Basics of Biology
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Module – XI: Summary and Conclusions
Lecture - 50
Summary (Part-II)

Hello everyone, this is Dr. Vishal Trivedi from Department of Biosciences and Bioengineering IIT, Guwahati and what we were discussing, we were discussing about the properties of the living organisms. And in this course, so far what we have discussed, we have discussed about the different aspects of the living organisms, and I hope that by discussing all these aspects, you could be understood the different properties of the living organisms.

So, if you recall in the previous lecture, we have summarized and discussed some of the important points, what related to this particular course, and why we are doing this, we are doing this because your exams are approaching very fast and the summarizing and revising the content what we have discussed in this particular course, is going to helpful for the preparing you are preparing for the examinations.

So, in the previous lecture, what we have discussed, we have discussed about the classification of the living organisms, and we have discussed that the different how the different criteria's are being used to classify the different types of organisms and based on these criteria's the, and for to describe these or to explain the classifications, we took the examples of the animal kingdom, where we have discussed about the how the different criteria are being applied.

And that is how the Animalia kingdom is been classified into the different types of phylums, whether it is the Porifera, coelenterata, ctenophora, platyhelminthes and so on. And then subsequent to that, we have also discussed how these different types of organisms are being originated onto the earth and how they are being evolved from the pre-existing animals.

So, that was we have a discussing the evolution and the origin of life. So, we have discussed about the different types of experiments and so on. And then after that, we have also discussed about the different types of the cells, whether it is the prokaryotic cell or the eukaryotic cell.

So, within the prokaryotic cell, we discuss about the cell walls and the different types of properties of the bacterial cells. And within the eukaryotic cell, we discuss about the plant cell and the animal cell. And we discuss about the different types of organelles, we have discussed the structures and the functions of these organelles, we discuss about the mitochondria, chloroplasts, endoplasmic reticulum, Golgi bodies, lysosomes, we discuss about the nucleus and so on.

And while we were discussing about the cells, the cellular activities are being completely being governed by the different types of biomolecules. So, we have also discussed about the different types of biomolecules. So, we discuss about the nucleic acid, we discuss about the carbohydrate, we discuss about the proteins and lipids and what we have discussed while we were discussing about the biomolecule is the structure and the function of these biomolecules in the cellular functions.

So, we discussed about the structure of the carbohydrates, classifications of the carbohydrates, different properties of the carbohydrates, and then we also discuss about how the carbohydrates are contributing into the cellular metabolism. So, while we were discussing about the cellular metabolism, we discussed about the glycolysis and Krebs cycle.

Same, in the same way, we have also discussed about the lipids, the different types of liquids, their classifications, the structure of these lipids, and then we also discuss about the function of these liquids. As far as the protein is concerned, we discuss about the different properties of the proteins, how the proteins are participating into the different functions of the body and so on.

So, now, in today's lecture series, we are going to discuss some more aspects of the, this particular living organisms, and while we were discussing about these aspects, we are also going to revise the content what we have covered in this particular course. So, these biomolecules are participating in the many types of cellular events and the cellular event what we have discussed in this particular course, is the central dogma of life.

So, central dogma of life is a way in which the message is being conveyed from the nucleus into the cytosol. So, in this you have the three different events, one is called as the replication, another is called as transcription and the third is called as a translations. So, what is mean by the replications?

So, DNA dependent DNA synthesis is called as replication and this is being done by the enzyme which is called as the DNA polymerase. Similarly, taking the information from the DNA it has been utilized to synthesize the RNA. So, we can have the different types of RNA whether it is the messenger RNA, tRNA or ribosomal RNA, and this activity is being done by an enzyme which is called as the transcription, it is called as the RNA polymerase.

And then we have the RNA dependent protein synthesis and this event is called as the translation and this process is being governed by the protein machinery of protein synthesis machinery which involves the ribosomes, which involves the different types of RNA species like the messenger RNA, ribosomal RNA, tRNA and it also so, and so, this all these three events are being a part of the central dogma of life. So, let us start discussing with the first event that is the replications.

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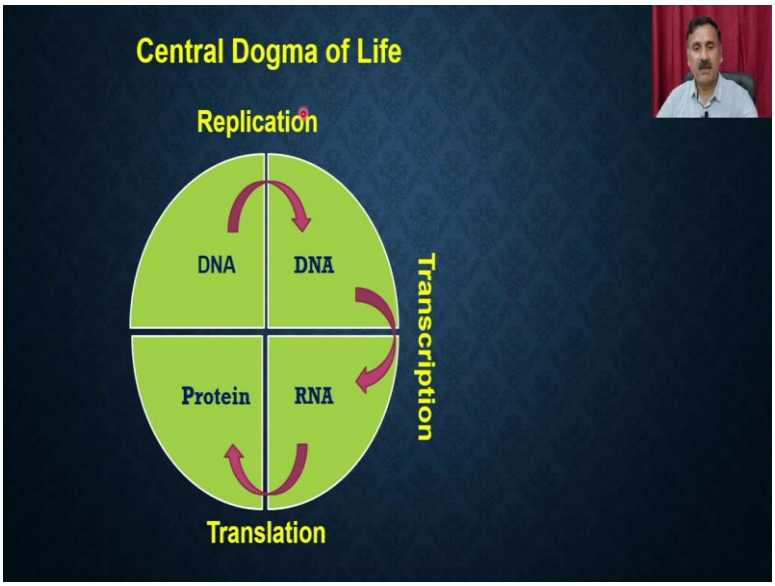

So, as far as the replication is concerned, so, what is mean by the DNA replication, so, duplication or the re-synthesis of the genomic content is essential to maintain the life of an organism. DNA has to be precisely replicate to maintain the sequence identical to the parent DNA and that is very important, because otherwise, there will be mutations and there will be incomplete replication of the DNA.

It will protect the appearance of the potential mutations and resulting the change phenotype. In the current, replication of a DNA fragment has to be performed keeping following point into the concentration. The replication machinery must duplicate the whole fragment what that means is that it should not have the incomplete duplications.

So, if you have the full genome, the whole genome of the organism should be replicated. The replication must be free of the errors, because if there will be errors, it is actually going to change the nucleotides and that will result into the mutation of mutation within the genome and that may result into the malfunctioning of the proteins.

The machinery must amplify the fragment in a given timeframe. So, timeframe is also very important for example, if a cell is dividing in 20 minutes, if a bacterial cell is dividing in 20 minutes, the replication has to be completed in that given timeframe, so, that you cannot have the incomplete replications.

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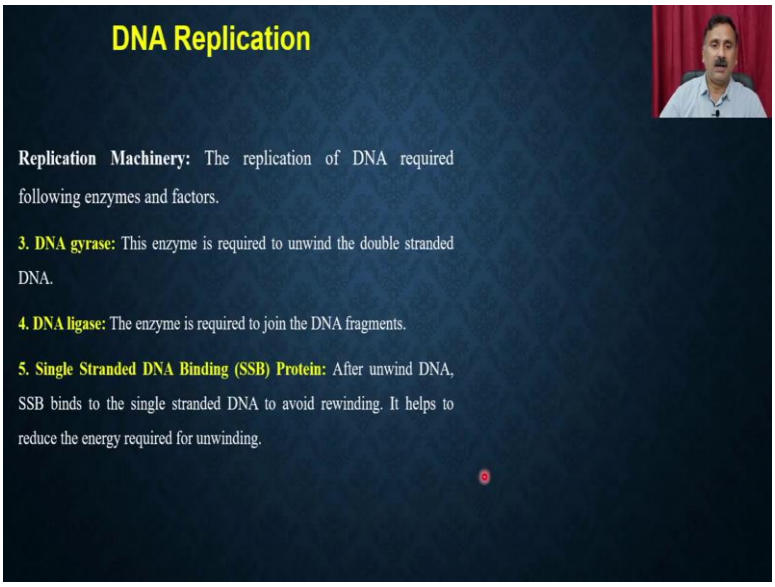

DNA replication is a very very complicated process. So, it actually requires a complete machinery. So, in replication machinery, the replication of DNA required the following enzyme and the factor. So, what you require is the DNA gyrase, DNA ligase, single stranded DNA binding protein, you require the DNA polymerase and the primase.

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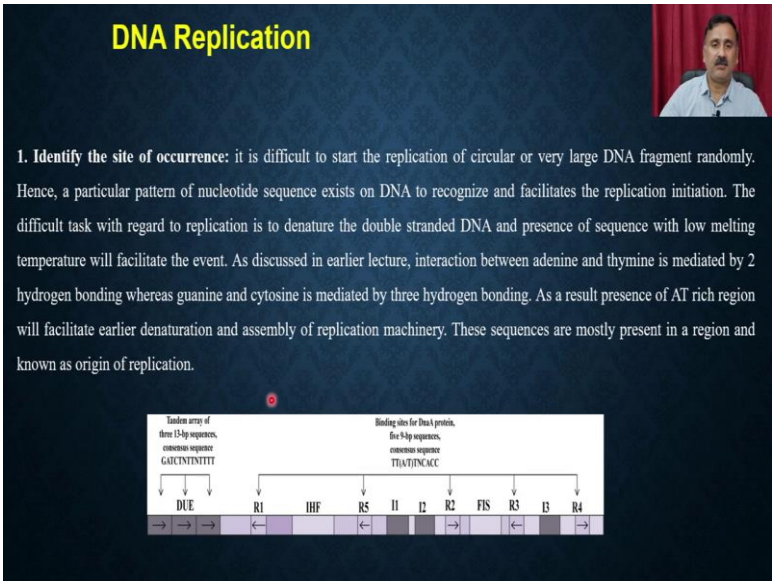

And how that process is going to happen? So, in the process, so, you are first going to identify the site of the occurrence which is also called as the origin of replications. So, it is difficult to start the replication of a circular or very large DNA fragment randomly. So, you cannot start the replication at any given time.

So, at any given locations. Hence, a particular pattern of nucleotide sequence exists on the DNA to recognize and facilitate the applications. The difficult task with regard to replication is to denature the double stranded DNA and presence of sequence with the low melting temperature is going to facilitate the event. Interaction between the adenine and thymine mediated by the 2 hydrogen bond whereas, the guanine and cytosine is mediated by the 3 hydrogen bonding.

So, as a result the presence of AT rich region will facilitate the earlier denaturation and the assembly of the replication machinery. These sequences are mostly present in a region known as the origin of replication. So, this is the classical example of the origin of replications. After that, we have the, so once you identify it from where you are going to start the replication, then it is actually going to have the three different types of events.

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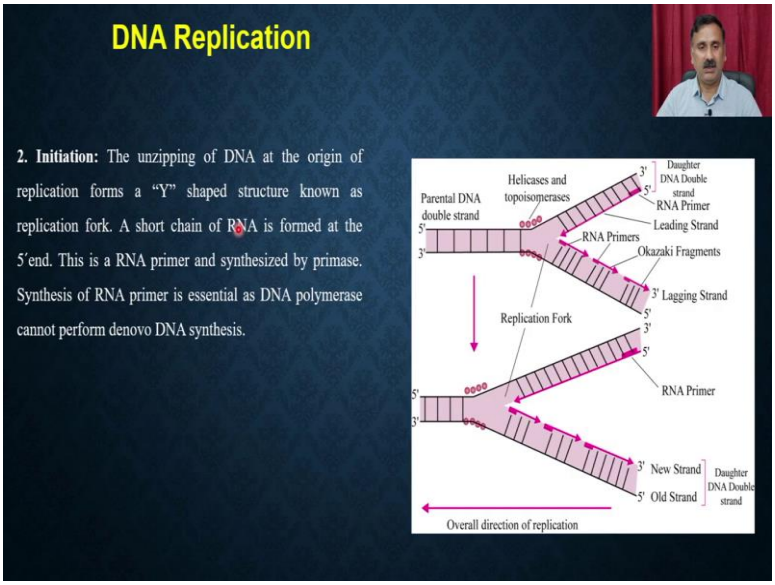

It is going to have the initiation, so unzipping of the DNA at the origin or application forms a Y shaped structure known as the replication form. A short chain of RNA is going to form at the five prime end. This is the RNA primer and it is going to be synthesized by an enzyme which is called as the primase.

Synthesis of RNA primer is essential as the DNA polymerase cannot perform the denovo DNA synthesis. So, what is mean by the denovo DNA synthesis is that it is actually require initiation points. It actually requires some synthesis of a DNA, it cannot start without having the second strands.

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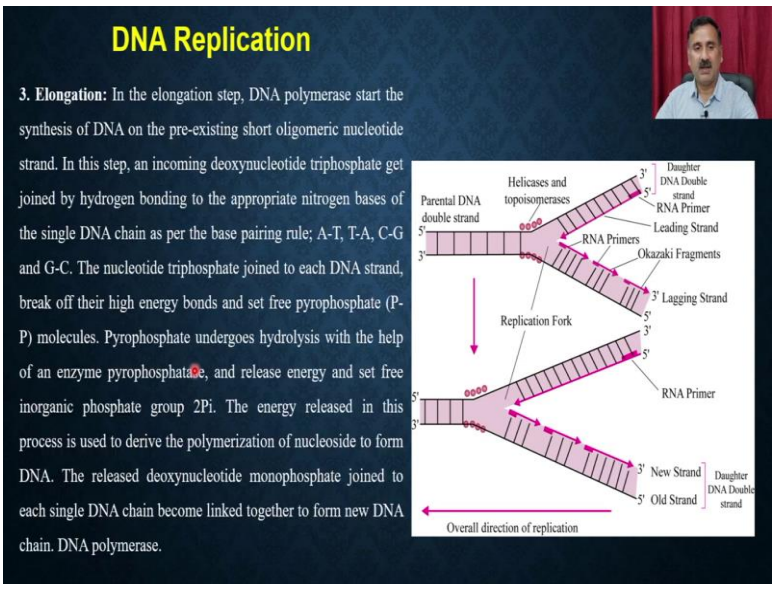

And then it also in the elongation step, in the location step the DNA polymerase start synthesis of DNA on the pre-existing short oligomeric nucleotide strands. And in this step an incoming deoxynucleotide triphosphate get joined by the harmonic appropriate nitrogenous bases of the single DNA as per the base pairing rule like the A to D, D to A, C to G and G to C. The nucleotide triphosphate joined to each DNA strand, break off their high energy bond and set up the free pyrophosphate.

The pyrophosphate undergoes hydrolysis with the help of an enzyme pyrophosphatase and released the energy and set the free inorganic phosphate 2Pi. The energy released in this process is used to derive the polymerization of nucleoside to form the DNA. The release deoxynucleotide monophosphate joined to each other into each single DNA chain become linked together to form the new DNA chain.

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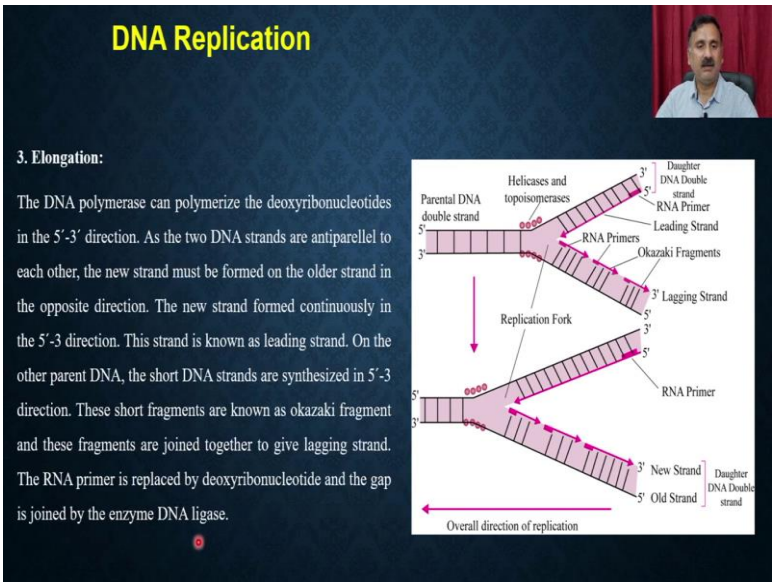

And then we have the elongation steps. So, in the elongation step, the DNA is going to be synthesized with the help of the RNA primers, and next to the RNA primers, you are going to have the addition of the nucleotides based on the base pairing of the nucleotides what is present on to the other strands.

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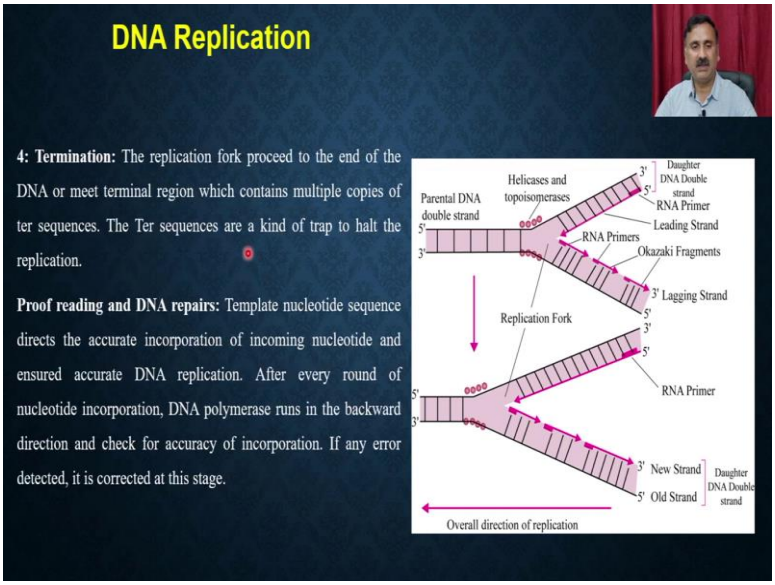

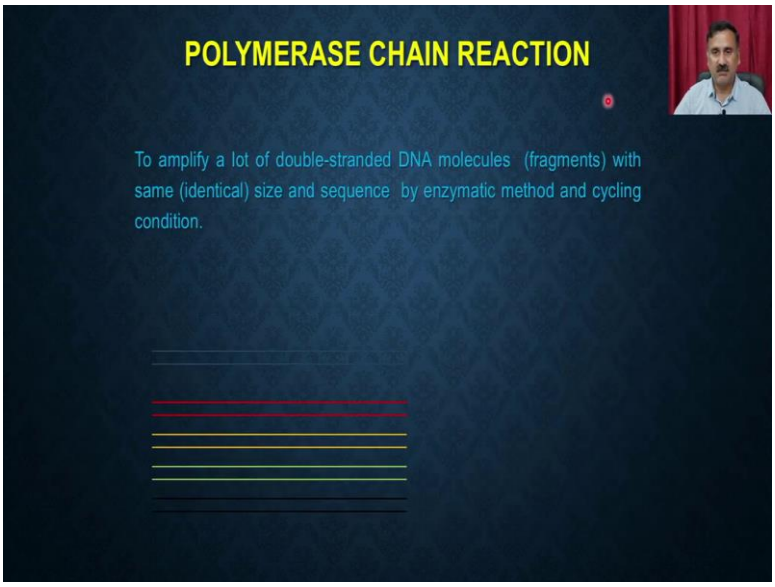

And then we have the termination, so termination is it been done by the, sorry, replication when it pertains to the end of the DNA or meet the terminal region, which contains the multiple copies of the ter sequences. The ter sequence are kind of a trap to hold the replication and that is how it is actually going to undergo those applications. Since the replication is a synthesis of DNA, so it actually should have the proofreading.

So, proofreading you are actually going to ensure that the DNA what you have synthesized is free of errors. Template nucleotide sequence direct the accurate incorporation of incoming nucleotide and ensure accurate DNA replication after every down from nucleotide incorporation, DNA polymerase runs in the backward direction and check for the accuracy of incorporation.

If any error detected, it is corrected at this stage and utilizing the RNA, DNA replication as a technique what has been presented in the cell, the people have also discovered a technique which is called as polymerase chain reaction. And Polymerase Chain Reaction is actually going to be used as a reaction is a technique which have been used to amplify the double standard DNA molecules with the same size and sequence by the enzymatic method and cyclic conditions.

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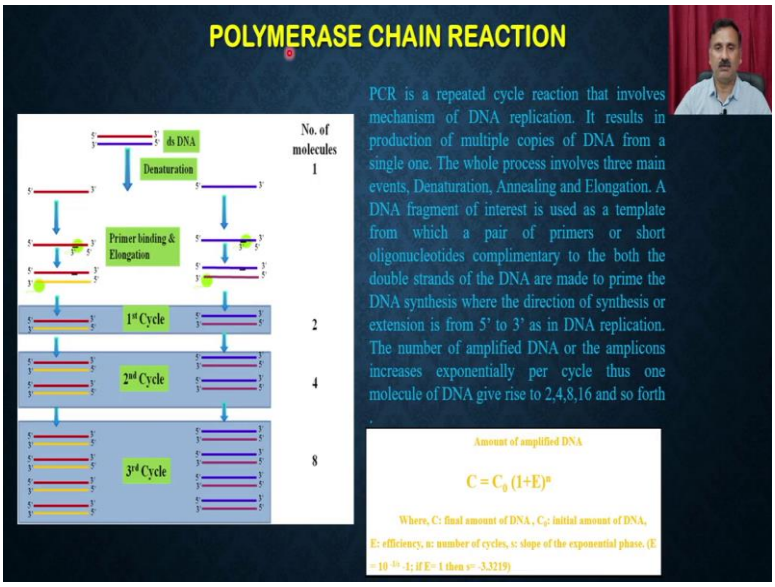

So, how the DNA polymerase is working? So, PCR is a repeated cyclic reaction that involves the mechanism of DNA replication, it results in the production of multiple copies of DNA from a single copy. So, you can imagine that you have a double stranded DNA. In the first step, there will be a denaturation, so both the strands of a template is going to be separate.

And then it will be having a synthesis of the primer binding and the elongations and after that, the DNA polymerase is going to sit and it is going to synthesize. So, that is how you are going to have the two strands. So, you have started with one strand, one template, you are going to have two templates. So, after the first cycle, you are going to have the two molecules.

So, you started with one molecule, after first cycle, you are going to have two molecules. After second cycle, you are going to have four molecules and after the third cycle, you are going to have eight molecules. So, that is why it is actually going to keep giving you the doubling after every cycle. So, that is why if you want to calculate the concentration or the amount of amplified DNA, you can use this formula to calculate.

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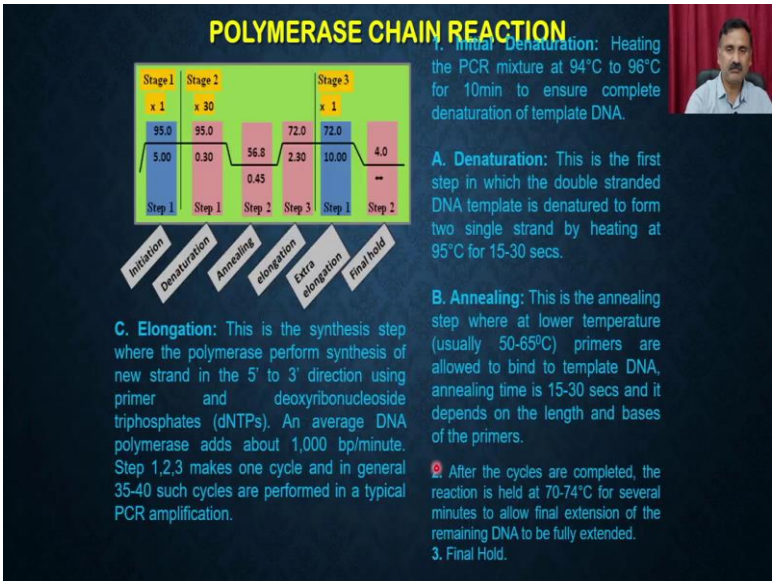

These are the different steps where you have the initial denaturation, then you have initial denaturation like the 95 degrees Celsius for 5 minutes or 10 minutes. And then we have the cyclic events of the denaturation, annealing and elongations that you have to do for the multiple reaction like for example, this case, it is going to be say the 30 cycles. And then after that, you are going to have the final elongation which is actually at the 72 degrees Celsius for 10 minutes and then the final stop.

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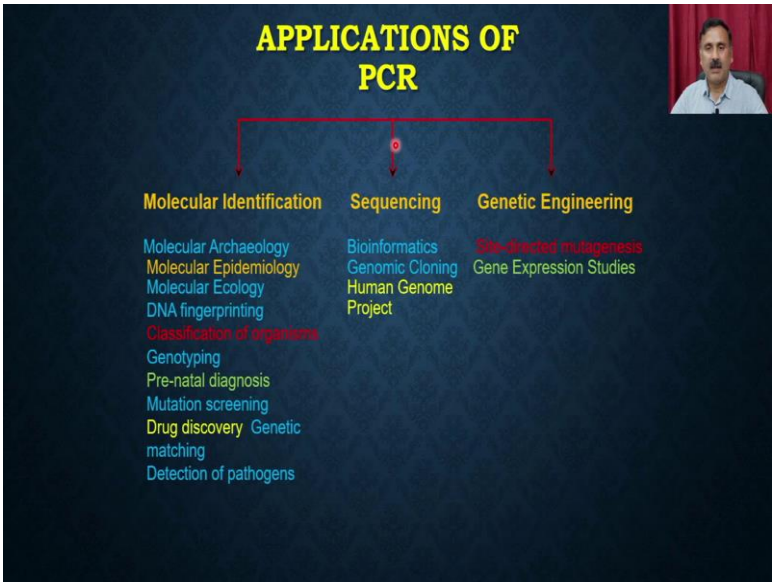

Polymerase Chain Reaction is being applied in the different fields. So, it can be used for the molecular identification, it has been used for the sequencing and it also used in the genetic engineering. In the molecular identification, the PCR is being used for the many different

types of fields like molecule archeology, molecule epidemiology, molecular ecology, DNA fragmentation.

It also been used in the classification of the organisms like the genotyping, prenatal diagnostics, mutation screening, drug discovery and so on. Within the sequencing that PCR is extensively been used to provide the sequences of the different types of genomes, so it can be used, it has been used very successfully for the Human Genome Project and genome projects of the other organisms.

As far as the lab is concerned, the PCR is being used very extensively for generating the site-directed mutagenesis and as well as for the gene expression studies and how we are going to do a PCR?

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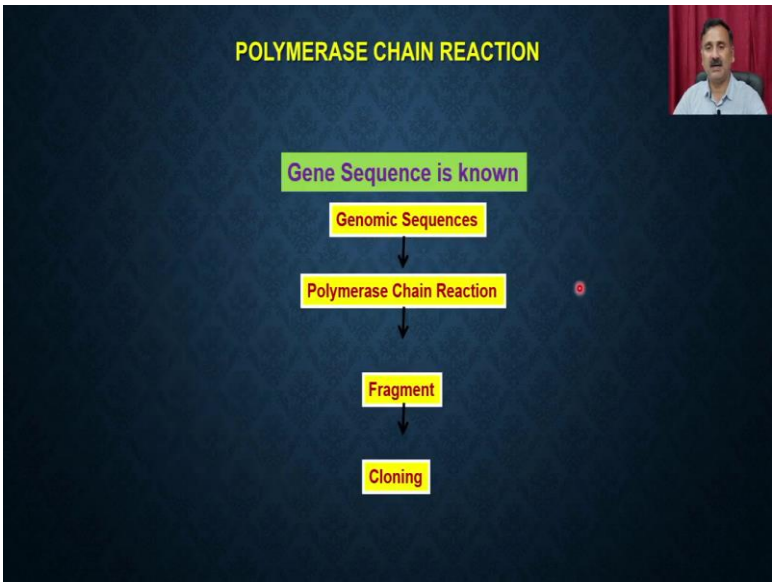

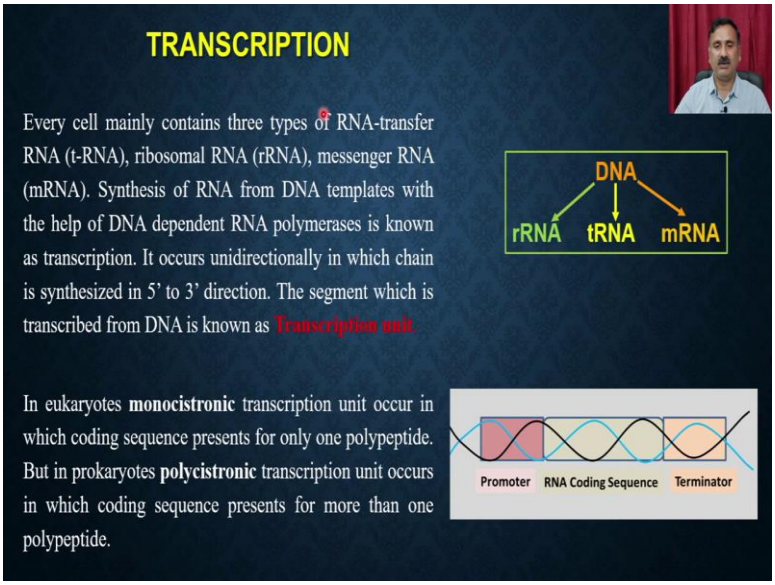

For the doing a PCR you require a gene sequence, you require the PCR fragments and cloning. So, this is the way you actually can be used the PCR into the laboratory conditions. Subsequent to the replications, we also discussed about the transcription. So, transcription means with the sequence what is present on the DNA, you can be able to synthesize the three different types of RNA whether it is the ribosomal RNA, tRNA and messenger RNA.

And the, so every cell contains the three different types of RNA, transfer RNA, ribosomal RNA, messenger RNA and synthesis of RNA from the DNA template with the help of the DNA dependent RNA polymerase is known as the transcription. It occurs unidirectionally in which the chain is synthesized in 5 prime to 3 prime direction.

Segment which is transcribed from DNA is called as the transcription unit. So, this is the transcriptional unit. So, in a in eukaryotes, the monocistronic transcriptional unit occurs in which the coding sequence present for only one polypeptide whereas, in the prokaryotes it has the polycisronic transcriptional unit and that codes for more than the one protein.

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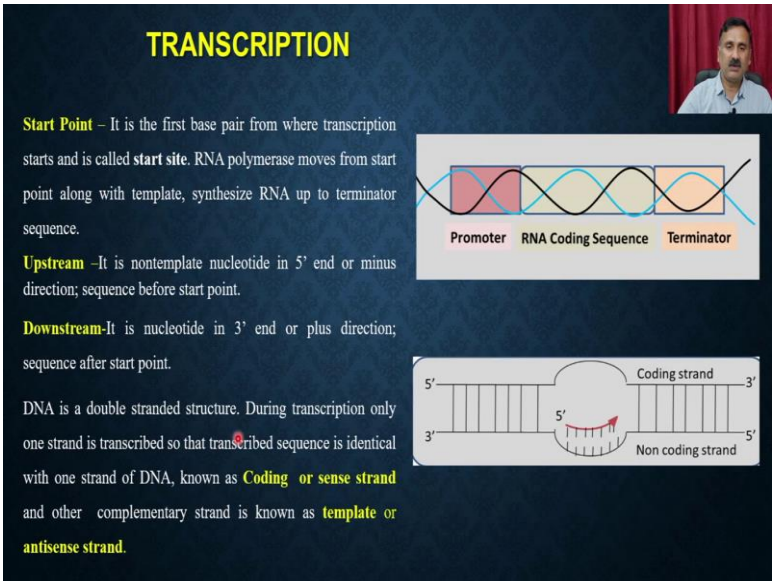

In an individual transcriptional unit, you have the start points, you have upstream and downstream factors and then also require the coding as well as the, or the sense strand and the template or the antisense strands. And then we also discuss about the mechanism of transcriptions and so on.

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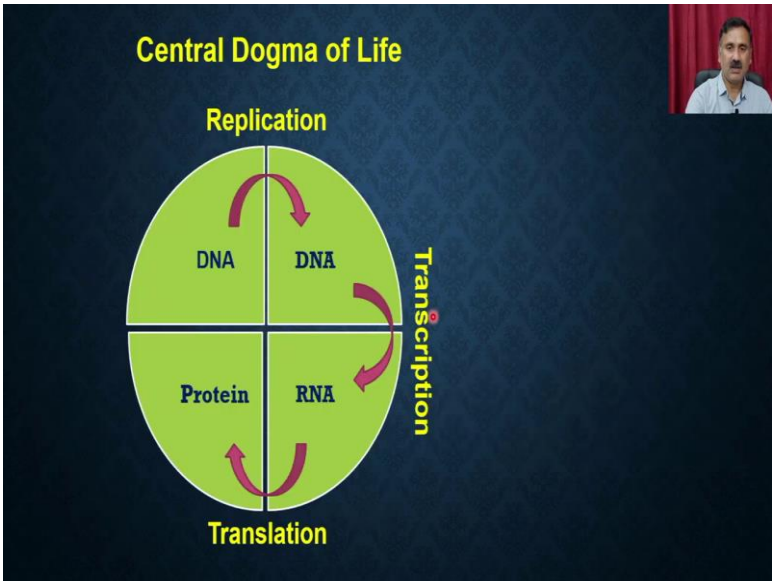

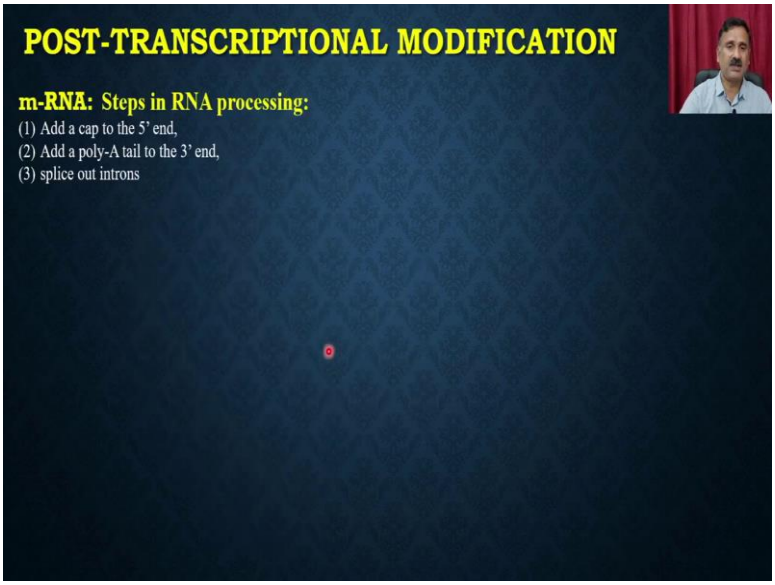

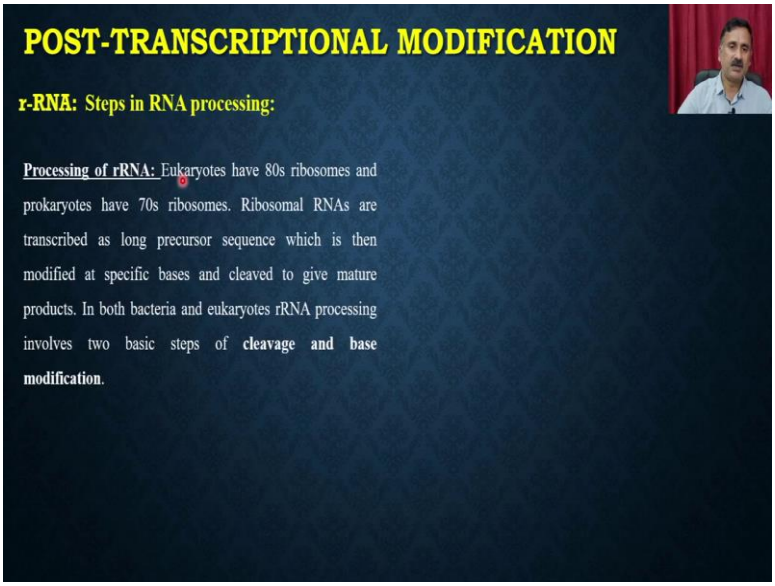

So, this is we have discussed so far, we have discussed about the replications where we have discussed about the DNA dependent DNA synthesis and then we also discuss about the transcription which is the DNA dependent RNA synthesis and then, we are also going to discuss, so once we discuss about the transcription.

We are also going to discuss about the post translational modifications and in the post-transcriptional modifications, we discuss about the post translational modification of the messenger RNA. So, in the messenger RNA, three steps or three different types of modifications what we have discussed, we have discussed about the adding a cap to the 5 prime end or adding a poly-A tail or the splicing of the different types of introns.

I am not going to discuss in detail about these steps because that we have already discussed in that that particular relevant module. Then we also discuss about the post translational

modification of the ribosomal RNA. So, in the processing of ribosomal RNA, eukaryotes have the 80s ribosomes, whereas the prokaryotes have 70s ribosome. So, the ribosomal RNAs are going to complex with the protein and that is how they are going to be formed the ribosomes.

So, you can have the two different types of ribosome, small subunit and the large subunit. And eukaryotes have the 80s ribosome whereas the prokaryotes have the 70s ribosomes and the kind of modifications, what are present in the ribosomal RNA? In ribosomes, ribosomal RNA in both bacteria and eukaryotes, ribosomal processing involves a two basic steps, the cleavage as well as the base modifications.

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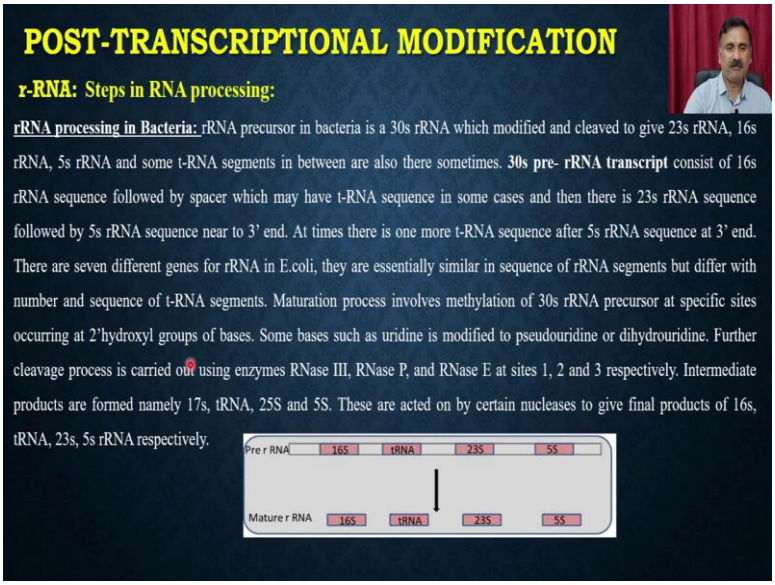

And this is what is the modification what has been done in the ribosomal RNA, so, ribosomal RNA processing in bacteria where you can have the pre-ribosomal RNA, where you have a big ribosomal RNA and that it is going to be chunked it is going to be cleaved off to give you the 16s ribosomal RNA, 33s and say 5s.

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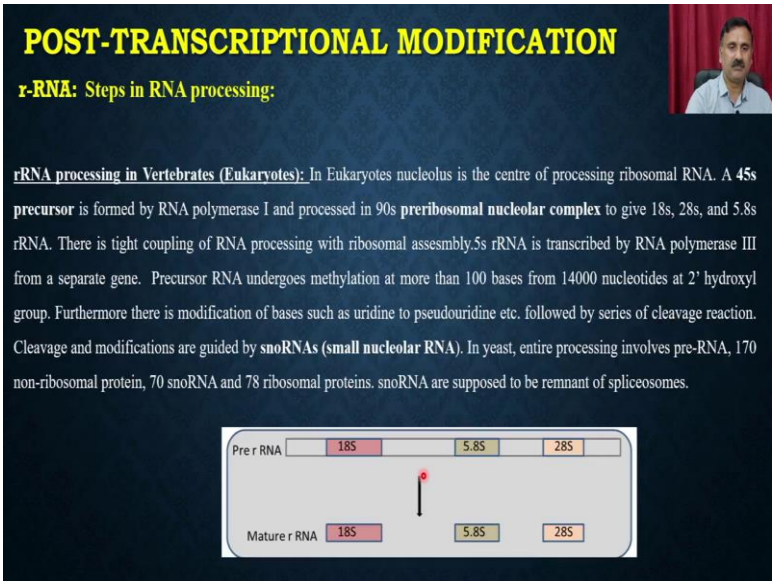

Then we have the RNA processing in vertebrates or the eukaryotes. So, in the eukaryotes, you can have the mature ribosomal RNA. So, this is the RNA transcripts, and that is going to be cleaved, and that is how you are going to have mature ribosomal RNA of 18s, 5.8s and 28s.

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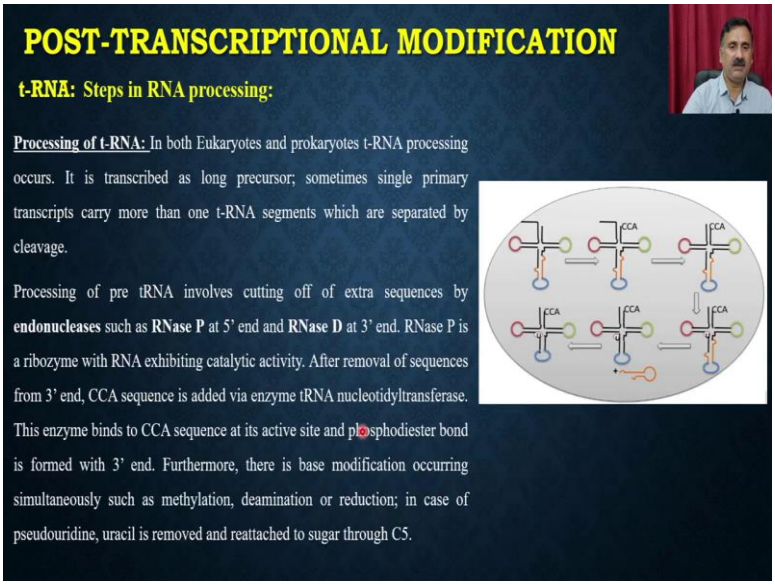

And then we have the post transcriptional modification of the tRNA. So, processing of tRNA in both eukaryotes and prokaryotes, the tRNA processing occur it is transcribed as a long precursors and processing of tRNA involves a cutting off an extra sequence by the endonucleus such as RNase P at the 5 prime end, and RNase D at the 3 prime end.

RNase P is a riboseime with the RNA exhibiting catalytic activity. So, after removal of sequence from the 3 prime end, CCA sequences added by the enzyme tRNA nucleotidyltransferase. This enzyme binds to the CCA sequence at the, at its active site and phosphodiester bond is formed with the 3 prime end.

Furthermore, there is a base modification occurring simultaneously such as methylation, deimination, induction and in case of the psuedouridine, uracil is removed and attached to the sugar through the C5 ounce. So, these are some of the post translational modifications what we have discussed in this particular course.

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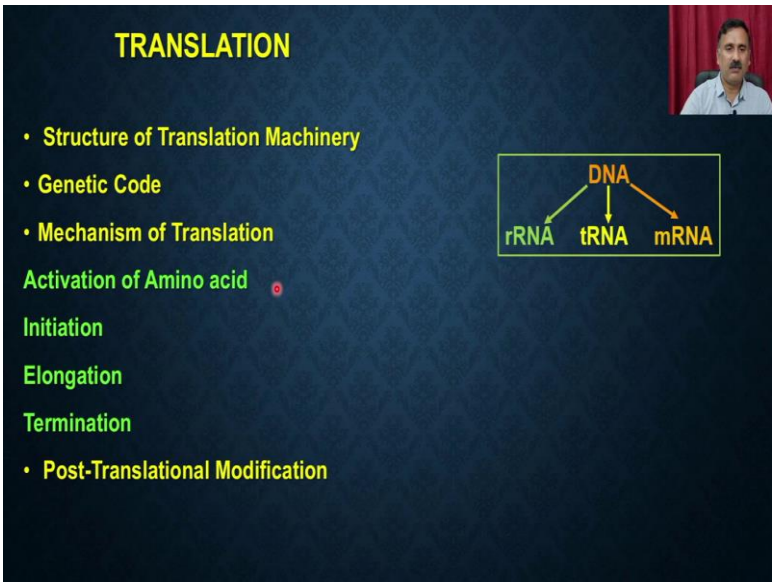

Now, let move on to the, this we have also discussed about the translation. So, in within the translation what we have discussed, we have discussed about the structure of the translational machinery, whether it is a prokaryotic machinery or the eukaryotic machinery, we discuss about the genetic codes, we discuss about the mechanism of translation. So, within the mechanism of translation, we discuss about the activation of amino acids, initiation, elongation and termination.

And all these mechanisms we have discussed in detail about the prokaryotic system as well as the eukaryotic system and what are the different proteins are involved in governing the different events, whether it is the activation of amino acids, initiation, elongation and terminations. And then we also discuss about the post translational modifications.

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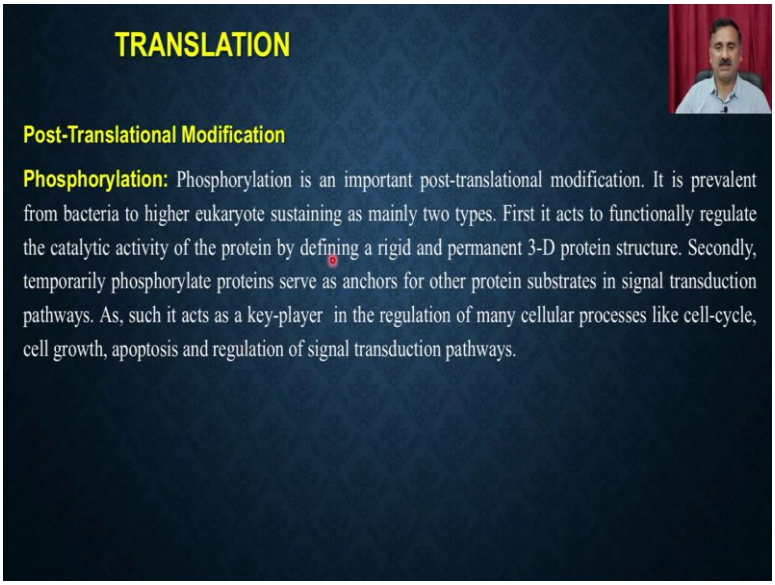

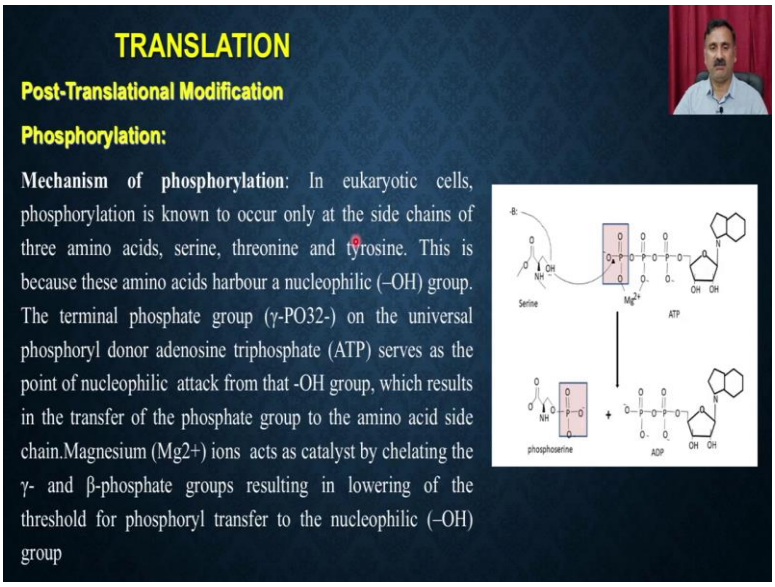

So, post translational modifications, these are the post translational modifications what we have discussed, so, we discuss about the phosphorylations. We discuss about the mechanism of phosphorylation where the phosphate is being transferred from the ATP to the serine. And that is how it is actually going to form the phosphoserine.

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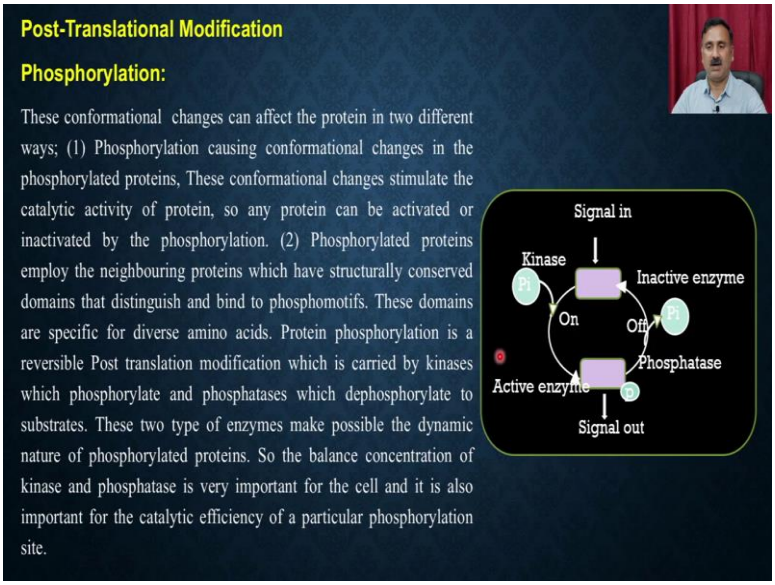

We discuss about the relevance of the this particular modification like the phosphorylations. So, phosphorylation causes the conformational changes in the phosphorylated protein and these conformational changes stimulate the catalytic activity of proteins. So, any protein can be activated or inactivated by the phosphorylations. Number two, phosphorylated protein employs the neighboring protein which have a structurally conserved domain that distinguish and bind to the phosphomotifs.

So, these domains are specific for diverse amino acids. Protein phosphorylation is a reversible post translational modification which is carried out by the kinases, which phosphorylate and it is and the phosphatase, which is dephosphorylated to the substrate. This means the protein phosphorylation is a reversible event and that is how it is actually going to regulate the activity of the different types of enzymes.

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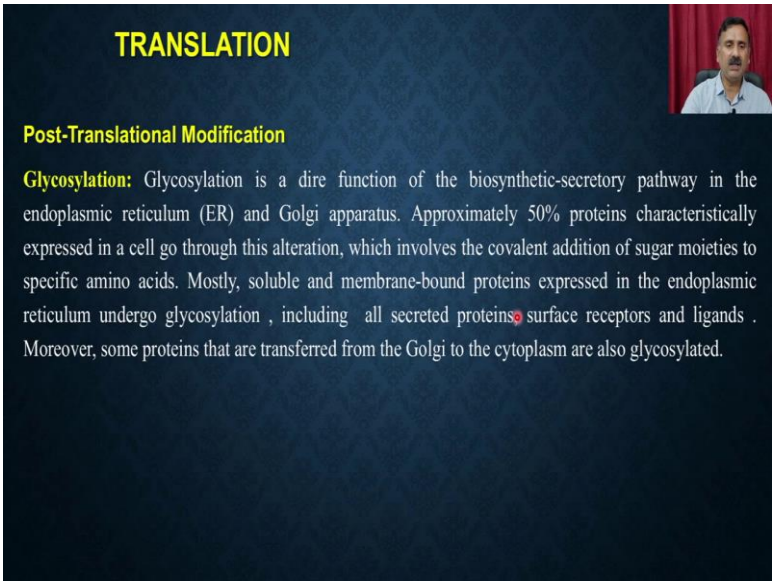

And then we also discussed about the glycosylation. And we also discuss about a different component or different mechanisms of the glycosylations.

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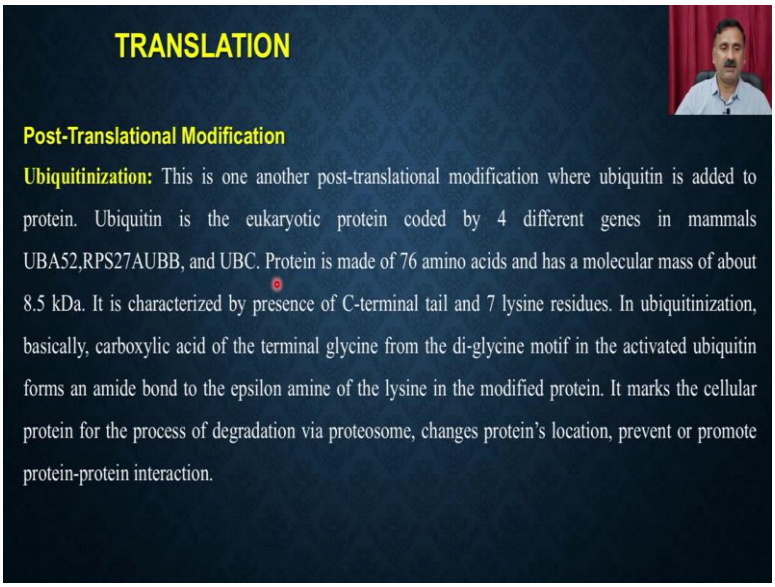

And then we also discuss about the ubiquitinations and ubiquitination is being governed by the complete ubiquitylation machinery where you have the different steps.

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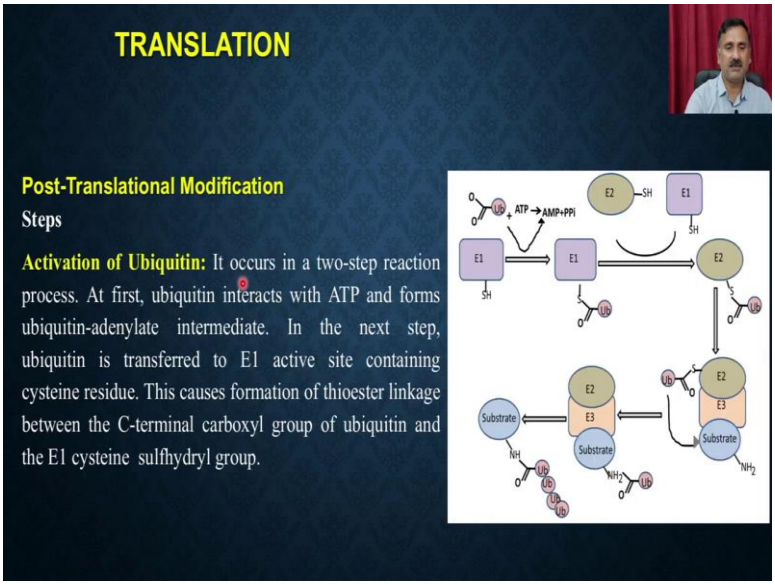

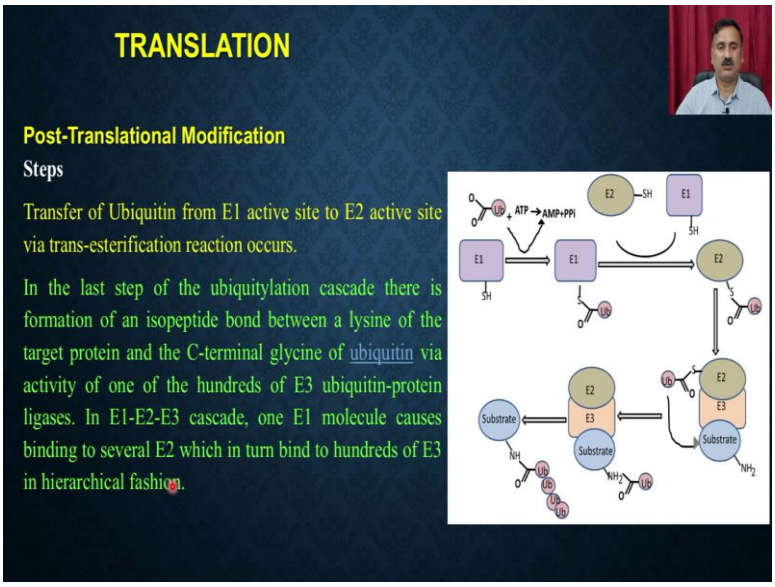

So, in the step one, you have the activation of ubiquitine. And so it occurs in a two step reaction. At first the ubiquitin interact with the ATP and form the ubiquity at pilot intermediates. And in the second step, the ubiquitin is transferred to the even active side containing the cysteine residue.

And this causes deformation of thioester English between the C-terminal carboxyl group of ubiquitin and the E1 cysteine sulfhydryl group. Once the activation is done then you can actually be having the transfer of a ubiquitin. And in the last step, the ubiquitin is actually going to be added to the target proteins and that is how you are actually going to have either the mono ubiquitylation or the poly ubiquitylation.

So, this is the mono ubiquitylations and once these events are going to be done for the multiple rounds, then it is actually going to form the polyubiquitylations.

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Apart from that we also discuss about the methylation. So, this process refers to the adding of methyl group to the nitrogen or the oxygen to form the amine to amino acid side chain and methylation is irreversible whereas, O-methylation is potentially reversible. Methylation enhances the hydrophobicity of the amino acid and utilizes the negative charge when attached to the carboxylic acid.

So, many methyl group contributor for such reaction is SaAm, which is called as the S-adenosyl mathogege. And this reaction is mediated by an enzyme which is called as the methyltransferases. Methylation process is involved in epigenetic regulation as histone methylation and demethylations. So, methylation is also very crucial in terms of regulating the many types of activities of the different proteins.

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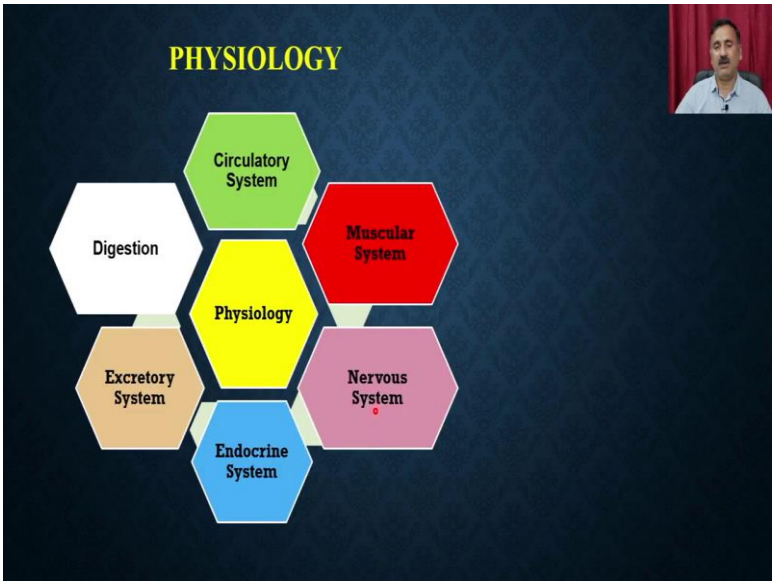

Subsequent to this, we also discuss about the human physiology and within the human physiology, we discuss about the digestion, circulatory system, muscular system, nervous system, and then we discuss about the homeostasis and within the homeostasis, we discuss about the endocrine system and the excretory system.

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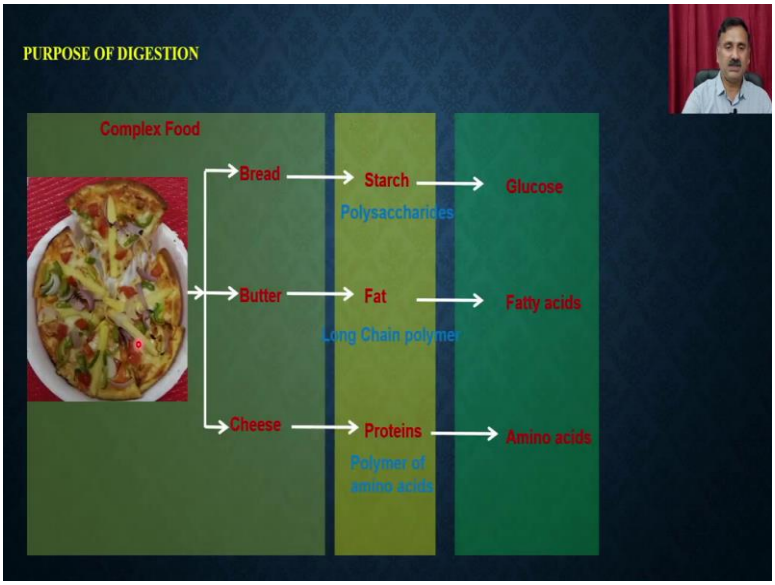

So, when we talk about the digestion, so, digestion, the what is the purpose of the digestion, the purpose of retaliation is that it actually going to simplify the complex foods. So, we have taken an example of the pizza, so pizza is made up of the three components, one is bread, butter and cheese, and bread is nothing but a starch which is actually a polysaccharide.

And the purpose of the digestion is that it should convert the starch into the glucose and that glucose is being absorbed by the human body and that is how it is actually going to be taken up for the nutrition. Similarly, the butter, butter is made up of the fat or fat or the fatty acids and that is going to be converted into the fatty acid and that fatty acid is going to be absorbed into the blood and it is going to be utilized for the energy production.

Then we have the cheese and the cheese is made up of the proteins and this protein is made up of the polymer of amino acids, and the protein is going to be digested to produce the amino acid and these amino acids are going to be absorbed.

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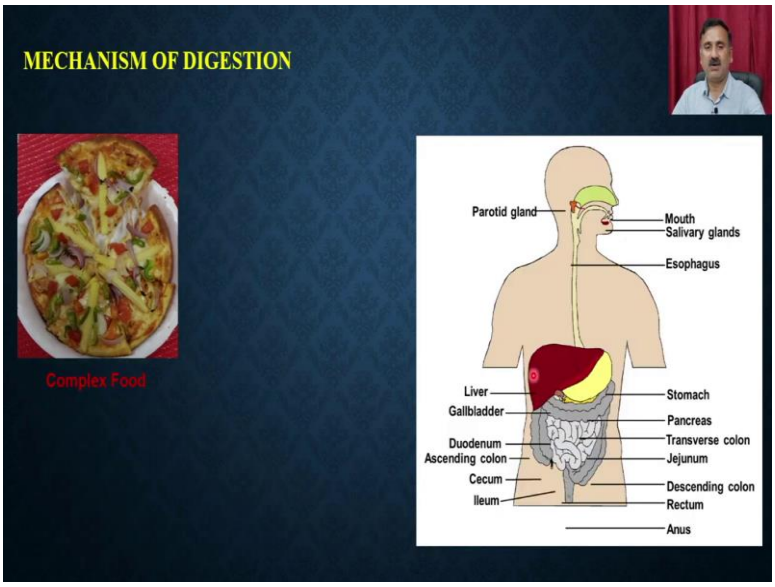

Now, what is the mechanism of digestion? So, mechanism of digestion is that you are going to have a complex food, so, you are going to take up the food through your mouth. There are so many glands water present in the mouth also buccal cavity that is going to help the swallowing of the food then it will enter into the esophagus.

And after that it is going to enter into the stomach and from the stomach it is going to enter into the small as well as the large intestine and in this chamber the reaction is going to take place with the help of the different types of enzymes. So, what are different enzymes?

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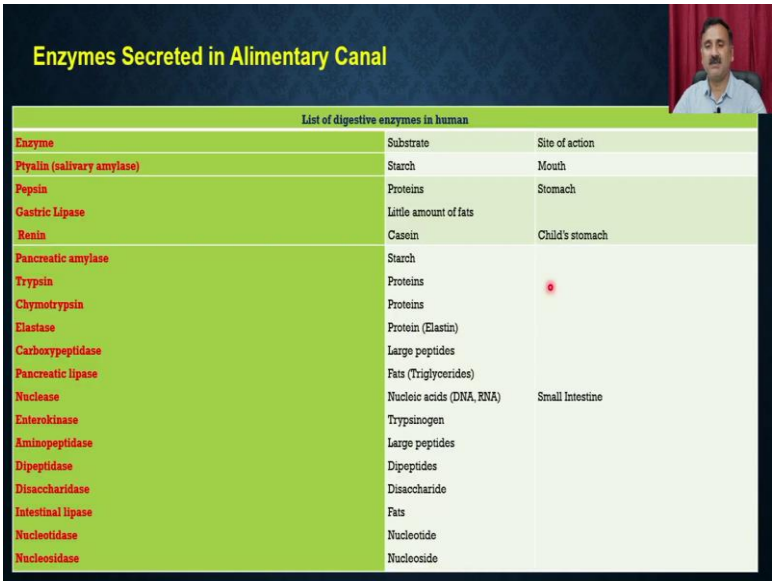

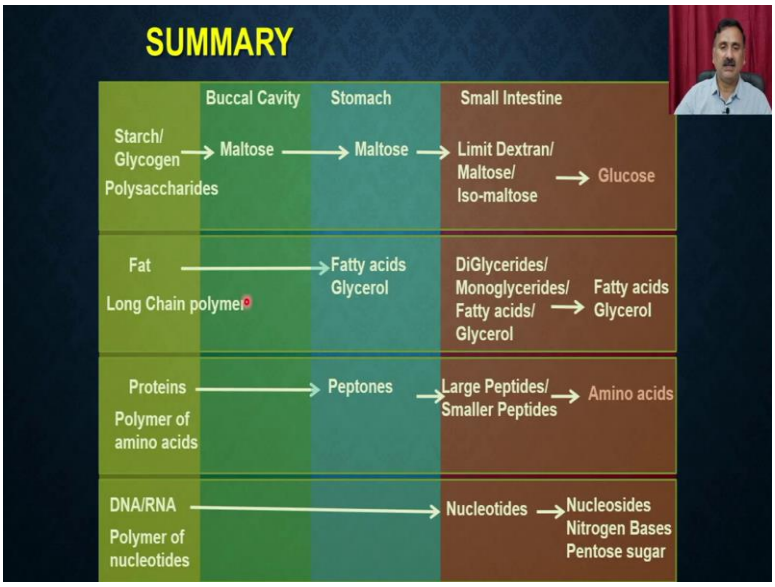

We have the different enzymes like the ptyalin, which is going to be act on the starch and is going to be present in the mouth or the buccal cavity. Then we have the couple of enzymes what is present in the stomach. And then we also have the couple of enzymes what is present in the small intestine and their target protein.

So, ultimately what is going to be achieved by the end of the digestion is that the starch or the polysaccharides are actually going to be converted into the maltose into the buccal cavity, it is going to be remain undigested within the stomach. So, there will be no further digestion in the stomach and then maltose is going to be converted into first into the limit dextran, maltose or iso-maltose.

And then ultimately it is going to be digested into the glucose in the small intestine and from there, it is going to be absorbed into the small intestine. Similarly, for the fat which is actually a long chain polymer is going to be digested into the fatty acid and glycerol in the stomach and from stomach it will move into the small intestine where it is going to be digested into the diglycerides, monoglyceride, fatty acids and glycerol.

And ultimately it is going to be converted into fatty acid and glycerol and in this particular fatty acid and glycerol is going to be absorbed by the body. Similarly, for the proteins, protein there will be no digestion in the buccal cavity it is going to be converted into the peptones then large peptide and a small peptide into the small intestine and ultimately, it is going to be converted into amino acid and it is going to be absorbed.

Then for the DNA or RNA it is going to be converted into nucleotide in the small intestine and from nucleotide it will actually form the first the nucleosides, the nitrogen bases and the pentose sugar and all these are actually going to be absorbed into the blood.

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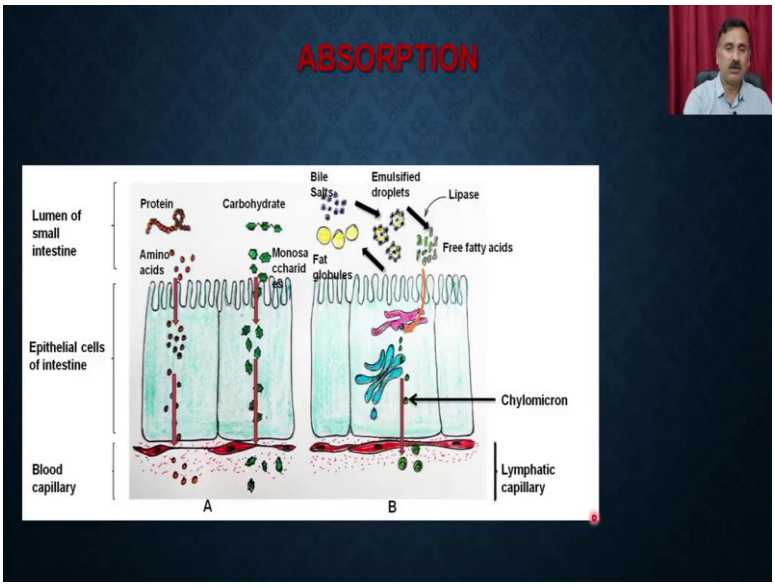

So, there is a discreet mechanism through which the absorption take place into the micro villi. And that is how the nutrition as well as the water and all these materials are going to be absorbed into the body into the small intestine, water is going to be absorbed in the large intestine and undigested material is actually going to be stored into the rectum in the form of feces and that is going to be a waste material and going to be removed from the body.

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Subsequent to digestion we also discuss about the circulatory system. So, within the circulatory system, we discuss about the structure and the function of heart, we have discussed about the how the heart is connected to throughout the body with a complex network of the arteries and the vein and what are the differences between the artery and the vein.

And what is the function of the blood in providing the protection against the infectious organisms and subsequent to the muscular circulatory system we also discuss about the muscular system. So, within the muscular system, we discuss about the different types of muscles, whether it is the involuntary muscles, voluntary muscles or the cardiac muscles. And then we also discuss about the mechanism of the molecular mechanism how the muscle cells are contracting.

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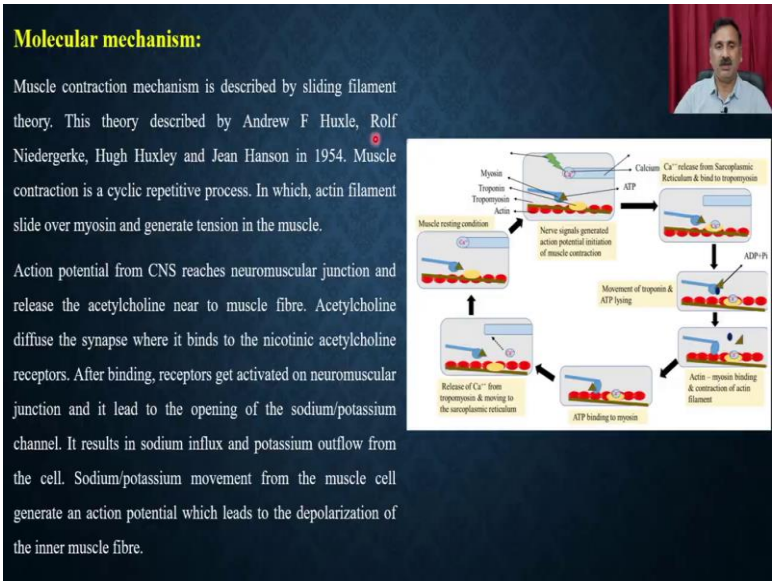

So, within the molecular mechanisms, so muscle contraction mechanism is described by a sliding filament theory. And this theory is described by the Andrew Huxle or, and Rolf Niedergerke and the Huge Huxley and the Jene Hanson in the year of 1954. The muscle contraction is a cyclic repeated process in which the actin filaments light over the myosin and generate tension in the muscles.

And the action potential from the brain is the initial stimulus and that is how it is actually going to have the, these are the cyclic reactions and that is how the muscles are actually going to contract.

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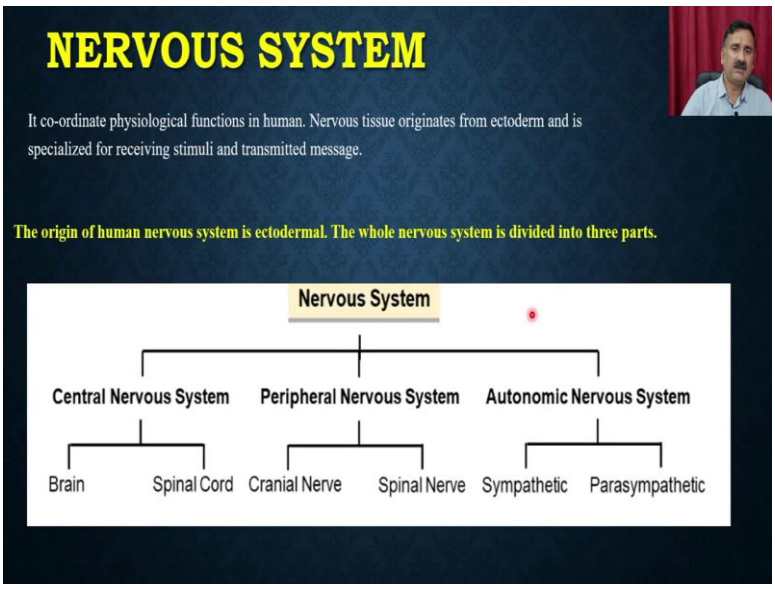

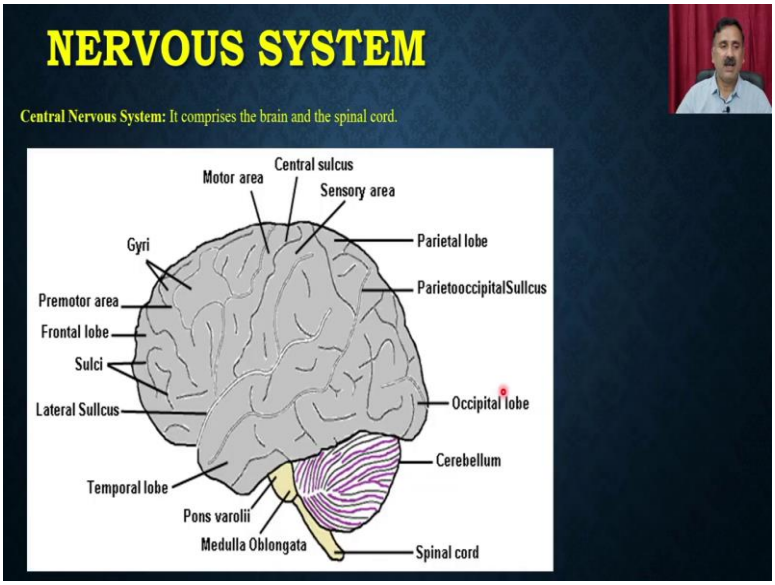

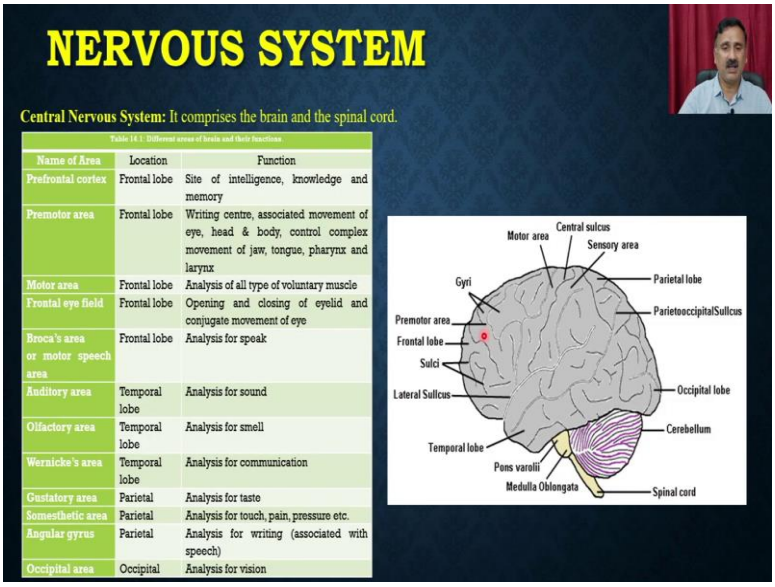

Subsequent to the muscle system, we also discuss about the nervous system. So, within the nervous system, we have said that the nervous system can be divided into three main parts. It can be central nervous system, peripheral nervous system or the autonomic nervous system, within the central nervous system, we have the two components like the brain and the spinal cord.

Whereas the peripheral nervous system is actually going to take up the message from the brain or the spinal cord, and that is being done by the cranial nerves or the spinal nerve, whereas in the autonomic nervous system, you can have the sympathetic autonomic nervous system or the parasympathetic nervous system.

So, within the nervous system, while we were discussing about the nervous system, we discussed about the structure of the brain, and we also discuss about the distribution of the

cranial nerves, from the brain and their role in the different types of activities. So, we discussed about like the, in what area of the brain the nerves are originating, and what is their function.

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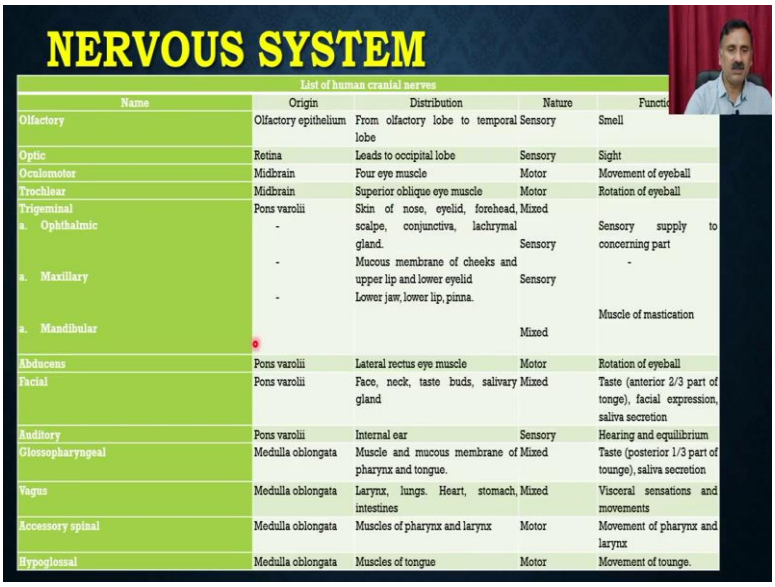

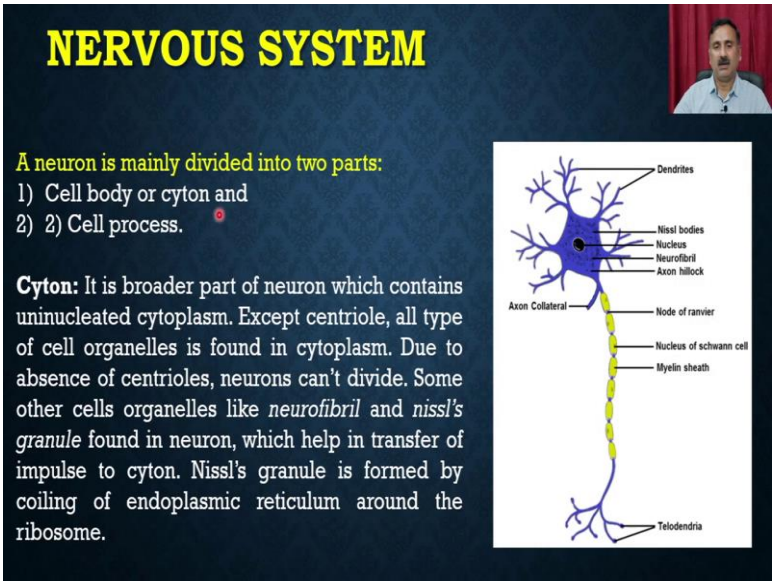

And so, these are the different types of cranial nerves, what is going to be originated from the different parts of the brain and what is their function. And we also discuss about the function the structure and the function of the individual neuron cells because the brain is made up of the different types of neuron cells. And in neuron cell is mainly been divided into two parts, cell body or cyton and the cell processes.

So, cyton, it is a broader part of the neuron. So, this is the cyton which contains the unit nucleated cytoplasm, except centriole, all types of cell organelle is found into the cytoplasm.

Due to the absence of centrioles, neurons cannot divide. Some other cells organelle like the neurofibril and Nissl's granules are found in the neuron which helps in the transfer of impulse to cyton. Nissl granule is formed by the coiling of the endoplasmic reticulum around the ribosomes.

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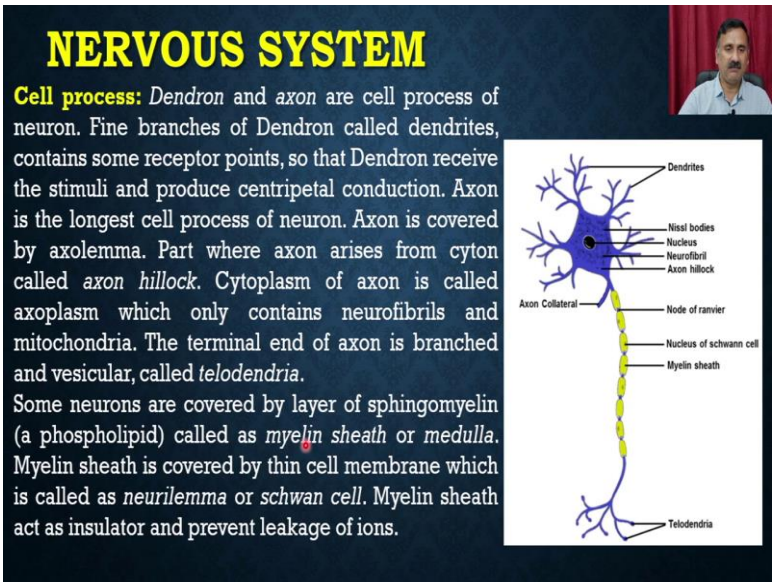

And then we have the cell processes. So, Dendron and axon are the cell processes of the neurons and they will actually going to convey the message.

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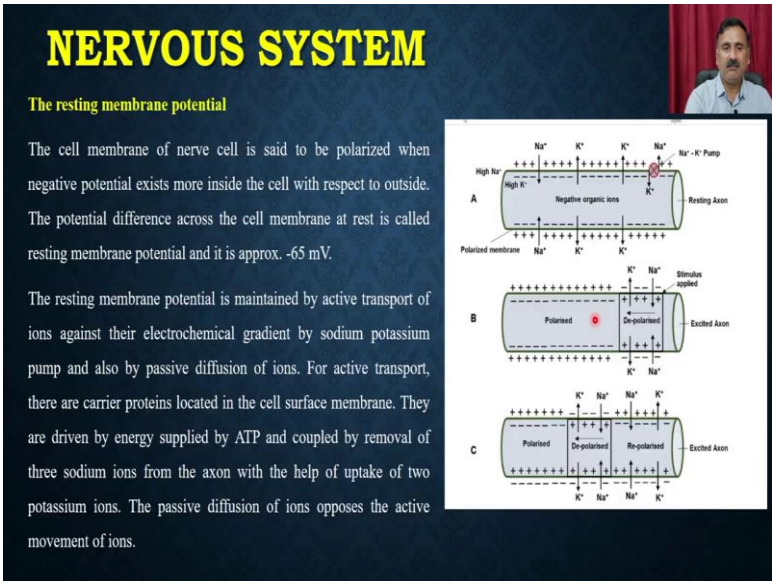

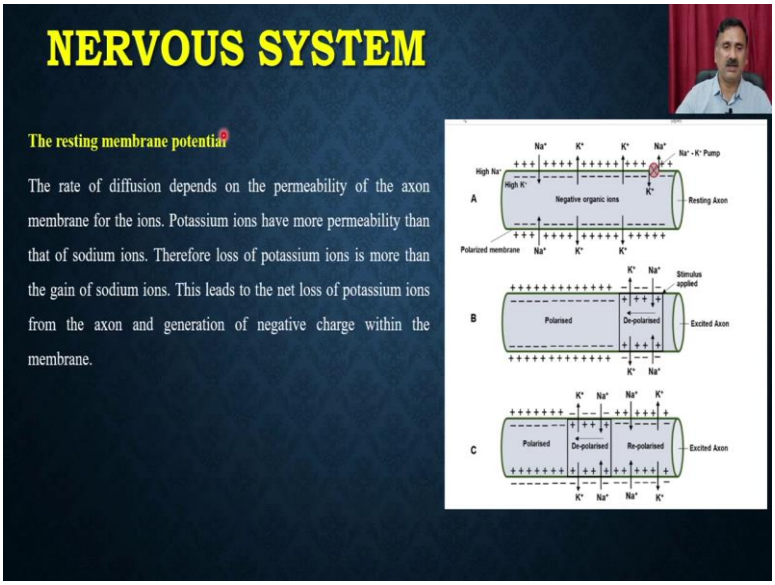

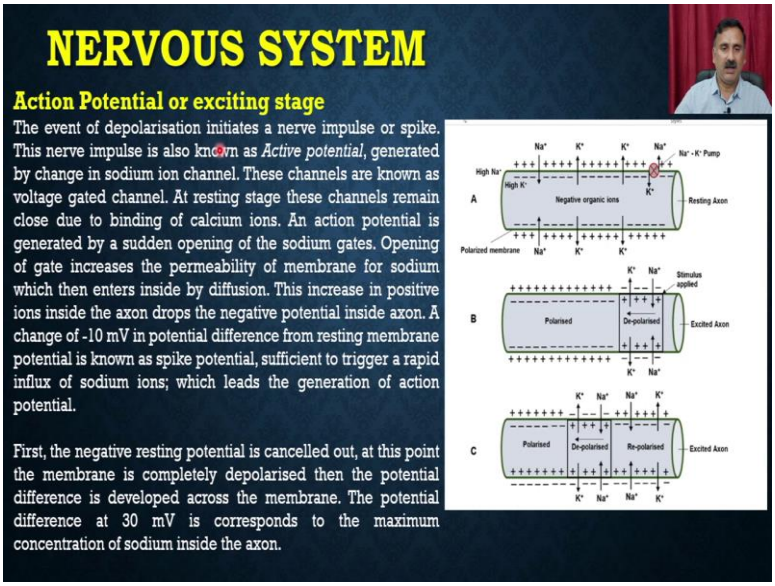

And then we have also discussed about how the mechanism through which the signal is traveling from the one end of the neuron to the other part of neuron. So, where we have discussed about the resting membrane potential, we have discussed about the action potential and then we also talk about the repolarization potentials. And we discussed in mechanism also that how the different events are happening and responsible for relaying the signal from one end of the neuron to the other part of the neuron.

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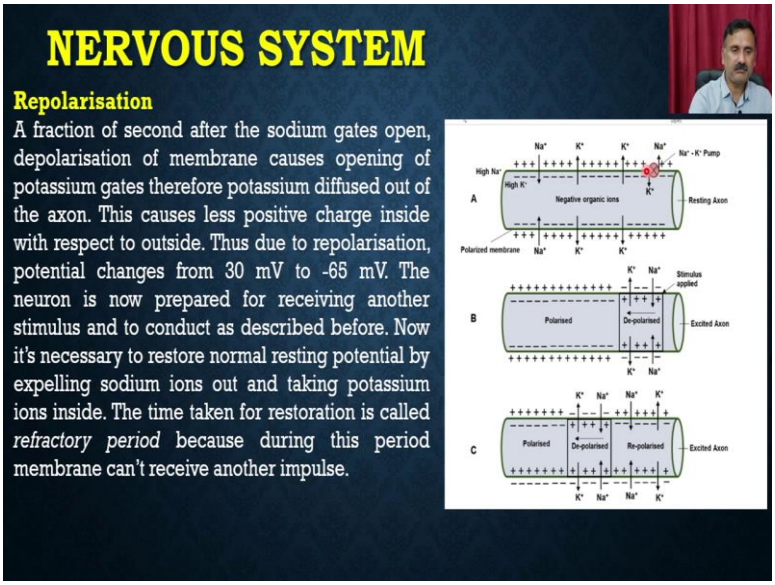

And this is what we have summarized in this particular picture that we have the resting neurons, excited neuron and as well as the repolarization neurons and these are the things that is going to happen. After this at the end in the previous module, we have also discussed about the homeostasis so, what is homeostasis?

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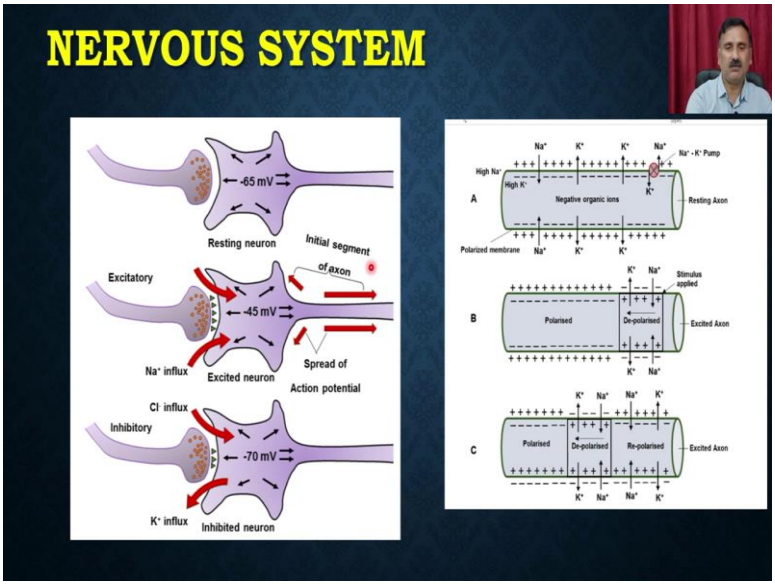

Homeostasis means the home like environment and it is the environment which you do not like to change. So, you always feel most comfortable when you are in your home. And that is why the homeostasis is very important for the any organism to remain healthy and to grow.

So, homeostasis what is mean by the homeostasis is that it is actually going to keep the conditions or the parameters unchanging, it is maintaining a relatively stable internal environment regardless of the external conditions and it allows the changes within the narrow limit and it is under that dynamic equilibrium which means the different parameters are actually going to affect each other, but it will remain within the dynamic equilibriums.

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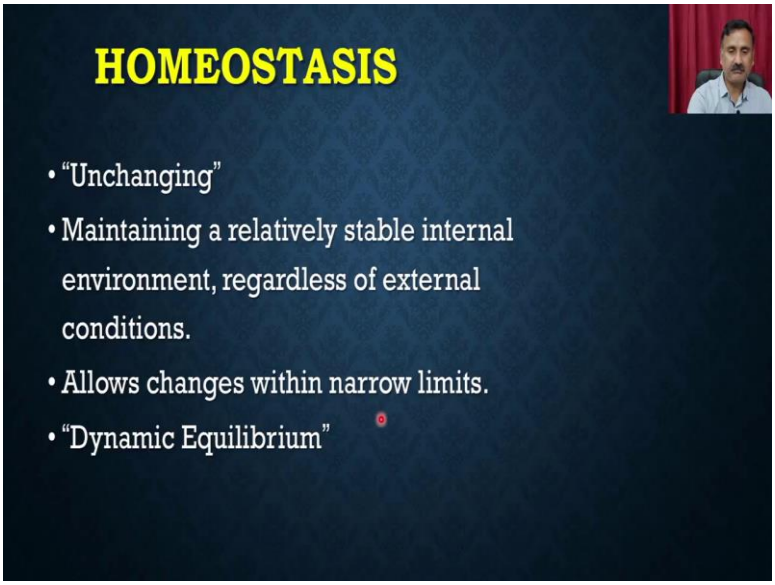

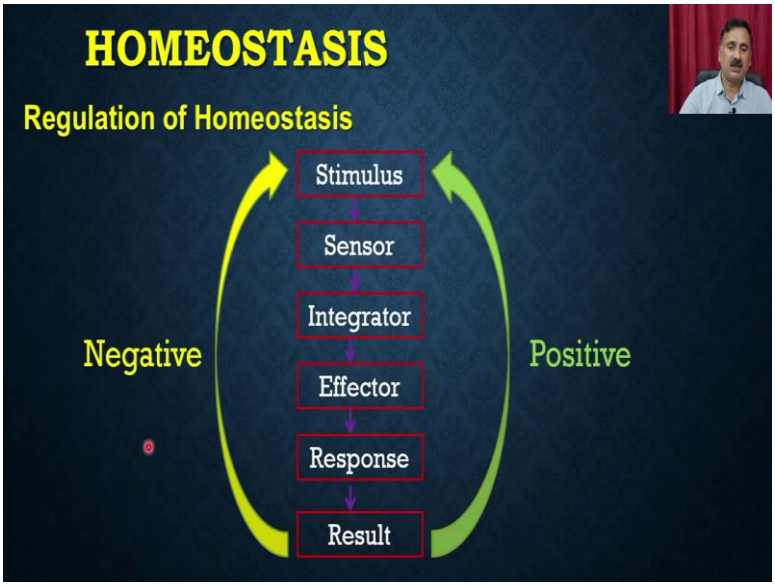

These are the machines part of the homeostatic machinery where you have the stimulus, sensors, integrator, effector, responses and results and what is the role of the stimulus, it is actually going to respond when there will be a deviation of the parameter from the set point and the error is measured by the sensor.

Once it measure that there is a deviation then the sensor is actually going to sense that particular signal and it is actually going to give that the integrator and the effectors. So, effectors are usually in an organ or tissue. So, they will actually say okay, what could be the effect what is going to form, and then it is going to result into the response and that result in response is actually going to either decrease the stimulus or increase the stimulus.

So, under what condition it is actually going to decrease the stimulus. So, when you have the negative feedback mechanism, it is the result is going to decrease the stimulus which means it is actually going to reverse the effects whereas, when the results are going to increase the stimulus then it is going to be called as the positive feedback mechanisms.

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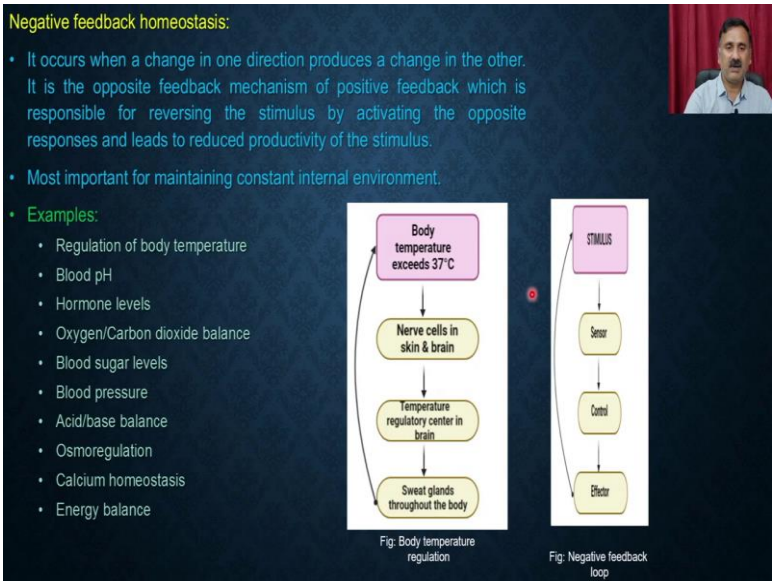

Fig: Body temperature regulation

Fig: Negative feedback loop

So, what is mean by the negative feedback mechanism? It occurs when the change in one direction produces a change in the other, this. It is the opposite feedback mechanism of the positive feedback which is responsible for reversing the stimulus by activating the opposite responses and leads to the reduced productivity of the stimulus, most important for maintaining the constant internal environment.

So, one of the classical example is the regulation of body temperature, blood pH, hormones, oxygen, carbon dioxide, sugar, blood pressure, acid, osmoregulation, calcium homeostasis and the energy balance. This is a classical example, I have shown how the body is maintaining the constant temperature of 37.

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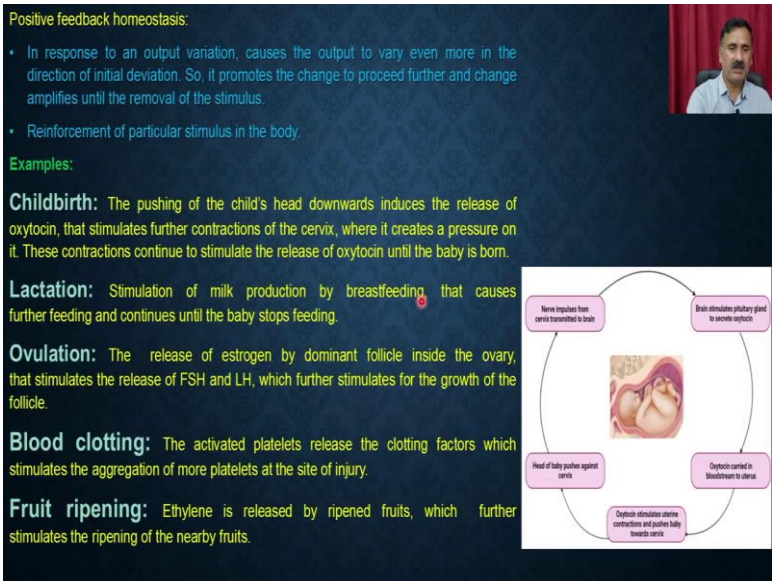

And then we have the positive feedback homeostasis. So, in response to an output variation, the, it promotes the chain to proceed further and changes amplify until the removal of the stimulus. So, it is rare, but it is occurring in the special circumstances. So, what are the special circumstances, you can have the childbirth, lactation, evolutions, blood clotting and as well as the fruit ripening. So, these are some of the classical events in which the positive feedback homeostasis is actually going to play a crucial role.

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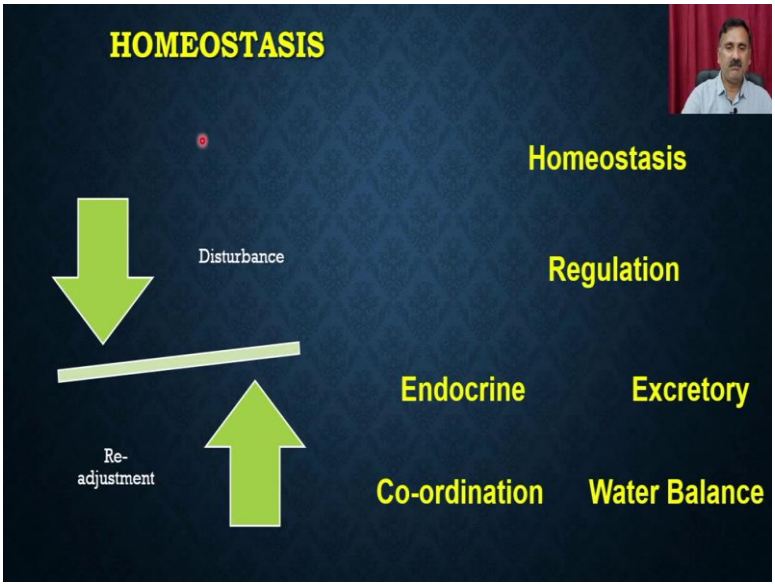

So, what is mean by the homeostasis is that there are factors which are actually going to disturb the homeostasis and but once this happens, it could be because of the positive or the

negative feedback mechanism it is actually going to reverse these changes and that is all the homeostasis would be under the dynamic equilibrium.

And homeostatic regulation required the activity of the endocrine system which is going to coordinate the different types of events or coordinate the activities between the different types of organs and whereas the excretory system it is actually going to maintain the water balance.

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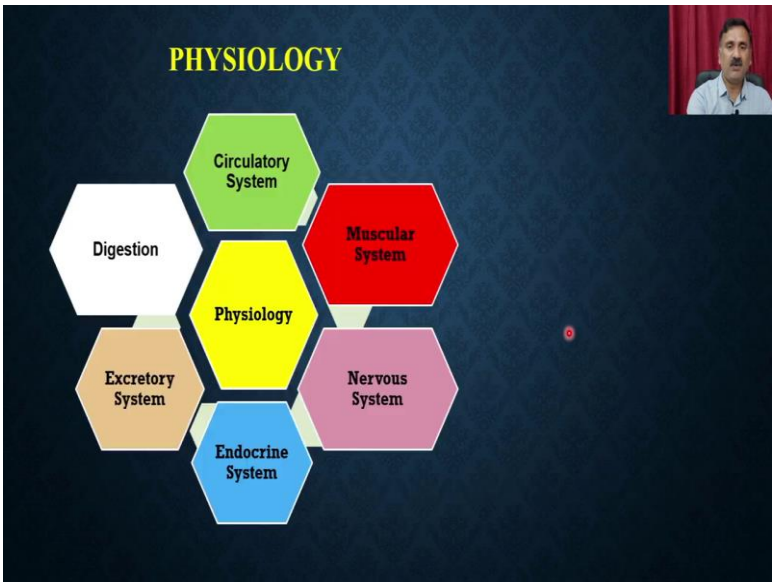

So, within the human physiology, what we have discussed, we have discussed about the digestions, regulatory system, muscular system, nervous system, and we have also discussed about the endocrine system and as well as the excretory system to understand their role into the homeostasis. So, in this particular course, what we have discussed so far, we have discussed many aspects related to the living organisms.

Whether it is related to classifications, evolutions and biomolecules, cellular processes or the human physiology. So, with this I would like to conclude my lecture here and I hope the summarizing and as well as revising the content in this particular module is going to be helpful for you to prepare for your forthcoming exams. So, with this I would like to conclude my lecture here. Thank you.