Animal Physiology
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Lecture – 05
Chemical basis of organization of the body

Welcome back to the lecture series in Animal Physiology. Today we will be starting the fifth lecture. So, just to have a little recap what we did in the last fragment of the fourth lecture. So, we talked about the references or the way you study a structure a dynamic structure like human body or as a matter fact any animal system what are the different planes how you cut it. So, we talked about the three different planes sagittal plane transverse plane and the frontal plane this is where we kind of wind up and earlier to that we talked about the lateral part proximal part superior inferior distal and proximal and medial part lateral part and all those terminologies.

So, when I wind up in the last class I kind of felt that the frontal plane I should have explained it much better for you people. So, when you talk about the sagittal plane I told you that you are giving the cut like this. So, half of the nose in one side half of the nose in another side half of the mouth is one side and another mouth is another side then when you talk about the transverse plains you are taking the head. So, you are cutting the body like this you know like this. So, you consider body of the cylinder and you are cutting the cylinder like this now talking about the frontal plane where I fell that in a little bit of a more understanding is that when you are making the cut like this. So, suppose you give a cut like this.

So, in the first cut you will have the nose eyes and everything the next cut you will have the part of the brain and is a good back all of the cut of the rare. So, that is what we call as the frontal cut. So, these are the different ways by which a three dimensional structure is being studied. So, every section what you get you study the anatomy histology of that section and then likewise you add all of them and then you figure out the three dimensional structure. So, there is lot of imaging processing which goes on in modern days anatomy because this is exceptionally essentially say for example: as I was telling you in the last class on a three dimensional object.

So, for example, a cylinder somewhere in a space at a particular x y z coordinate there is some e element. So, how you locate it you needed reference point. So, you really have to image a person section by section. So, having said this these are the olden days how anatomy has been has been studied by the modern days anatomy is more on the side of imaging noninvasive imaging techniques how without damaging the system you can image the whole inside thing it is almost something like an x ray what we do when you pass through the scanner you know you are getting scanned by the x ray similar to that, but that only can do for the hard tissues not for the soft tissues.

How we really can image a system without destroying it and there is enormous amount of research which is going on all over the world for non invasive imaging techniques and this is one of the most challenging area falls under a multiple expertise starting from optics to imaging to mathematics to image processing and to advanced camera and advanced microscopy. It is a very very interdisciplinary area, but area which will flourish in the decades or the centuries to come because one of the things just think of it say for example, in your body blood is going. So, it means it is just like you are taking a remote sensing image or something from the top you can see river is moving exactly similar to that within your body blood is moving it is come from the heart it travel all over your body comes back to the heart.

So, now could you have imaging scanner which can tell you at what speed blood is moving. So, even without checking the pulse without checking the blood pressure just you can be able to visualize the flow of blood in a real system without doing any inviscid application. So, this is where modern days anatomy with if you those who are aware of Grey's anatomy these are very old books and almost biblical in terms of the way it had shaped the modern day medicine by the modern days anatomy is heading more on a different frontier which is of course, basic anatomy has changed, but much more life into it; it is no more ecstatic subject it is a very very dynamic subject and why not think of it a cancerous tissue grows or a lump grows, it is a dynamic system it is not a static system at some point it is happening.

So, those of you who have a player to enjoy image processing or who have a player of reconstructing three d image from 2 d slices they may explore what all modern days medical anatomy or as such anatomy as such can offer and there is another component to that the death for any object there is a depth components. So, you just do not have x and

y it is the three dimensional objects. So, if there is a depth component and how you know major all these things having said this- today we will move on to the molecular organization followed by the cellular organization and followed by the tissue organization of a body.

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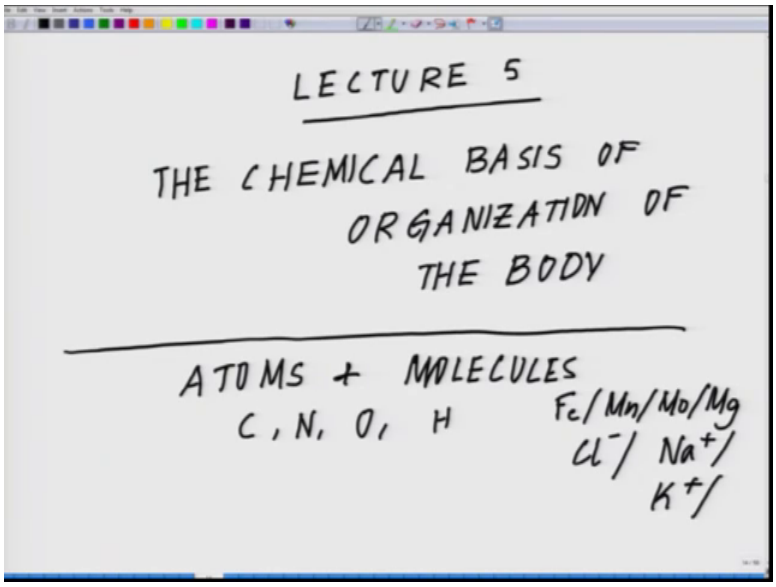

So, let us move on to the next slide. So, in lecture 5, today we will be dealing with. So, let us put in. So, we are in to lecture 5. And the first thing today we will be dealing with is the chemical level of organization. So, in these three sections what we will be dealing with I will kind of you know brush up your basis the chemical basis of organization of the body organization of the body.

Now if you look at it we all are made up of atoms and molecules and nature has picked a very simple atoms to design us in respect of carbon in respect of nitrogen in respect of hydrogen in respect of oxygen apart from it, it has picked up few other transition metals like iron cobalt manganese molybdenum. But in a very small amount and these different molecules or these different atoms eventually form molecules and these molecules have self assembled some of them are complex molecules some of them are simple molecule they have self assembled to form their structural component of our body and some of these molecules standalone has formed the framework or the conditions or the base where all the reactions of our body takes place some of these simple molecules have taken part in synthesizing much more complex molecules.

So, just if we kind of what I will be doing here, I will be outlining all those different molecules which are involved in the chemical basis of the organization of the body. So, while outlining. So, just now I talked you about we are having series of atoms and molecules and if you look at the different atoms which are involved carbon nitrogen oxygen hydrogen iron manganese molybdenum magnesium chloride sodium potassium there are handful of them which dictates our system.

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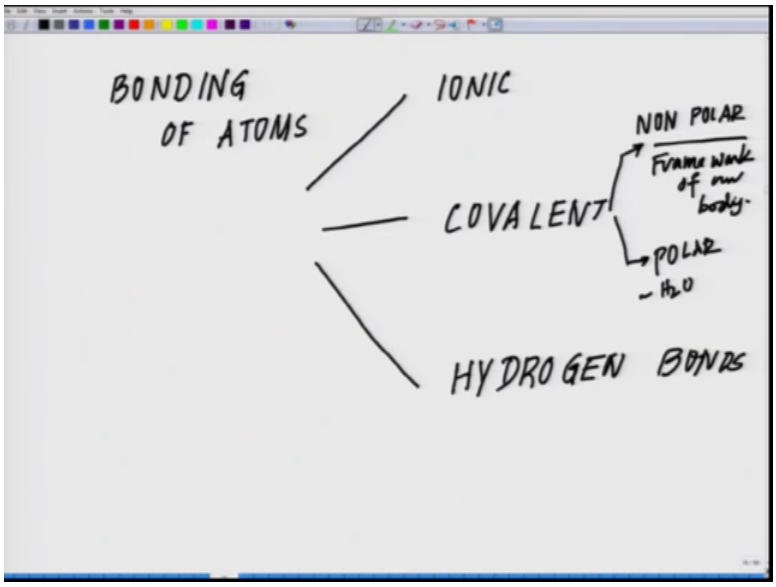

And followed by that most of these atoms are bonded with each other by different three different kind of bonds bonding of atoms here I am just kind of you know brushing basics because eventually while I will be going through the detailed course all these things will come very handy. So, you will have the ionic bonds where full filled transfer of electron taking place then you are having the covalent bonds and then you are having the hydrogen bonds these are the key things which you have to revise and I wish to request you please pick up any biochemistry or any go to any online just read couple of sentences about them.

Because, we will be asking some small questions on these things multiple choice of course, on these things what are the ionic bonds what are the covalent bond and I am not going to get in depth into it because these are been covered in several courses, but we will be needing all this things. So, it was just kind of give, you a refresher here.

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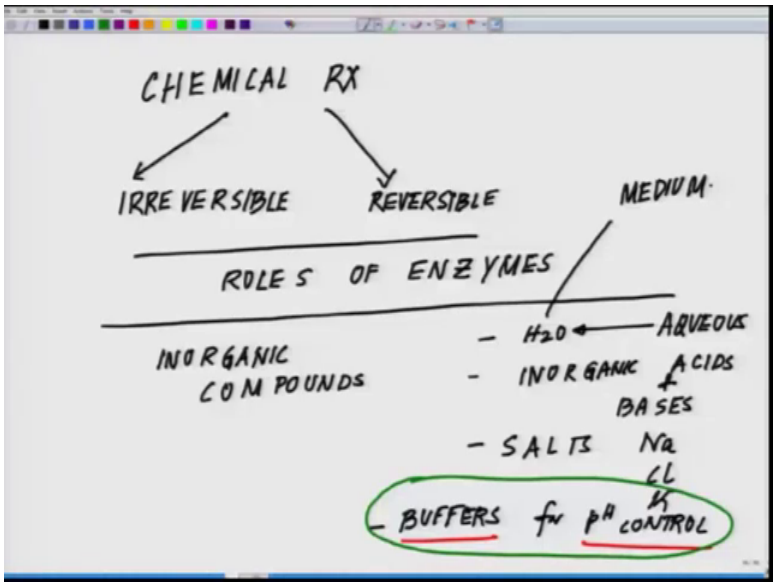

So, these are the points you should know. So, from here we move on to what are the basic. So, all these different kind of molecules goes through a series of chemical reactions RX stands for the reactions and they could be either irreversible or these are reversible and one more thing which I just forgot in the previous like to mention you these covalent bonds could be further classified into non polar and polar covalent bond.

So, among the example polar covalent bond is like water which is a polar molecule and non polar covalent bonds are the one which form the framework most of the molecules which form the framework of our body this is the some of the points you should remember and coming back to the next slide you are having series of chemical reaction in the form of reversible irreversible chemical reaction and the roles of enzymes and this process. So, what I expect from you; you should of course, will be talking about the specific enzyme as we will be moving like if enzymes like carbonic anhydrase nitrogen. Agen series of them we will be talking as we will be moving through, but just have an idea at least a very very fundamental idea what are enzymes.

How the enzymes function what is k cad value and all those kind of things I just wish you guys to can I go through that as a part of yourself assignment to brush all these basic concepts the roles of different kind of enzymes followed by that. We talk about the different kind of inorganic compounds which are involved in our system, and the major

inorganic compound which plays a critical role is water inorganic acids and bases sodium hydroxide.

So, I am talking about water all our reactions in the body the medium is water that is why we call it aqua system all the reactions all the reactions you can think of all have the medium as water then we are having a series of salts starting from sodium salt chloride salt potassium salts magnesium salt. Likewise then we are having the series of buffer systems for p H control these are very important as we will talk about the different kind of buffer systems in the kidneys in the lungs in the blood these different buffer system.

So, what I expect from you people you should know the basic very very basic of what is p H what is a buffer and how these different buffer systems regulates the p H of the body these basic knowledge I expect you guys to know brush during this process these are all you know you all have studied all these things in your school level.

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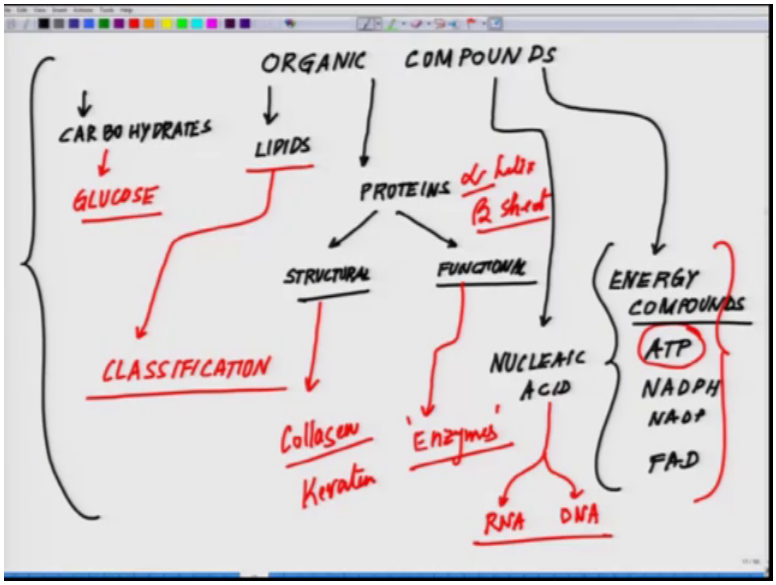

Next from here we move on to we talk about the organic compounds again this is the basic biochemistries first chapter the different organic compounds which are involved which includes your carbohydrates. So, I expect you to know what are the common carbohydrates you have the lipids we will talk little bit about more about lipids as we will talk about the bi lipid membrane in the cellular organization then you have the proteins; proteins could be classified 2 level it could have a structural proteins as well as you have the functional ones of course, both are functional.

But these are the ones which I had taken part in direct reactions, and these are the one which are forming their structural components then you have the genetic machinery which is run by the nucleic acid and they have a specific locations within the body and then the most critical one energy compounds like ATP, ADP and NADPH like ATP, NADPH, NADP, FAD, likewise these are the difference of course, the most critical one the most important one is the ATP.

So, what I expect you people to kind of know the different kind of carbohydrate specially why glucose is. So, significant lipids in terms of the classification of lipids you pick up any biochemistry text you will you will figure out nature of polar head groups and a non-polar tails the different kind of lipids which are present in the neurons in the brain ceramides go through any text book you will figure that out. And we will talk about the proteins what is alpha helix what is beta sheets these are the confirmation alpha and alpha helix and beta sheet confirmations we talk about the different structural proteins like collagen carotene in terms of the functional we will talk about the different kind of enzymes except of course, one of them which is a nucleic acid enzyme.

Then different other proteins which has different kind of functional roles then we will talk about the nucleic acid what you people get to know are the RNA and the DNA and the energy compounds and where all their involvement when we talk about the energy compounds.

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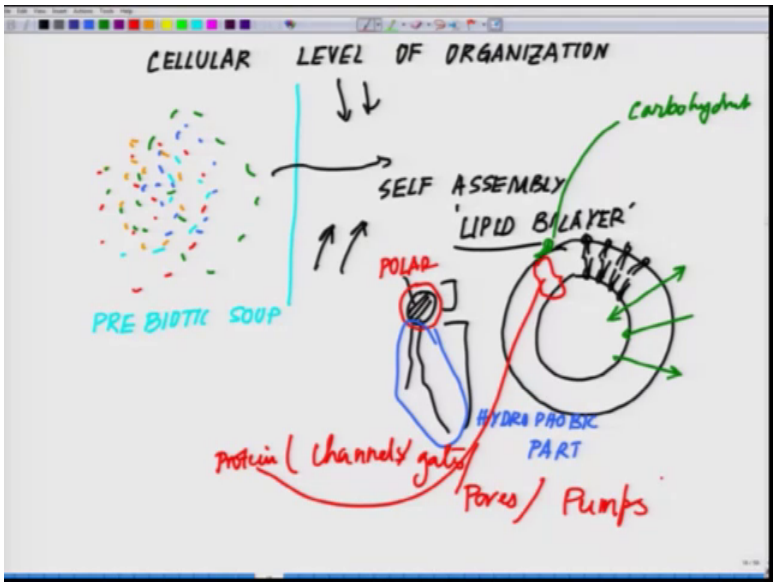

We come in the very next slide about the different cell organelle where they are concentrated all these different kind of molecules from here we move on to cellular level of organization cellular level of organization. So, the big is prime of life form which is evolved on the floor of earth or wherever in the universe is the self assemble ling of certain unique molecules to form a confined structure what we call as cell.

So, say for example, suppose I will just represent that these are the different these different colors what I am going to are assume these are the different kind of atoms which are there in the pre biotic soup k all different kinds of atoms which are present there and this is the pre biotic soup billions of years ago out here at one point by some physical forces of nature or something somewhere or other there is a self assembly which occur these could be complex molecule. These could be simple atoms, these could be molecules of lipids or something and they form the first confined structure what we today call modern day as a cell and this cell is formed by the self assembly of lipid bi layer. Just few minutes back I was telling you I want you guys to know about the polar head group of the lipids and the hydrophobic tails. So, here is a hash part is the; should get this is the polar head group which can interact with water where as the tail which I am showing in blue is the hydrophobic part.

So, the biggest tramp was or is how the self assemble to form my structure and on such as structure they; they develop systems of continuous different kind of transport mechanism energy dependent transport uni-directional transport bi directional transport channels they form a series of channels here sodium channel potassium channels chloride channel water channels and all these channels are of course, made up of a proteins as well as they have marker molecules on top of these channels have them to identify which are of carbohydrates.

So, if you see a memory in itself sorry; this is proteins which are forming channels gates pores pumps. So, what you see just in the previous slide if you go back. So, all these different molecules what you see there is one thumb rule which has given all of them they all have self assembled somewhere rather and we do not know how these different lipid molecules or as a matter like the proteins how the self assembled what made them the formation of the peptide bond what their situations how such a long chains were formed.

How the DNA evolved we do not know we do not have a answer to these question in the pre-biotics how these molecules were formed we just have no idea because this is far and beyond in the time where we start saying the DNA, but how DNA evolved because if you look at the cell in the left side I just give this let me draw a classic cell when you talk about a classic cell if it is a in mammalian its mostly a spherical shape.

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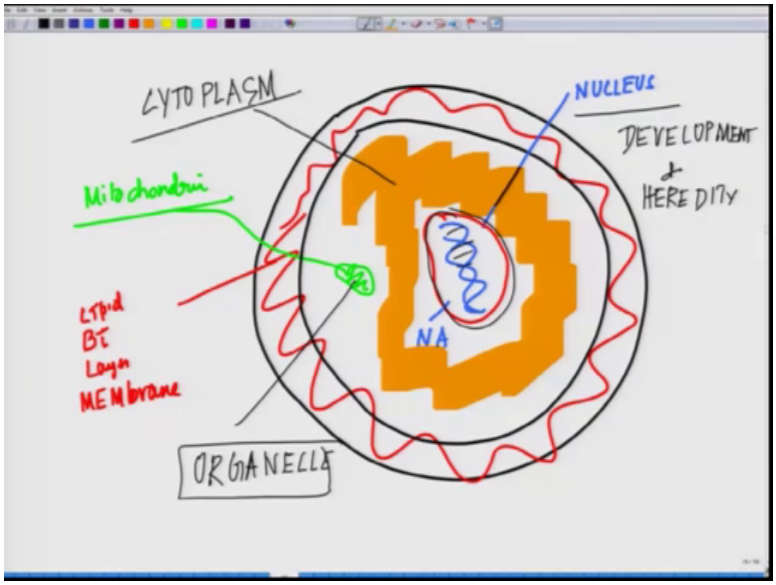

So, this is the membrane what just now which is a bi lipid layer and even nucleus inside within the nucleus you have the nucleic acid in a and this is the nucleus and this is the lipid bi layer membrane l stands for lipid bi layer bi l stands for the layer lipid bi layer membrane.

Then you have another organelle called mitochondria which is taking part in all the energy production machinery of the cells if it is a plant cell of course, you have chloroplast which is harvesting the sunlight. So, it is a very complex structure what we talk about as a cell it is a very very complex structure, but how this complex structure evolved is a one heck of a tough question we really do not know how it has evolved, but what we know are these though we do not know the origin of it, but what we know is it forms a membrane.

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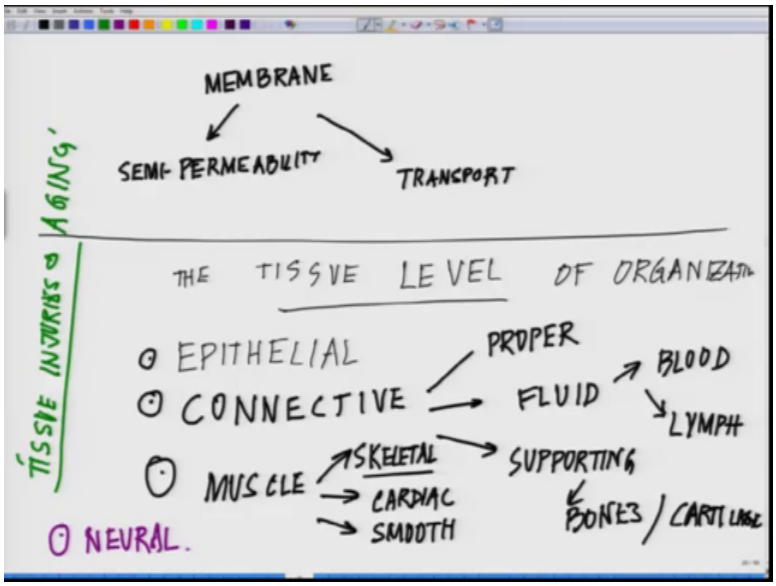

And this membrane has a semi permeability it does not allow everything to go in or go out it has a lot of transport rules and regulation. As I was telling you it could have diffusion it could have facilitated transport and this part what you see here this is called the cytoplasm between the nucleus and this is cytoplasm, and these are the different organelles. Again I am not going to in depth of it because I want you guys to you know brush your basics on this.

And here you are having the nucleus which is regulating your development and heredity all these features all the different aspect of a unique cell type are being conserved in this DNA and through the expression period each cell changes its forms. And then finally, rest at a final form before it you know dies out and there are certain cells in our body which remain intact throughout our life which includes nerve cells cardiac cells likewise and if this is the cellular level of organization. The last in the final level of organization what I wish to highlight here is these cells from different kind of tissues which is called the tissue level of organization.

And at the tissue level of organization what we are having there are four different kind of tissues we deal with mostly which is epithelial which is forming the cover of the all the covering- say for example; all the surface these are all epithelial cells of a body one. The next one is connective tissue we will talk a lot about these connective tissues as well as epithelial cells in the sections to come connective tissues are different kind they could be

something called a proper connective tissues they form a structural framework of our body. Then we have fluid connective tissue which includes the blood and the lymph then we have supporting connective tissue which includes your bones and cartilage and the very next section post integumentary system. We will talk about the bones and the cartilage.

Third important tissue classification is the muscle tissue muscle tissue could be classified into three groups and we will separately deal with them which includes a skeletal muscle cardiac muscle skeletal. I do not need to tell all the muscles which are present in the body are the skeletal muscle the cardiac muscle the one which is handling your heart and then you have the smooth muscle which is lining the gut of the body and the fourth and final non regenerating one is called the neural tissue.

So, we will have individual sections in each one of these things and of course, later we will be dealing with the tissue injuries and aging tissue injuries and aging is the process where you know things different shapes. So, what I wanted to highlight here while closing in on this class is that this is the framework where from molecular self assembly at some point during our evolution cells are performed. The cells learnt a machinery to divide and replicate and conserves it information in the form of nucleic acids and at some situation may be in the form of proteins they could conserve information. And they further develop in to very complex structures of tissues these tissues join together to form organs. These organs joined together to form systems and different systems form together or join together to form what we call as a body.

So, with this brief introduction of 5 classes of different level of organization we will be hitting the subject from the mostly from the tissue level of organization well or rather the organ level of organization. So, next class we will be on integumentary system followed by the bones and the cartilage.

Thank you.