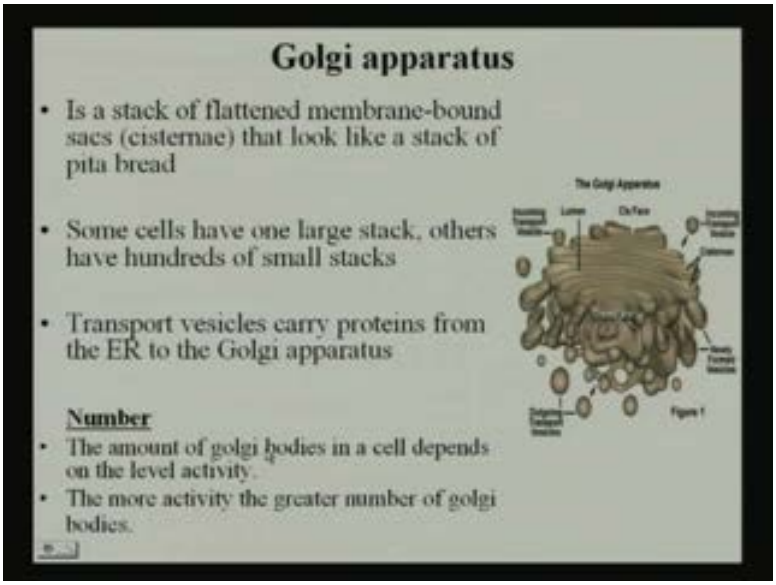

Now, coming to the next important organelles which is present in the cell is the Golgi apparatus. It is the stack of flattened membrane bound sacs that look like a stack of pita

bread. Some cells have one large stack, other they have hundreds of small stacks. It is the transport vesicles carry protein from the endoplasmic reticulum to the Golgi apparatus so, nucleus to endoplasmic reticulum to Golgi apparatus. Now, the number of Golgi bodies in the cell in a cell depends upon the level of its activity. That means how efficient a cell is performing or doing its activity. The more activity, the greater is the number of Golgi bodies, so more active the cell number of Golgi complexes are more.

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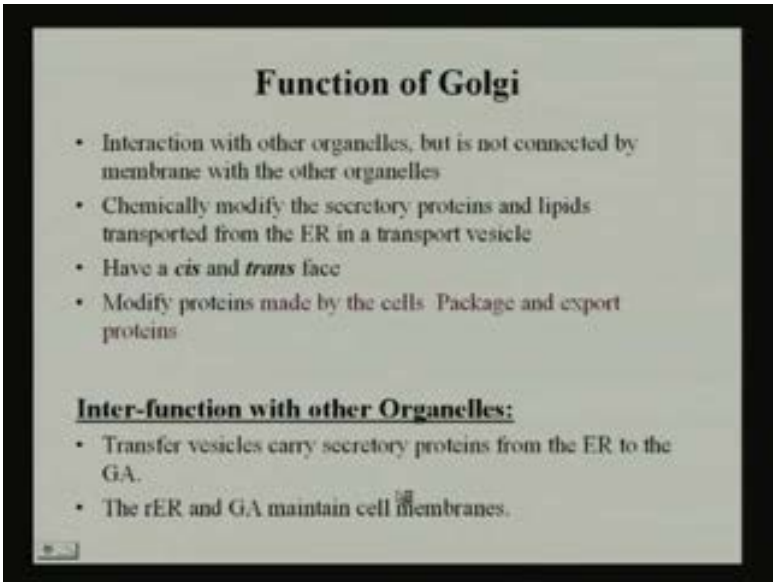

If you see the function of Golgi bodies then we can find that, it is the interaction with other organelles but, is not connected by a membrane with the other organelles. Chemically modify the secretary proteins and lipid transported from endoplasmic reticulum in the transport vesicle. This Golgi bodies has got Cis and Trans face and modify the protein by the cell which is package and export the protein. The inter-function of this organelle is that, it transfers the vesicle to carry the secretory protein from endoplasmic reticulum to the Golgi apparatus. The rough endoplasmic reticulum and Golgi apparatus also maintains the cell membrane. The structure of cell membrane that means what is the major function of this Golgi bodies? The the protein which is synthesized by the endoplasmic reticulum is coming and getting transported to the Golgi apparatus and this particular organelle help in transportation of this protein and lipid.

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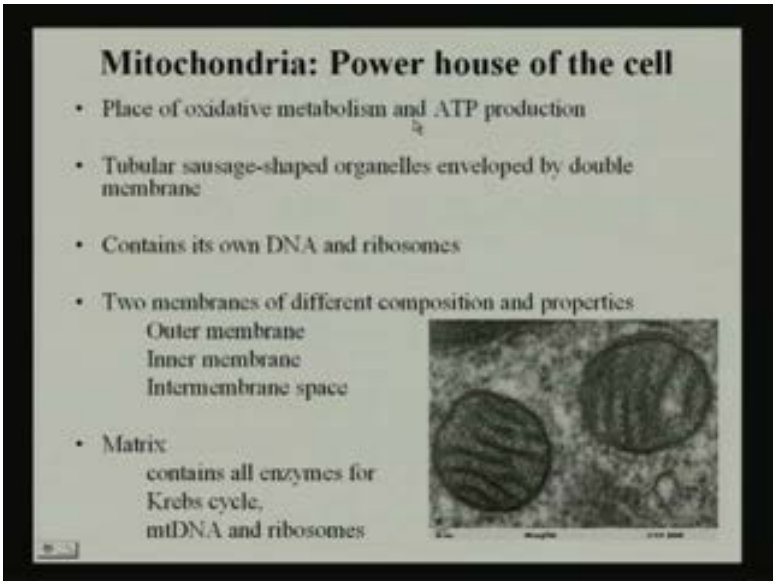

The most important organelle, one of the most important organelle of the cell is the mitochondrion which is otherwise known as the power house of the cell. It is the place of oxidative metabolism and ATP production the tubular sausage shape organelle enveloped by a double membrane. It contains its own DNA and ribosome which is called mitochondrial DNA and mitochondrial ribosome. This this mitochondria is bilayer organelle which has got a outer membrane and inner membrane. And in between the space of outer and inner membrane, is the intermembrane space. Mitochondria is the site of all enzymes for Krebs cycle and it contains as I have mentioned that mitochondrial DNA and ribosome.

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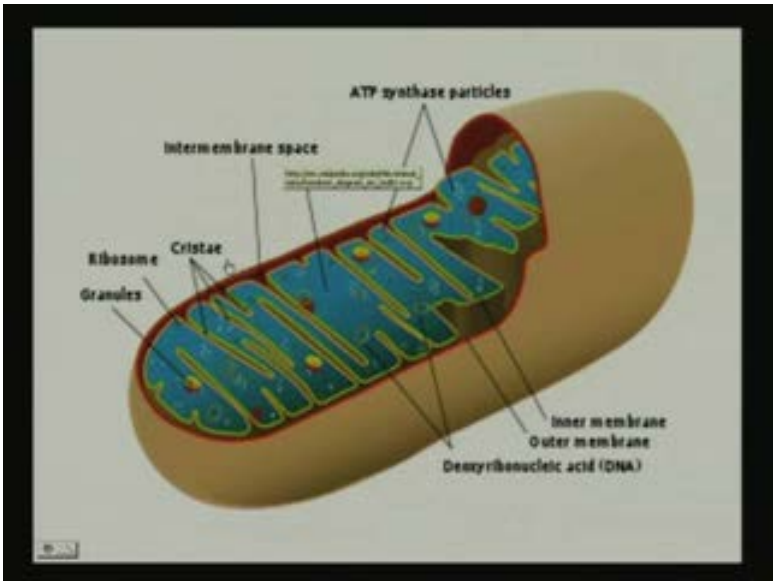

This is the structure of mitochondria. It has got the inner membrane and the outer membrane and this is the site for ATP synthesis and this is the inter membrane space. And this is the ribosome which is present and these are the granule and this is the most important that is the Cristae of the mitochondria.

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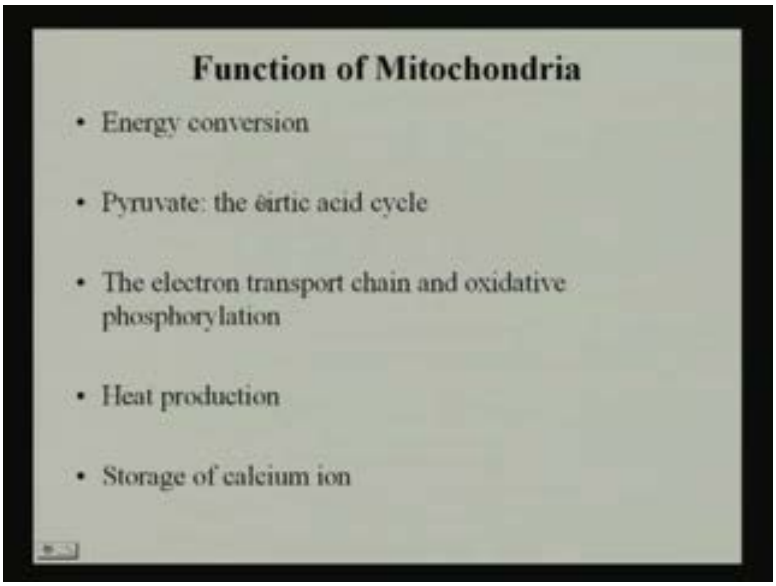

If you see the function of mitochondria then, it is the organelle where energy conversion is taking place. This is the site for citric acid cycle or Kreb cycle. It it is the site for electron transport chain and oxidative phosphorylation. That means mainly the

respiratory process is taking place in this organelle. Here, heat production is also taking place and it is also the storage of calcium iron.

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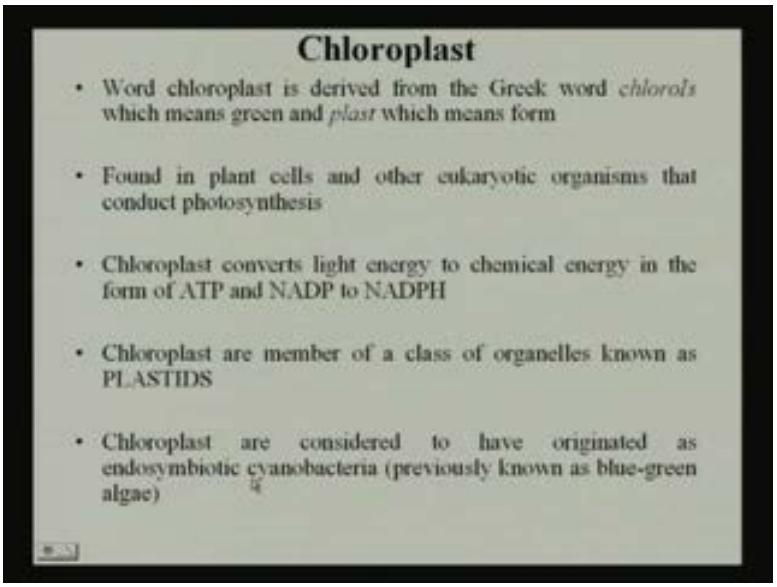

Now, coming to the next important organelle is the chloroplast. The the word chloroplast is derived from the Greek word where Chloros means green and plast means the form. It is otherwise known as the plastid. Now, in many cell it is mainly found in the plant cell or some of the microorganisms which are photosynthetic in nature. This is the organelle which helps in photosynthesis. The chloroplast converts the light energy to chemical energy in the form of ATP and n a d p to n a d p h.

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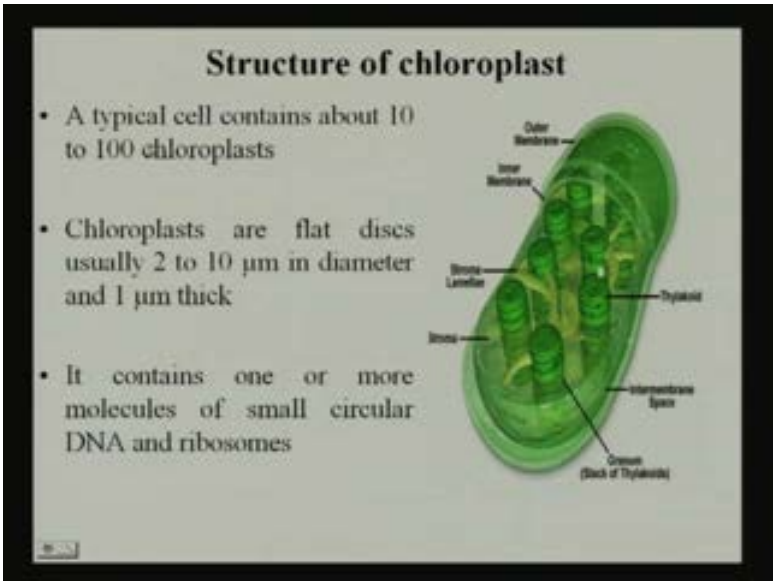

Now, a typical cell organ organ which contains about ten to 100 of chloroplast molecules, the chloroplast if you see the size, it is a flat disc like structure and its diameter varies from 2 to 10 micrometer and thickness is one micrometer. It contains one or more molecules of small circular DNA and ribosome within it.

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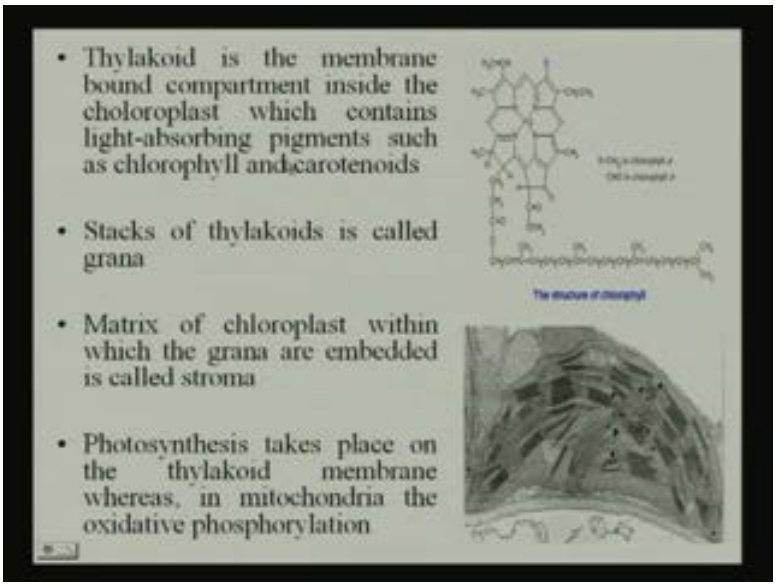

If you see the structure of this chloroplast we can find that this is here, the thylakoid membranes are present in the chloroplast. And thylakoid is the membrane bound compartment inside the chloroplast which contain light absorbing pigment which is the

chlorophyll and carotenoid. See the structure of chlorophyll. It is a very complex structure. It stacks the thylakoid, the stacks of thylakoid is called the grana. And the matrix of chloroplast within the grana are embedded is called stroma. Photosynthesis takes place on the thylakoid membrane whereas, mitochondria is the site for oxidative phosphorylation.

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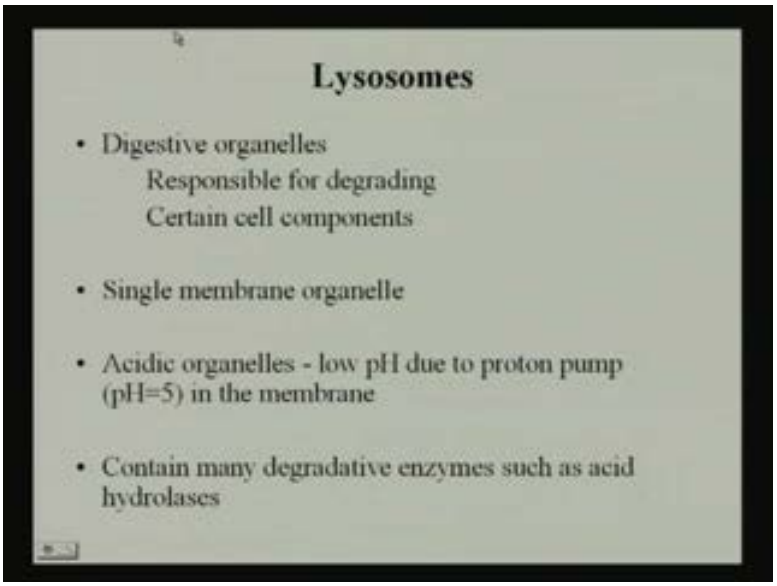

So, this is the two major difference between the chloroplast and the mitochondria. Now, next important organelle which is present in the cell is the lysosomes. Lysosome is also otherwise known as the digestive organelle which is single membrane bound organelles. If you see the nature, it is the acidic organelle and it PH varies from p h is in the range of 5 in the membrane. It contains the degradative enzymes such as the acid hydrolase.

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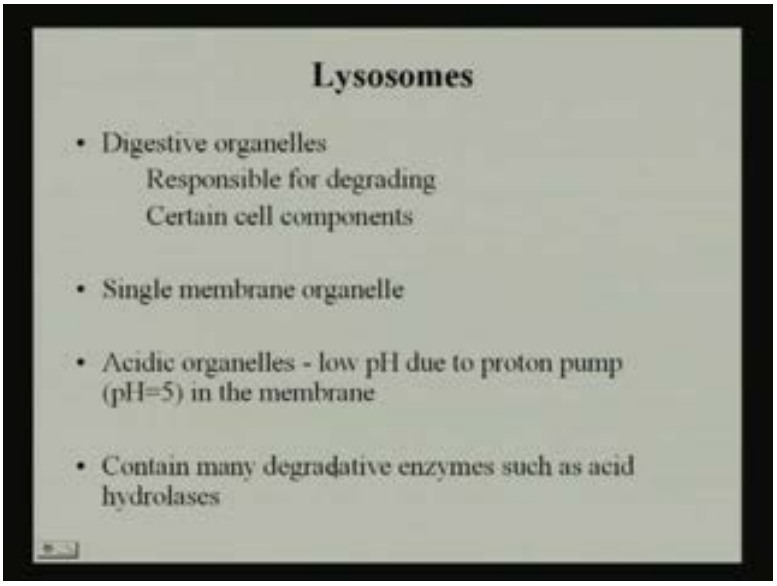

The major function of lysosome is that, it is the digestive plant of the plant lipid and carbohydrate and it helps in transportation of undigested material to the cell membrane for its removal. It varies in shape and depending on the process being carried out. Now, this particular organelle is otherwise known as the suicidal bag. If by any chance the membrane of this lysosome is getting cracked, it is all digestive enzymes come in contact with the other organelles and it kills the total cell.

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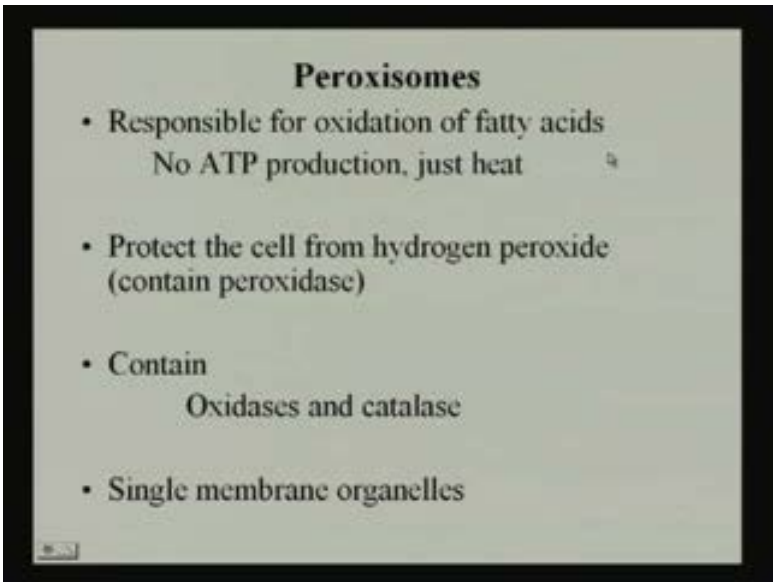

Now, let me come to another important organelle which is the peroxisomes. This is

responsible for the oxidation of fatty acid. No ATP production is taken place in this particular organelle but, just the heat production is there. It protects the cell from hydrogen peroxide, that means for oxidation as it contains the peroxidise enzyme. Besides this oxidoreductase group of enzyme, it contains oxidases and catalase group of enzymes too. It is single membrane organelles.

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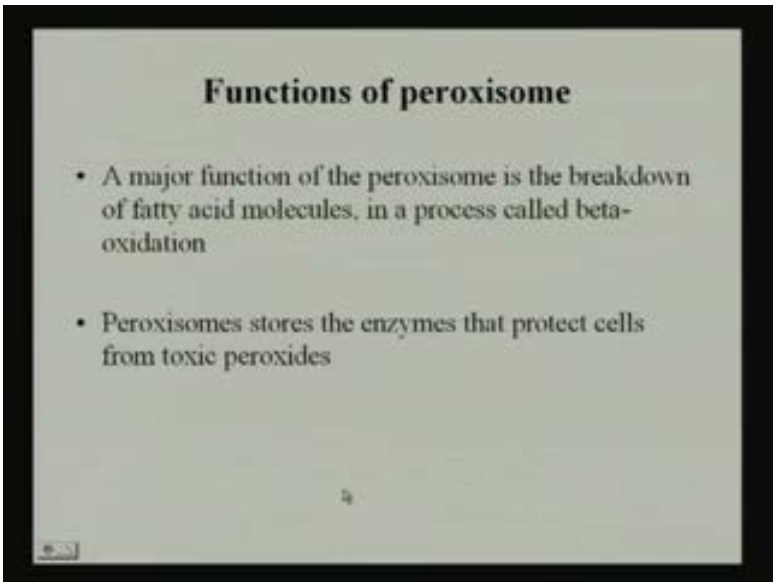

If you see the function of peroxisome, it is the major its major function is to breakdown the fatty acid molecule through beta oxidation. Peroxisomes stores the enzyme that protect the cell from toxic peroxides.

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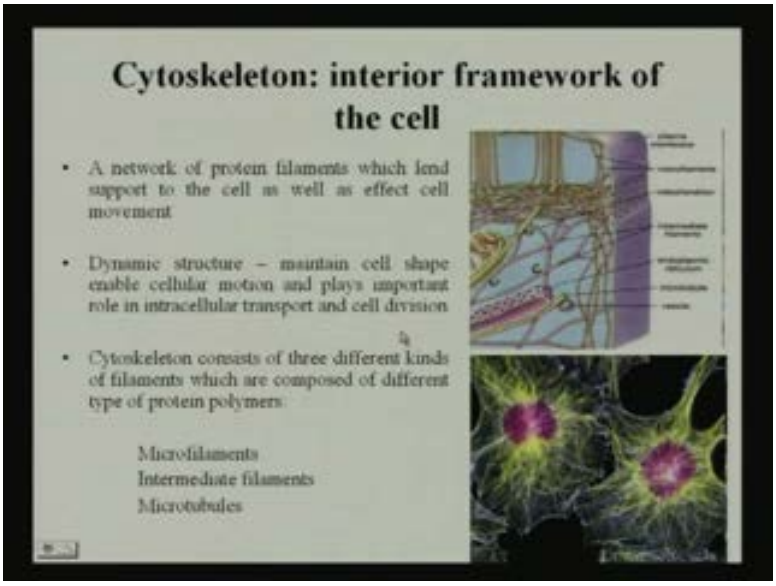

Now another organelle which I will be talking about is the cytoskeleton. Now, cytoskeleton is the interior framework of the cell. Now, when we are talking about the cell and when it it undergoes different activities, the network of protein filaments which lend support to the cell as well as its effect on the cell movement is the cytoskeleton material. The dynamic structure, it it has got a dynamic structure and it maintain the cell shape, enable the cellular motion and plays some important role in intracellular transport and the cell division. Cytoskeleton consists of three major kinds of filament which are microfilament, intermediate filaments and microtubules. the These are mainly composed of the protein polymers.

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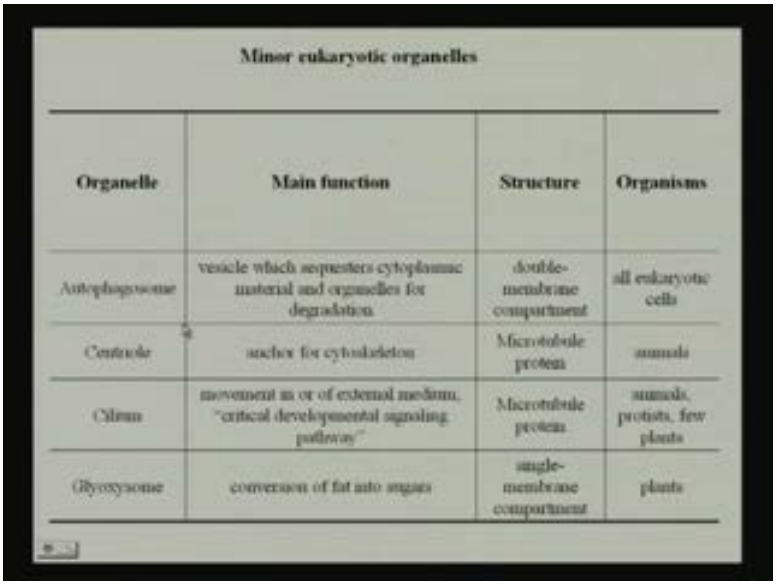

Now, I have talked to you about the different organelles which are present in the eukaryotic cell. Besides this cell, beside this organelle, the cell may contain autophagosome. this The main function is the vesicle which which sequester the cytoplasmic material and organelles for the degradation. It is a double membrane compartment and it is present in all eukaryotic cells. Another organelle which is present is the centroide. It is the anchor of cytoskeleton. It is the microtubule protein which is present in particularly the animal cell. The cilium, it is the movement in or of external medium that is a critical development and signalling pathway. And, it is its structure is that microtubule protein. It is mainly made up of protein structure and it is present in animal protists and few plant materials. Glyoxysome is another important organelles which converts the fat into sugar and it is a single membrane compartment and mainly present its Glyoxysome to the plant system.

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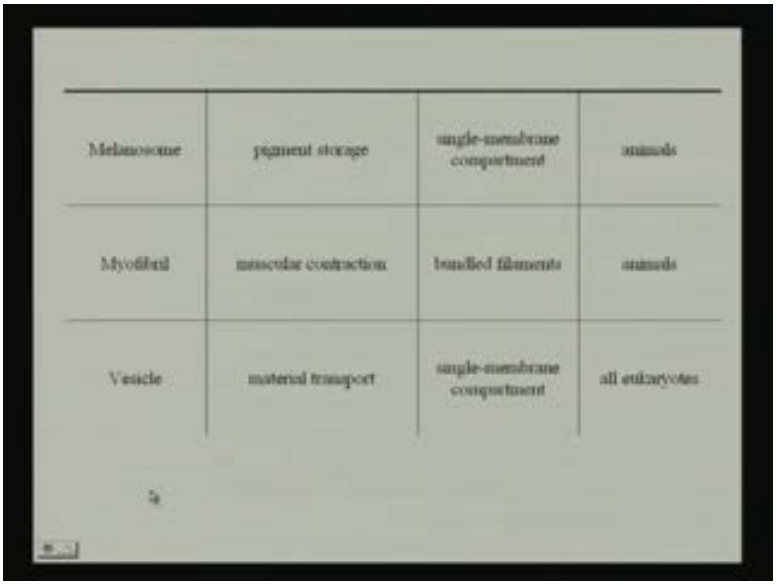

Melanosome is another organelles which is a single membrane compartment and it is a pigment storage organelle which is mainly present in the animal system. Microfibril is the bundled filament which helps in muscular contraction and it is present in the animal cell. The vesicle which is also present in the eukaryotic cell and is a single membrane compartment and it helps in the material transport system and it is present in all eukaryotic cells. So, with these different organelles, I have tried to give you an overview of the different organelles and their function, how they perform different activities in the living cell. And I think you have now a little bit idea about this particular cell; Eukaryotic as well as Prokaryotic cell and how they perform and how they work.

So, with this today I am concluding my lecture. Thank you very much.