Animal Physiology
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Lecture – 2

We finished the first lecture. So, today we will be starting with the second lecture. The first two lectures are about the introduction to physiology of cells and general physiology.

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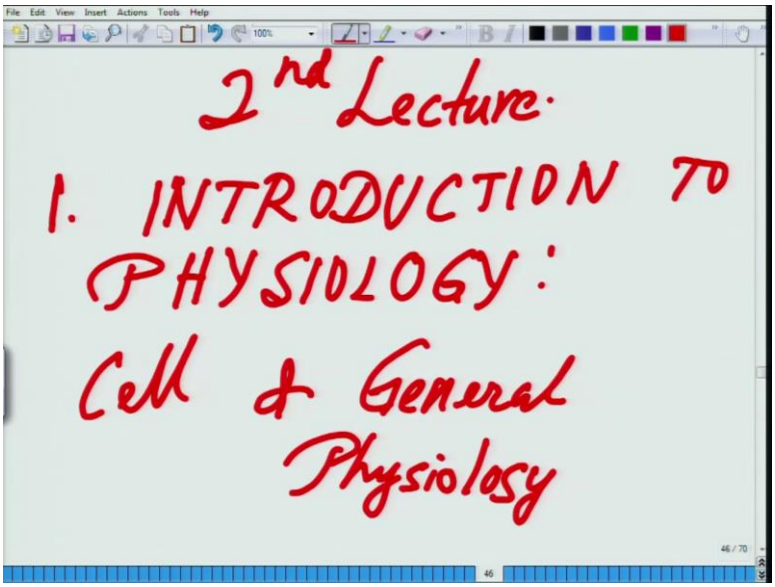

In the first class, let me just do like this. This is how we have divided it, section 1- Introduction to physiology and under that we are dealing with cell and general physiology. There are two dedicated lectures on this. So, this is the second lecture. In the first lecture, we talked about the chemical organization and the way, the chemical level of organization has taken place.

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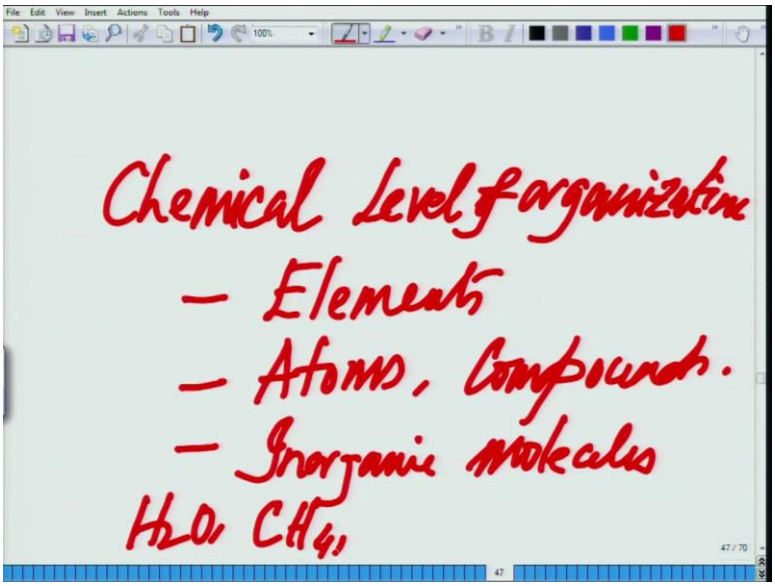

In the second lecture, today let us put it like this, we talked about the chemical level of organization. In the chemical level of organizations, we talked about the elements, atoms, the compounds followed by some of the inorganic molecules.

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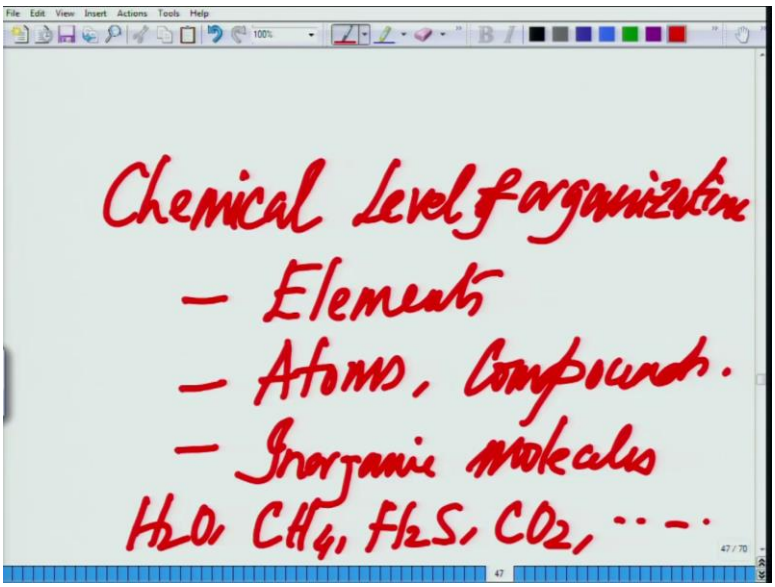

The major inorganic molecules including water, methane, sorry, methane and H2S, CO2 and likewise and so forth. Today, what we will do, we will talk about some of the organic molecules.

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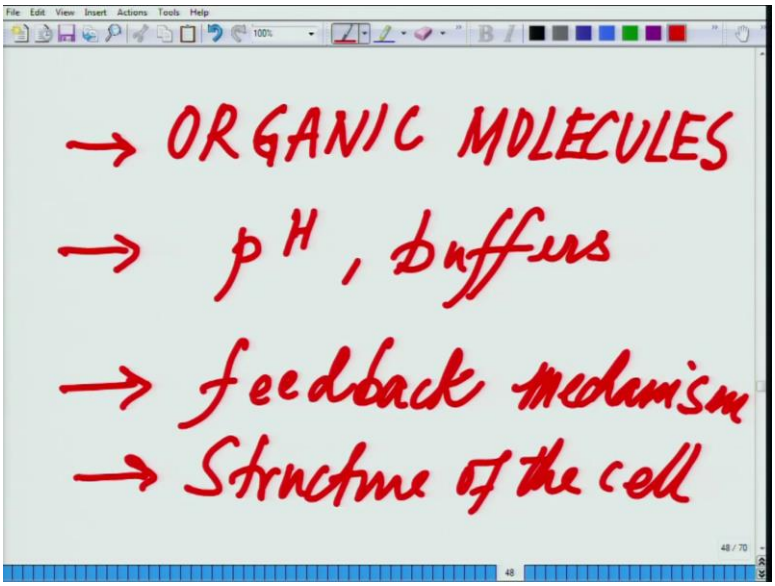

In this lecture, one aspect we will be dealing with is the organic molecules. Then, we will be dealing about some of the factors like Ph and buffers. Then we will be talking about the feedback mechanisms, and we will revisit the structure of the cell at the end. These are the four aspects, which we are going to deal about. What I will do, I will give you some practical example of feedback mechanism. What really feedback mechanisms are. Let us think of a situation; it is a hot weather outside.

We go out. Once we go out, we really feel very hot. When we feel very hot, what we see. The next thing is that we have a lot of sweat, coming from our skin and everything. After sometime, we start feeling comfortable; It is ok, a kind of adjustment. What exactly has happened when you go out? Here is the situation.

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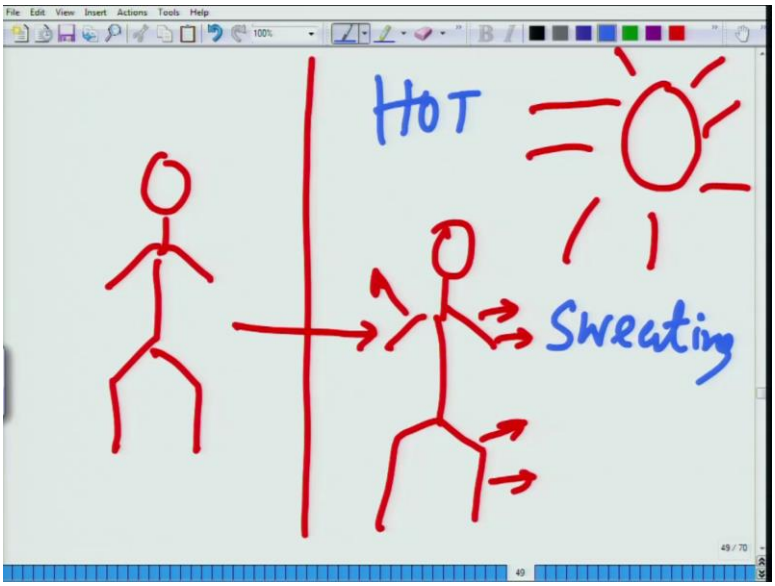

Here is a person inside a room. Here the temperature is fine and here, there is a bright sun. Now, this person goes out. As soon as this person goes out, you see lot of sweating from the body. It is a hot bright sun. So, what exactly happened? At the biological level or at the physiological level, there are two to three things, which happened.

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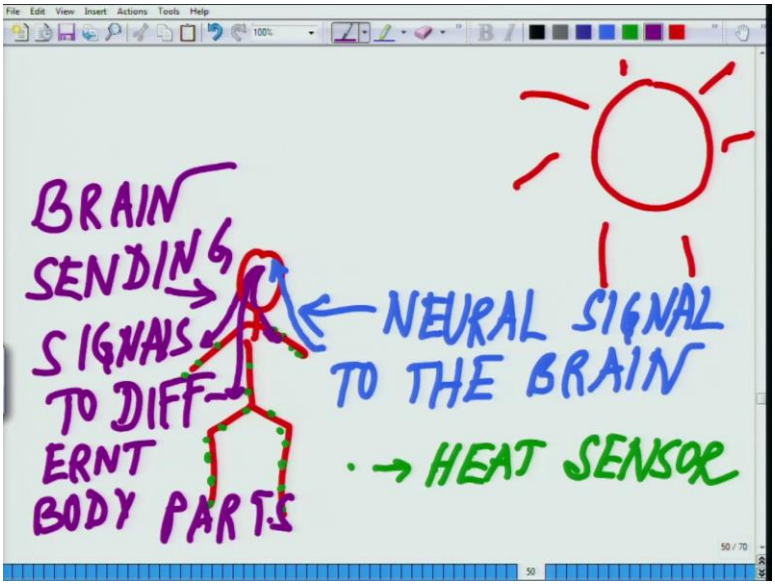

The very moment, for example, there is a bright sun and this person has gone out. The first thing, what happens? Our body has lot of heat sensors all over this body, and which are represented by these green dots. These heat sensors immediately sense that it is hot.

What these heat sensors did; they send a signal to the brain. Let me put it this way. This represents the heat sensors, and this blue line is neural signal to the brain. Brain is being told, that we are exposed to a very hot weather. What brain does at this point; brain does this. It sends back a signal to all these different organs, which are exposed to heat, which is brain sending signal to different parts of body.

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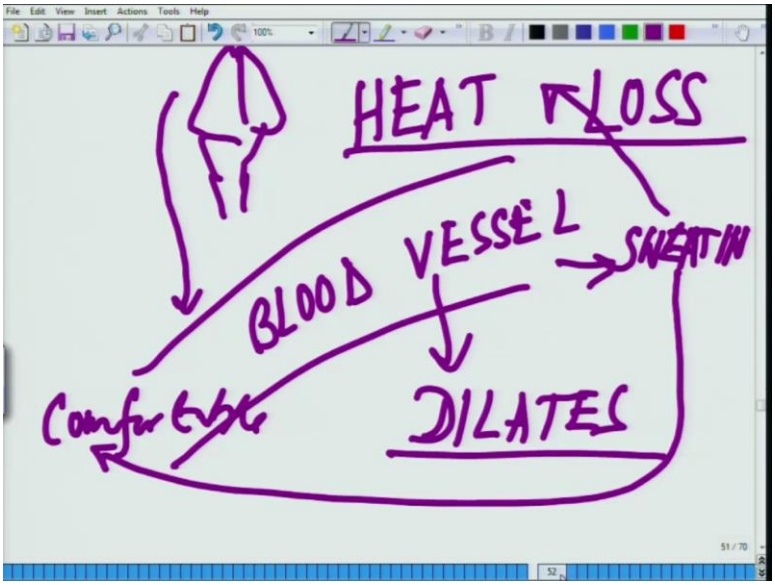

The output is the blood vessels, once the brain signal comes, like this; this is signal and this is blood vessel and here, is the signal coming from brain. For example, this is the brain from where, the signal is coming. These blood vessels dilate or in other words, they start losing a bit of water; they become much more fluidic. End result is that from the body, the water starts coming out in the form of sweating, and this sweating makes you feel comfortable. In other words, in the form of sweating, there is a heat loss in the form of sweating. What exactly happen in terms of engineering? Our body has a specific temperature to maintain.

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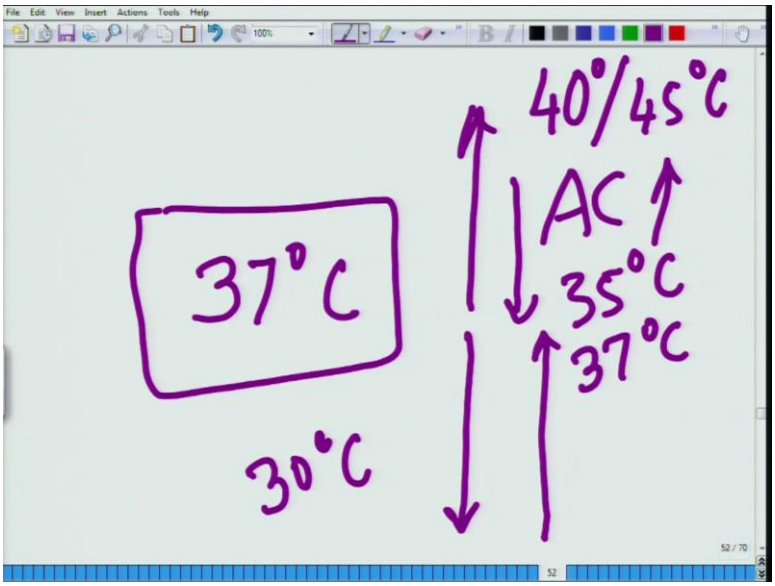

Say for example, the body maintains 37 degree centigrade. Let us imagine a room. Inside a room, we decided the room temperature should remain as say, 37 degree. The very moment, the temperature of the room goes up, say for example, it becomes 40 or 45 degree centigrade, automatically, there will be a thermostat switch, which will ask the AC to get on, and AC will bring back the temperature to 35 degree centigrade. Vice versa, from 37 it fells down to 30 degree centigrade, there will be a heater, which will get on, and which will bring it back to 37 degree centigrade. So, this is how it works. Exactly the same analogy, the body follows.

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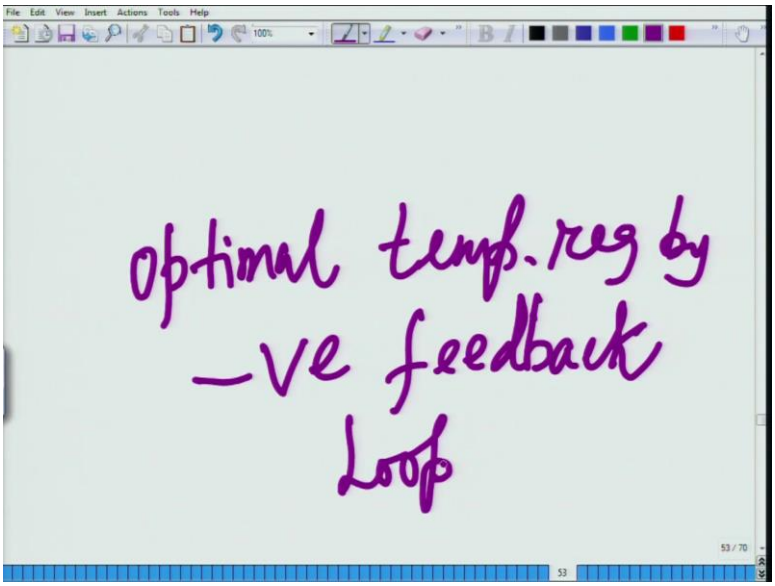

Body has to maintain an optimal temperature of the body. It does so the same by having something called the negative feedback loop. The negative feedback loop means; let me put it like this; optimal temperature regulation by negative, sorry, actually, negative feedback loop. What exactly happen?

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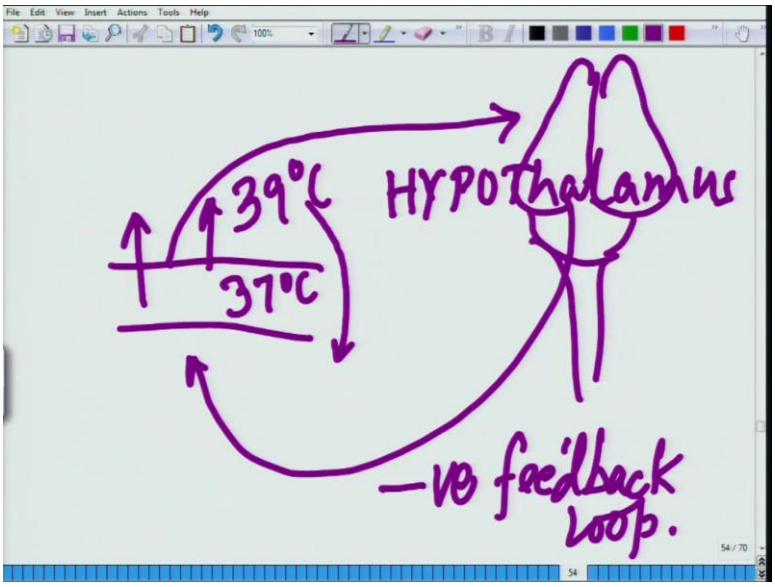

Here is the skin surface. The temperature goes up. Signal is sent to the brain. A specific area of the brain which is regulating is called hypothalamus. Hypothalamus sends a signal back to this thing, and asks the blood vessels to dilate, thereby maintaining the temperature. Bring it back, say for example, this has to maintain a temperature of 37 degree centigrade, and this goes up to say, 39 degree centigrade. Then, the hypothalamus tells these muscles, or another part of the body, to bring it back to 37 degree centigrade. So, what will happen? Because of this signal, 39 will come back to 37. This kind of feedback loop system is called negative feedback loop. This is one of the control mechanisms by which, body controls the temperature. There is another feedback that is called; this is one such example of feedback loop.

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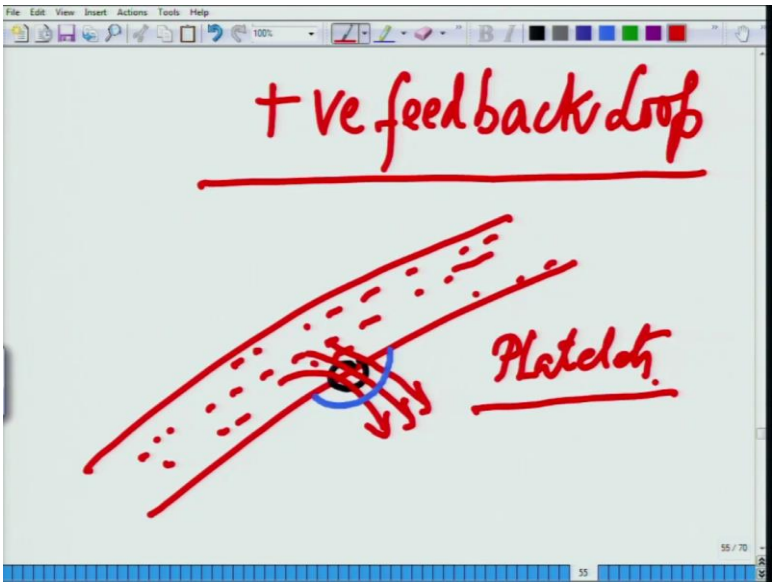

There is another feedback loop, which is called positive feedback loop. What is positive feedback loop? In our first class, I gave you an example of blood vessel, say for example, this is a blood vessel and I told you, in this blood vessel blood is flowing. You see this; these are the blood, which is flowing across this vessel. Say for example, there is a small rupture. There is some kind of a rupture. As soon as there is a rupture, what will happen; blood will start coming out from here. As soon as blood will start coming out from here, I told you that there some specifics cells in the blood, which are called platelets. These platelets will immediately come at the site, and will try to create a kind of adhesive or something, which could stop a pipe, from where water is coming out. In this situation, the blood is coming out from the blood vessel. So, what is that reaction exactly happening in this situation?

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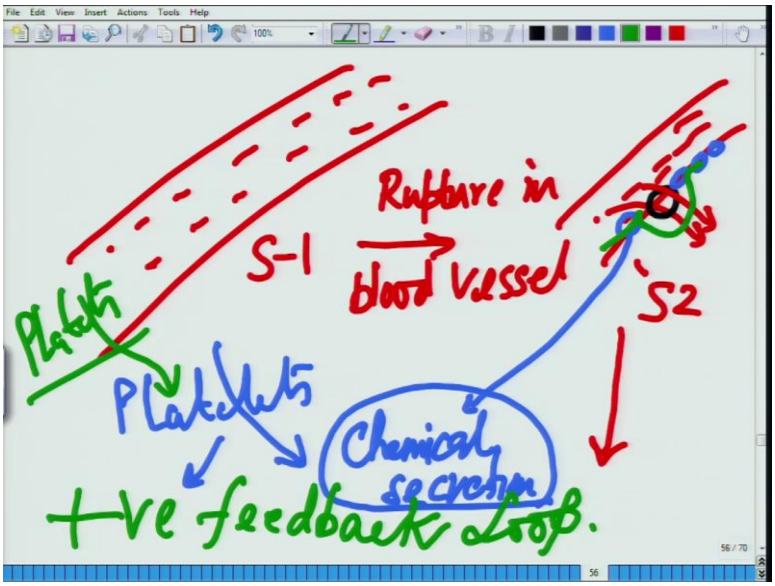

What exactly is happening is this; whenever, there is this kind of, for example, let me take another page to show you what exactly is happening. This is normal situation. There is no reaction. Stage one: now, there is a rupture; rupture in blood vessel, which is this situation, when there is this rupture. Because of this rupture, blood starts coming out. This is stage two. The next reaction, what happens is this. These surrounding cells which are present out here; these cells, which are present in the lining; they secrete some chemicals. Chemical secretion following the rupture of the vessel. These chemicals recruit the platelets, from the blood and these platelets, start forming a kind of say, plug in, in order to close that leakage. This process is further enhanced by the platelets, because; platelets further recruit more platelets to do this job. This kind of system is called positive feedback loop. All across this course, we will come across several positive and negative feedback loops.

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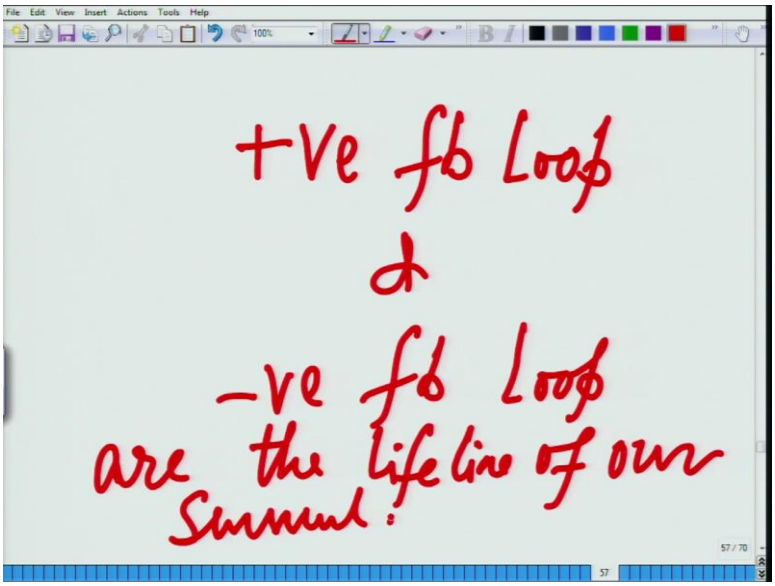

These positive and negative feedback loops are the life line for the survival. They are the ones, which help us to maintain something, called homeostasis.

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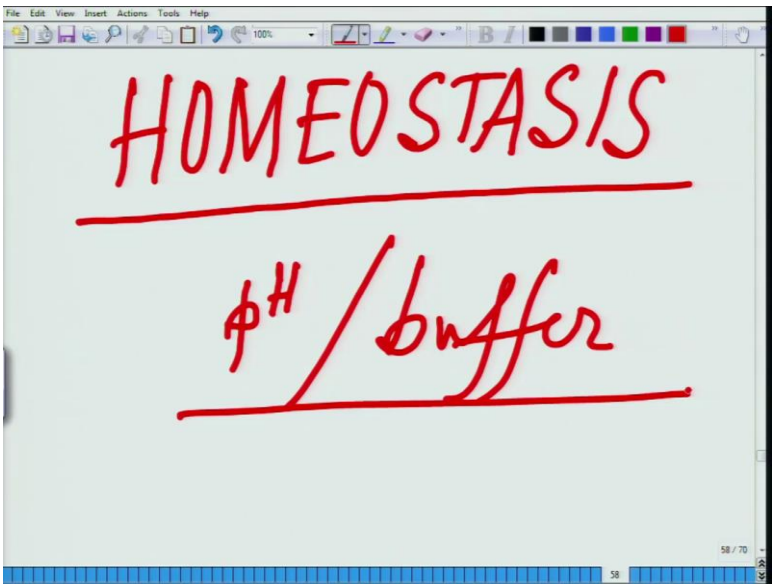

This word is extremely important. Homeostasis means maintaining the balance; maintaining the normal functioning of the system, which is called homeostasis. This homeostasis is dealt at several levels. One of the levels is the level, where we talked about ph and buffering. From the feedback loop, we will talk a little bit about the ph and buffer systems, which regulate our body. Regarding the ph and the buffer systems, let us

put it like this. These are the next two topics we are going to talk about. Let us take a practical example. Whenever, we all suffer from this problem; whenever, we eat something outside, we always say I am feeling very acidic.

Whenever we feel acidic, doctor or mother or somebody recommend us; why do not you take an antacid? What exactly does that mean and what does this antacid means? Whenever, we talk about acidic; what is acid? What is base? These are some of the basic terms, which we need to understand. In order to understand, how these different antacids or any other molecule exactly work in the system; let us introduce the concept of ph here, which will help us to understand little bit more about our own body that how it works.

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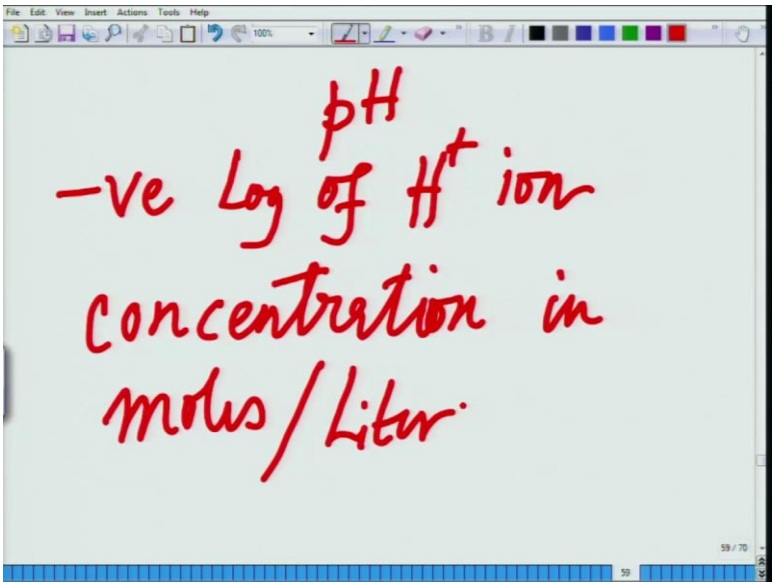

Those of few have forgotten the definition of ph. It is basically, negative log of H plus ion concentration, in moles per liter, what exactly this means?

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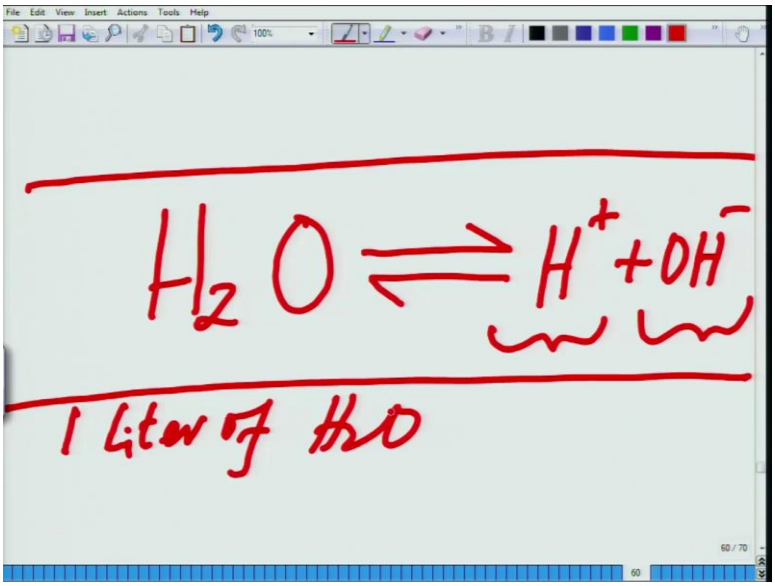

In order to understand this, you have to realize the major component of our body is water. These water molecules form hydrogen bonding and which you can find in the power point presentation. There are lots of very nice examples out there. I will keep on citing examples as, we will move through. A huge part of our body or most part of our body is (( )) in water. What really water does and from where, this concept of ph really arises; if you look at this formula for water, this could dissociate into H plus and OH minus ionic species. There is a positive ionic species and there is a negative ionic species. Under normal conditions, when, sorry, in a normal condition, a very small fraction of water is in ionized state. If I have to give you the value of exactly, how much water is in ionized state, in a pure one liter of water; I will go to the next page, that it will be useful for you guys to understand.

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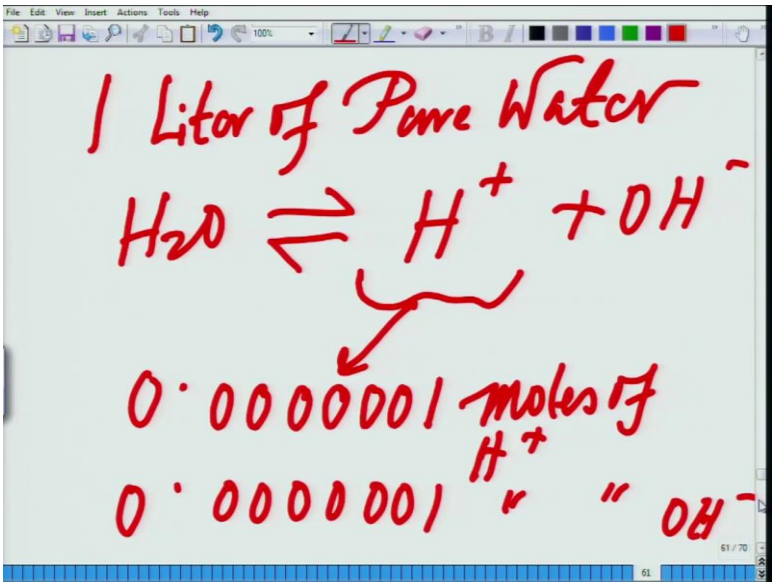

One liter of pure water, H two O, let me redo the reaction. H plus O minus in one liter of pure water; your ionic species of this is around 0.0000001 moles of H plus, and an equal amount of OH; 0.0000001 moles of OH minus.

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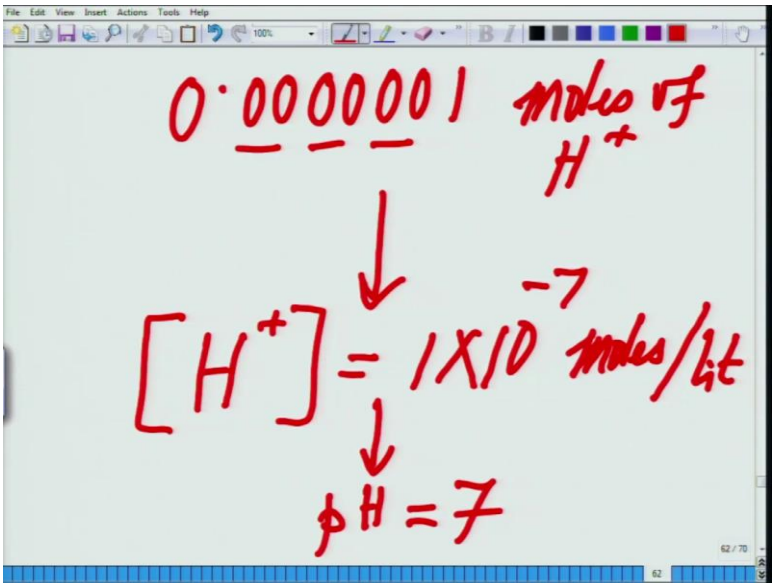

If you translate this, what does that mean? Let me again write it down 0.0000001. There are 1, 2, 3, 4, 5, 6 moles of H plus ions. That means, molar concentration wise, H plus ions equals to 1 into 10 to the power minus 7 moles per liter. This we consider; normal water at this point is called ph is equal to 7. This is the basic concept of ph is equal to 7.

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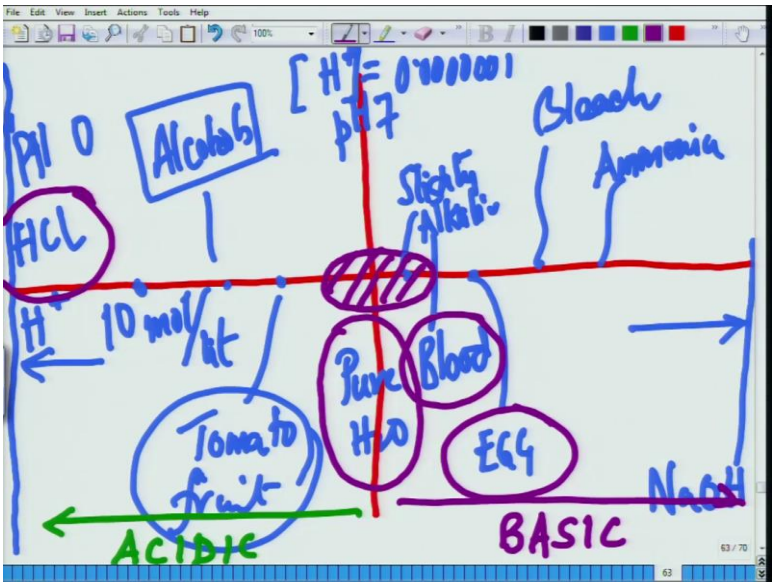

If I draw the scale like this now, let us draw the ph scale and I call this as ph7. At ph7, h plus ion concentration will be equal to 0.0000001. Now, in that scale, let us see how the other, who all lies at different zones. This is at the left side of the scale and this is extreme right side of the scale.

If I come extreme right of the scale; extreme left of the scale, sorry, extreme left side of the scale, this is where lies hydrogen; HCL, which is around, ph is almost equal to 0, which is, in other words, h plus concentration is 10 to the power 0 moles per liter. Same way, out here you have the alcohol. That is why, whenever you consume alcohol or beer or these kind of things, you feel acidic. Tomato juice or fruit juice; they are all acidic. Whenever you consume this, you are increasing the acid of your system, and this is pure water. On the basic side of it, your body blood is slightly alkaline. This is blood slightly alkaline. There is slightly more alkaline in the egg.

Then, you have bleach, is very alkaline, which helps you to clean your cloths. Then, you have ammonia; domestic ammonia and at the far further end, you have NaOH, which is exceptionally basic. So, on this side you have all the acidic component, and on this side you have all the basic component. If you look at carefully in this, you will see your blood is slightly basic. Pure water is absolutely at of 7. Alcohol, pickles and all these things are on the acidic side. Egg is on a slightly alkaline side. This is what determines, where and how your body is doing. Most of the time, body tries to maintain the ph somewhere

around here, except in the stomach, where the p h is very low, where you have lot of hydrochloric acid. So, this is the overall concept of ph.

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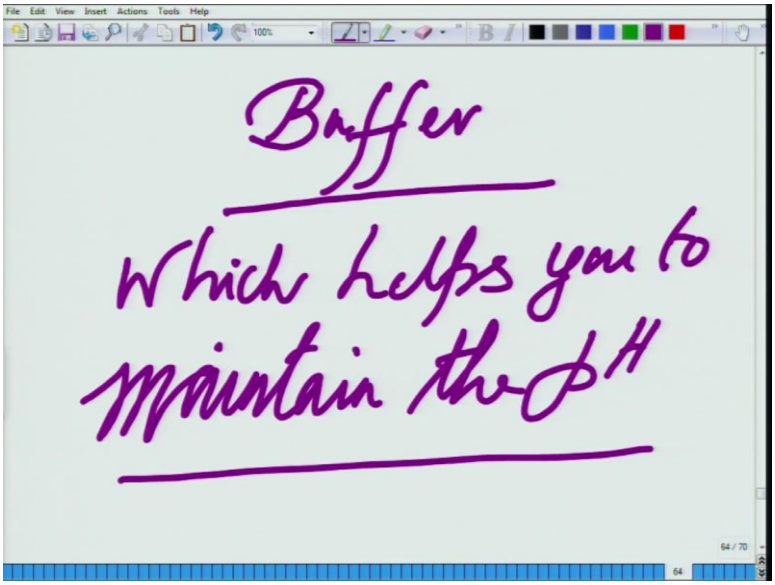

Now, what is buffer? Buffer is something, which helps you to maintain ph; which helps you to maintain the ph of the body. Now, if I ask you this question what an antacid does basically, what an antacid does is, some of these antacids, which you see in the market is like, one second.

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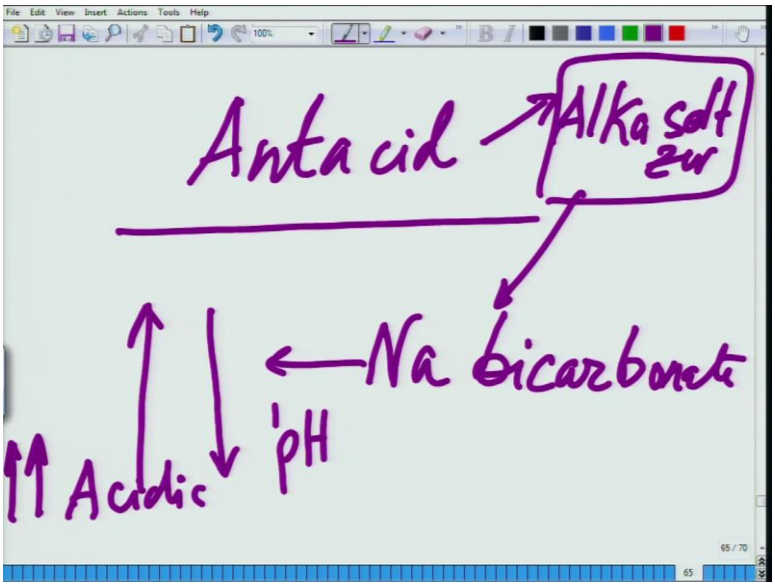

Say for example, you went for a party and you feel very acidic. You come back and then, your parents or somebody ask you to take some antacid; some of the antacids in the market are like, Alka seltzer and all these kind of thing. These are the brand name of some of them.

What they are basically? They are basically, nothing but sodium bicarbonate. What exactly it does? Say for example, your body has become very acidic. Then this sodium bicarbonate brings it back and maintains, or helps to maintain the ph, by neutralizing the excess acid which is formed in your systems. Whenever, next time onwards, you take any kind of drug like that, you should understand basically, what you are trying to do is that; you are trying to balance the ph of the body, and that is how, all these small antacids and all these kind of molecules work. These are different kinds of mechanisms.

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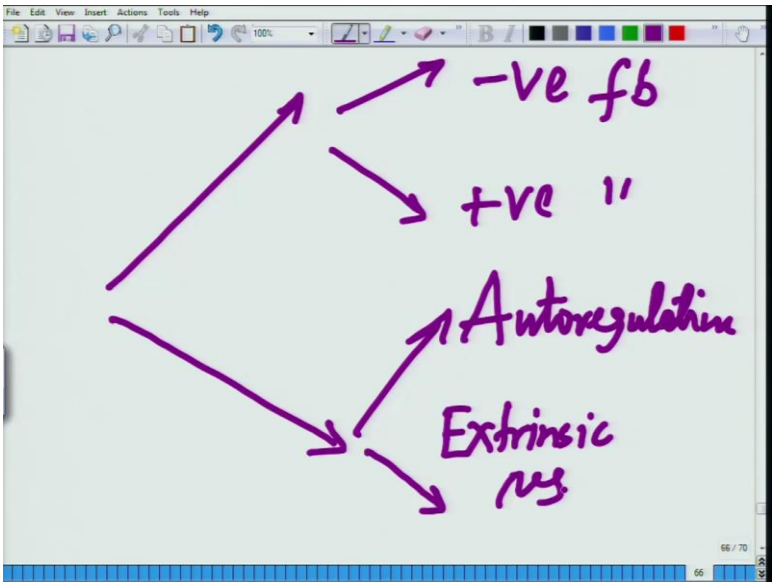

There is another control system, which, while talking about the negative and positive feedback, I did not mention. Let me mention that. One we have already discussed; negative feedback and positive feedback. The other is auto regulation and extrinsic regulation. What does this mean? Extrinsic regulation is, say for example, within your body somewhere, there is lack of oxygen. What exactly happens? Whenever, there is a lack of oxygen or something, there is a scarcity of oxygen. The cells, which need oxygen, secrete certain chemicals, which dilate the blood vessel, and draw more and more oxygen. If I have to diagrammatically show it, it looks like this.

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Say for example, this cell in the body; this particular cell needs more oxygen. It is deficient in oxygen. Under this situation, what it will do is that, for example, there is a blood vessel, travelling along in a close proximity of this. This red one is the blood vessel. Now, what this will? This cell will secrete certain compounds like this. That compound will dilate this. It will make this vessel more perforated and thereby, this cell will draw more oxygen into it. This is a classic example of auto regulation, which is taken care by the cell itself. This is one mode of regulation. There is another mode of regulation that is called extrinsic regulation.

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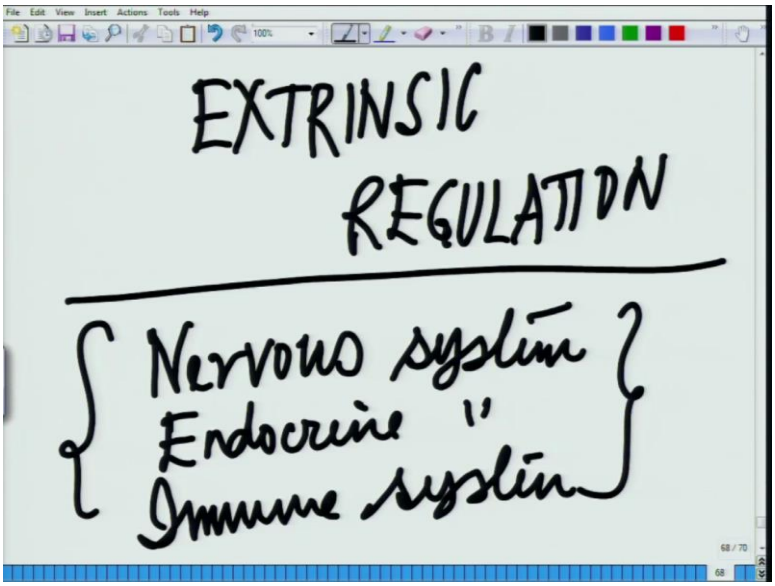

Extrinsic regulation is the one, which I discussed in the first class. I told you, it is taken care by the nervous system where, the cell or the individual system is depending on nervous system, or the endocrine system, or the immune system. These are the three systems which take care of the extrinsic regulation. From here, we will move on to some of the organic molecules, what we discussed, which we have.

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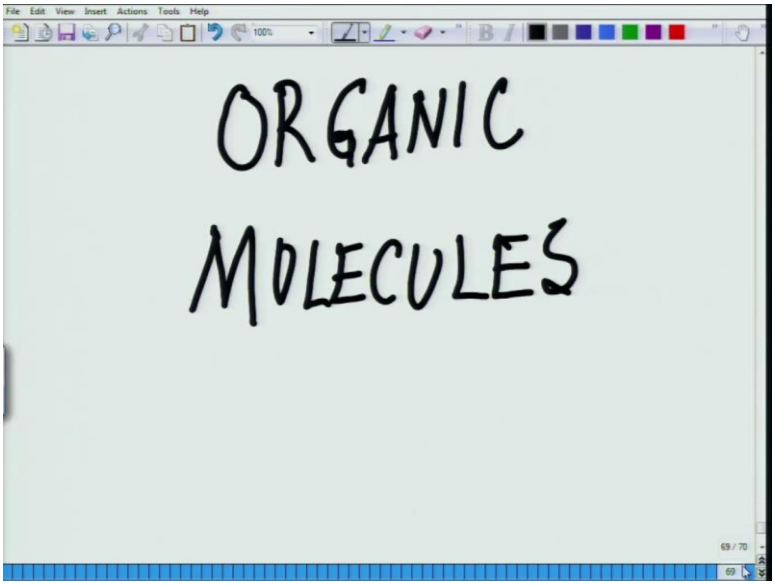

Because, we talked about the inorganic molecules; we talked about the ph; we talked about buffering; we talked about negative feedback; negative and positive feedback loops; we talked about auto regulation and extrinsic regulation. Now, we will talk about some of the organic molecules which, in our next section, while we will be entering into the membrane physiology of nerve and muscle. That will be very important. We have to have some basic idea about the organic molecules. The major class for organic molecules, which are present in our body; let me enumerate them for you guys, that will help you to understand.

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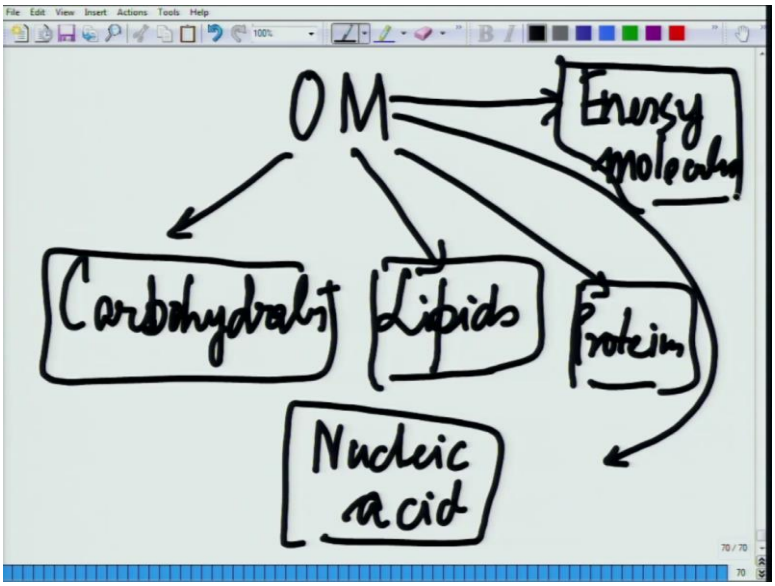

Organic molecules fall under carbohydrates, lipids, proteins, nucleic acid and energy molecules. As we will go through this whole course, on innumerable occasions we will be touching upon these. At this stage, I will give you an overall idea about their structure, and where they are present. As I will proceed through the course, we will go in depth with these different structures; how they look like; and where the changes are taking place and all and so forth.

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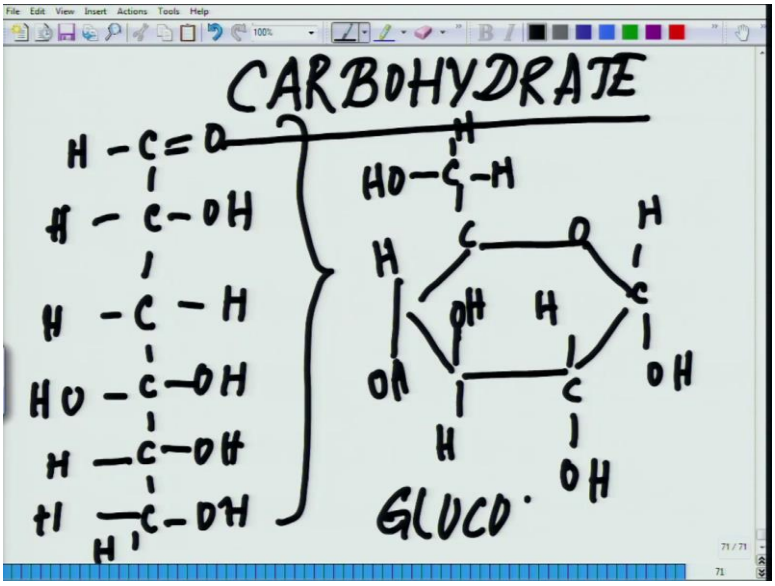

Coming to the first structure, which I will be talking about, is carbohydrates. To start with carbohydrates, all of you know, whenever we feel tired or something, we take glucon d; glucose. Because, we say those are that, will help you to gain the energy. We take some fruits, they say they are. What exactly we meant by these? What are carbohydrates? Every time you sit to eat your lunch or dinner, you take chapattis, you take rice. We say they have lot of carbohydrates. Carbohydrates are simple sugar molecules. How they really look like?

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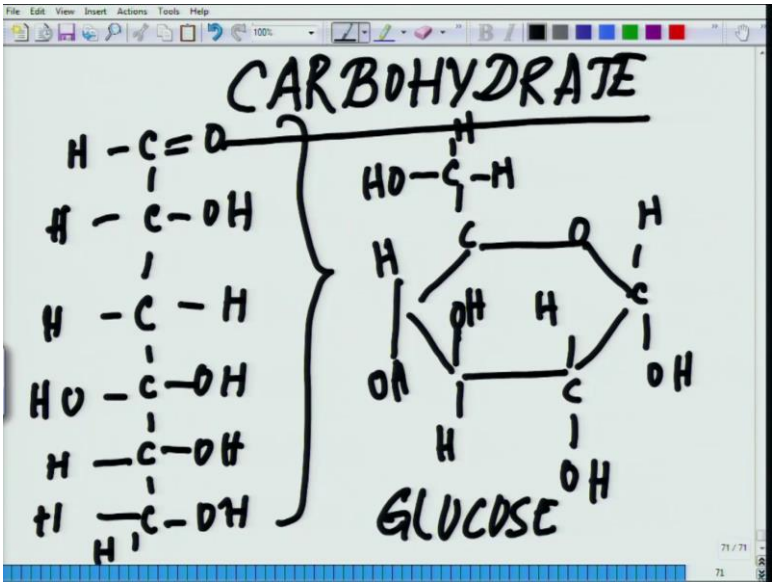

A general structure of carbohydrate is something like this. Carbon-Carbon-Carbon; these are molecules of carbon and hydrogen. Like this nitrogen OH group; hydrogen, three, four, five and h t o four done c hydrogen. Here you have the OH group. Hydrogen-Hydrogen, then you have OH and here, you have OH and hydrogen here.

This is a basic structure of a glucose molecule in the extended ring, like this structure. The same structure when it, kind of, form in the ring like. It looks like this; hydrogen, hydroxyl group. Then you have oxygen here. Hydrogen, you have OH here, h, you have OH here, OH moiety. You have OH here, H here, you have OH here. This is the basic structure of glucose, which is the most simplest sugar, which is known to us.

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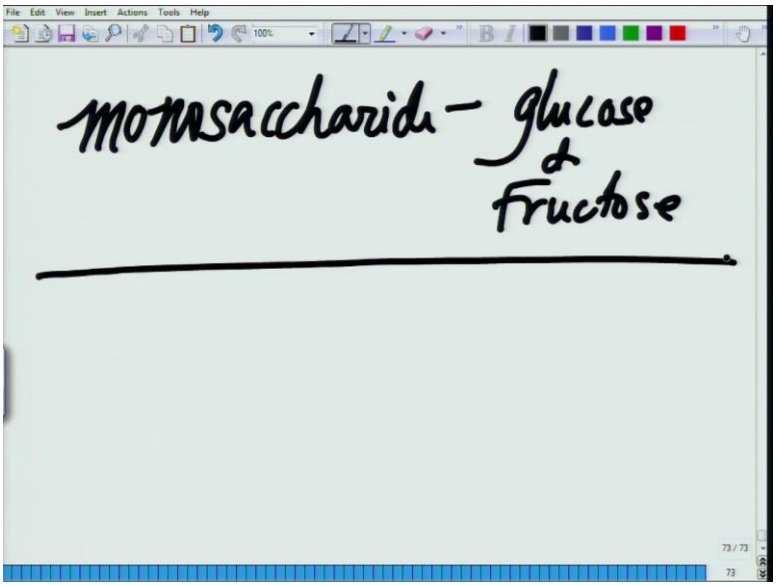

They could be monosaccharide. They could be disaccharide. They could be polysaccharide. What does this mean? Monosaccharides are basically, glucose and fructose. These are the monosaccharides. These are the single unit, very similar to the one, which I drew here. This is a monosaccharide.

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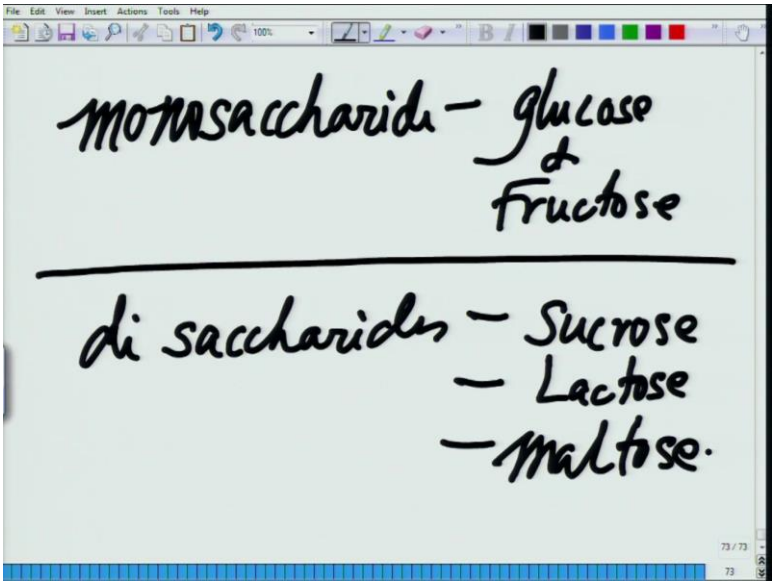

Then, we have disaccharide. Di means two, where two monosaccharides join and form a molecule. That is called as disaccharide. The smallest simple example is sucrose, which you use as table sugar, and lactose, which is your milk sugar. They are present in the

milk. And you have the maltose. These are disaccharides and yet, there are polysaccharide, where there are very many such units, which are formed. These are called polysaccharide.

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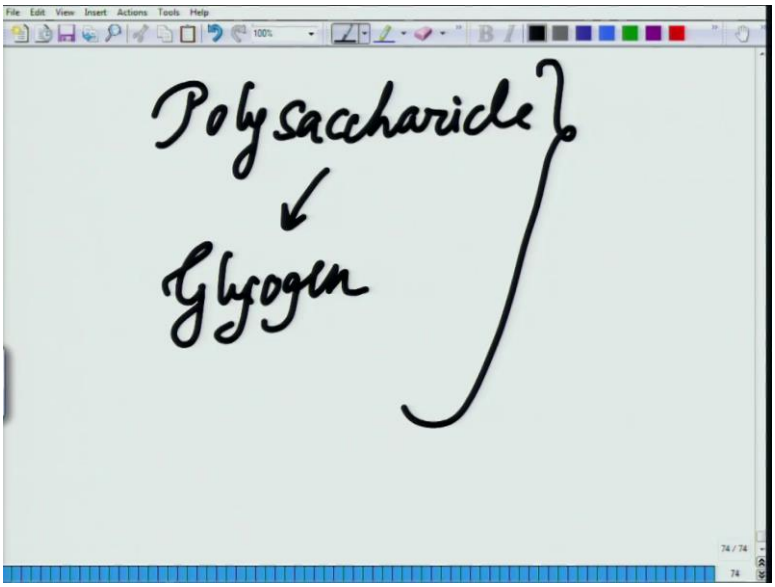

Polysaccharide are energy molecule like glycogen. These molecules are the major source of energy for a body to survive, and they could be classified further in another way

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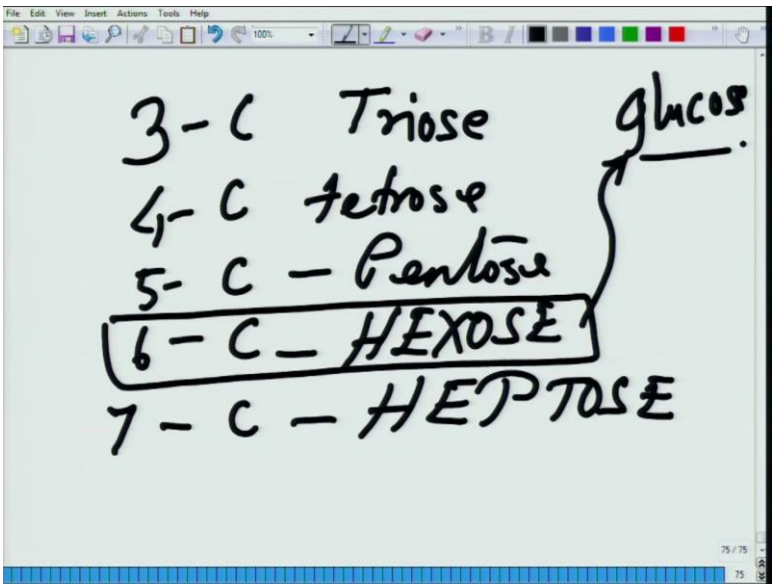

They could be 4-carbon; they could be 5-carbon; they could be 6-carbon; they could be 7-carbon; based on that they could be triose; they could be tetrose; they could be pentose

sugar; they could be hexose sugar; they could be heptose sugar; likewise. Glucose is an hexose sugar. So, this is another way you can classify them. These molecules form complex with different kind of lipids and they form glycol lipids, and several other glyco proteins and likewise. Now, here will move on to very simple basic structure of lipids.

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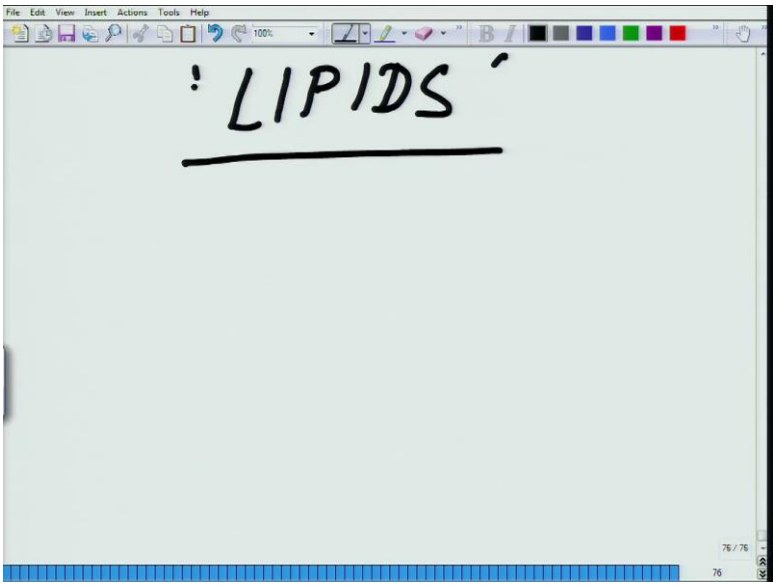

Now, we will talk about water lipids because, this part is very essential. Because, as we will be talking about the brain structure, which is nothing, but bilayer or two layers of lipids arranged together, which is our next class, we will be starting that. Before we enter in the next class, we need to understand, what lipids are and how the basic structure of lipid looks like. We talked about the carbohydrate in a very simplistic manner. Now, we will talk about the lipids. Lipids are something like this.

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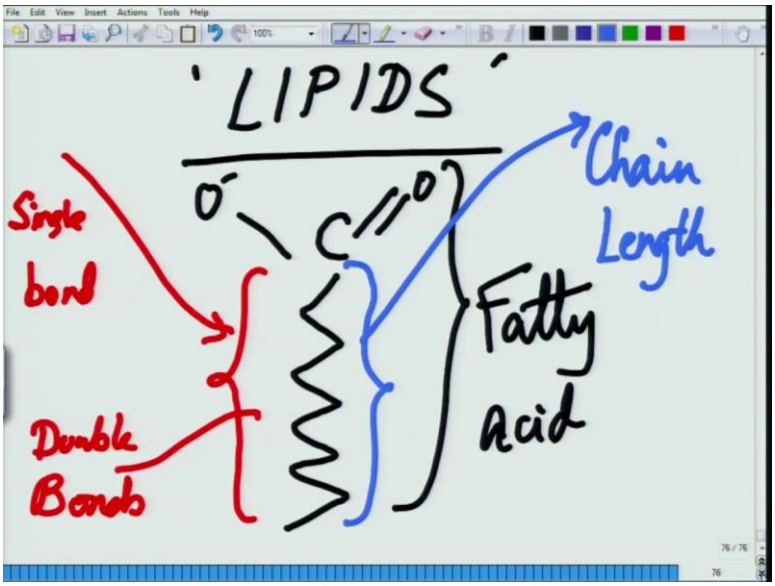

You have a curvoxile here, and a hydrophobic tail like this, of carbon-carbon tail. This is what, constitutes something called a fatty acid. This is the very basic structure of fatty acids. Within this structure, there are several variations, which can come up. This chain could be all single bond or this chain could have double bond. Based on that, they have different kind of nomenclatures. Second way of classification is this chain length; that is another way of classifying it. If you have to classify them they will look like this.

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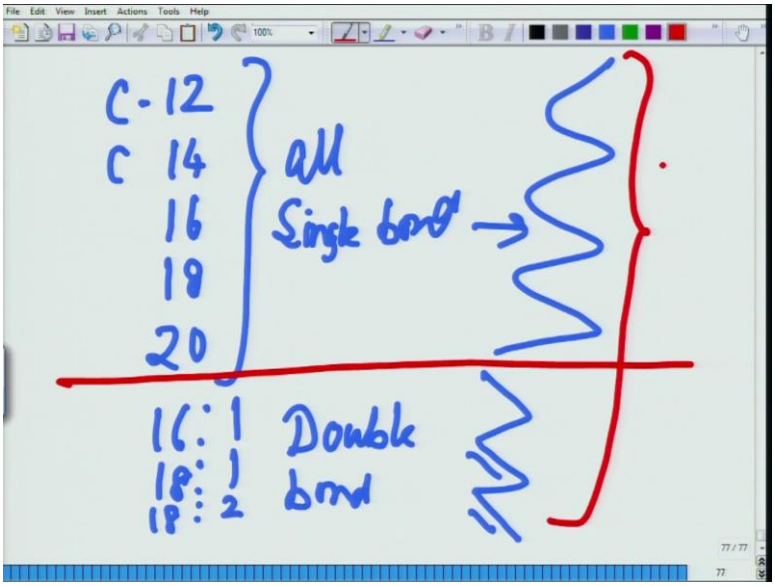

They could be C-12; Twelve carbon. They could be 14; they could be 16; they could be 17; they could be 18; they could be 20. This is assuming all single bonds on the chain Like, on this chain all are single bond; there are no double bonds. Yet, there could be a situation, where 16 is to 1, you will see this thing; 18 is to 1 or something like, 18 is to 2 or you will see 18 is to 3 or 20 is to 4; that means, at those different position there are double bonds. Based on that, I write to classify it like this, there are double bonds. Based on that, there is another series of classification, which is called, let me move to the next page.

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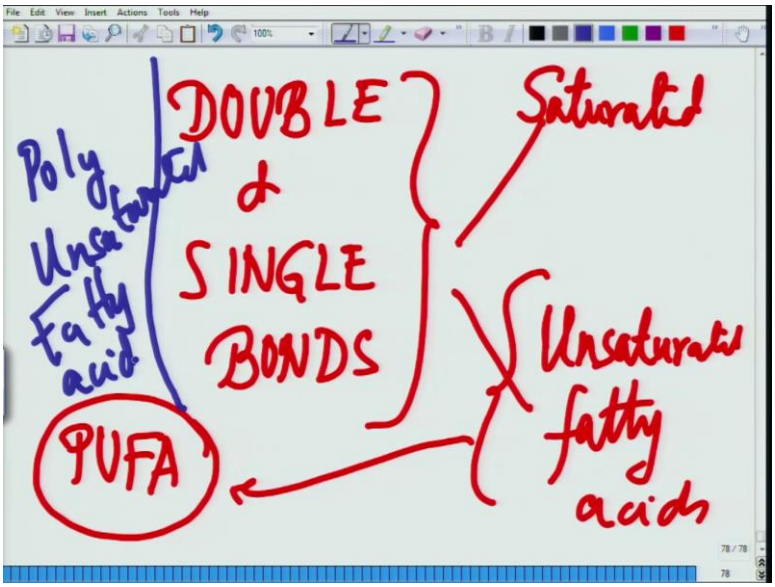

Based on the double and single bond of the chain, you have saturated and unsaturated fatty acid. I will just give you a small assignment. You please look up on what is PUFA and what is the importance of it? Just for your basic knowledge. PUFA is a short form. It is called Poly unsaturated fatty acid. If you go to a grocery shop, you will find different oils, mentioning the PUFA concentration. How much PUFA and based on that, the housewives prefer which one to buy. What is the role of it? This is what I wish you people to look up on web, or any other book or wherever. What really PUFA means and where it is important? Anyways, we will be touching this as we will go further, but I wish you will be able to look into it.

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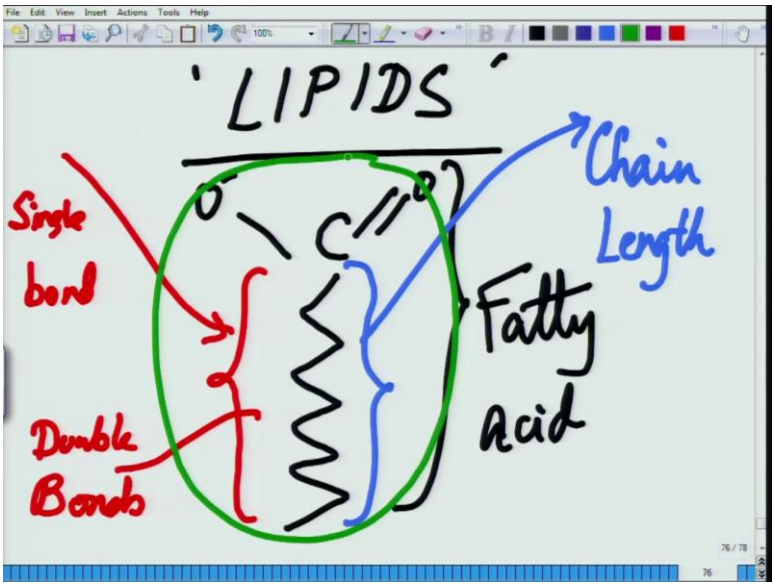

This is another set of classification. If I go back to the previous slide, you see, this is how it looks like; a single bond; double bonds; chain length. So, this is the very basic fundamental structure of a fatty acid. This is the basic structure. On that, based on the chain length and from there, we will move on to; this could be 12 members; 14 members; 16 members; 18 members; 20 members; all single bonds. Then, we have the different double bonds at different places. Then from there, we move on to saturated and unsaturated fatty acids. So, this is the basic structure of the fatty acids, but these fatty acids has further modifications.

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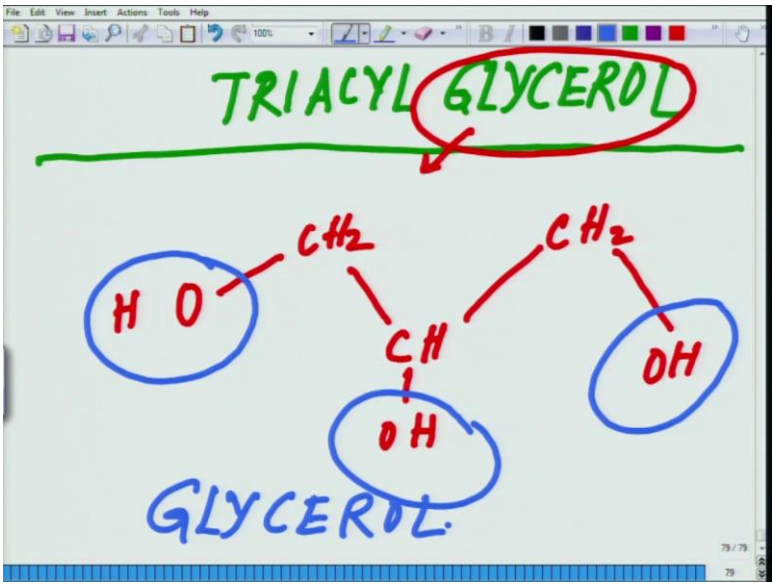

Those are called another set of lipids, which are called triacyle glycerol. We will talk more on next section about lipids because, this is very important for membrane. Glycerol; you could see this word out here. Let us draw this structure of glycerol and then, we will talk about that triacyle glycerol means. The structure of glycerol is something like this; there is hydroxyl group, a CH2, there is a CH here, there is a CH. There is a CH2 here, there is a OH group here and there is another OH group here. This is how it looks like. If you look at this structure carefully, this is one functional group attached here; there is a second functional group attached here; there is a third functional group attached here; and this is the basic structure of a glycerol molecule.

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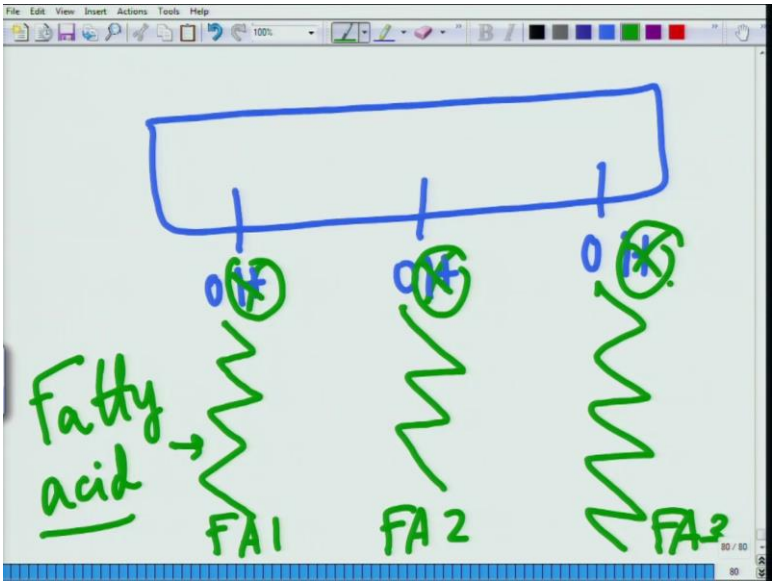

Now, on this structure, if I will represent this structure in a box like this; with a OH dangling out; OH dangling out and a OH dangling out. If I modify this OH with, say for example, with different fatty acids like this; different kinds of fatty acids. These green ones are the fatty acids; fatty acid one; FA2- fatty acid two; FA3- fatty acid three. There could be same kind of fatty acids and there could be different kind of fatty acids. Based on that, basically, what will happen, when the fatty acid will join, this one will get out; this one will move out this one will move out.

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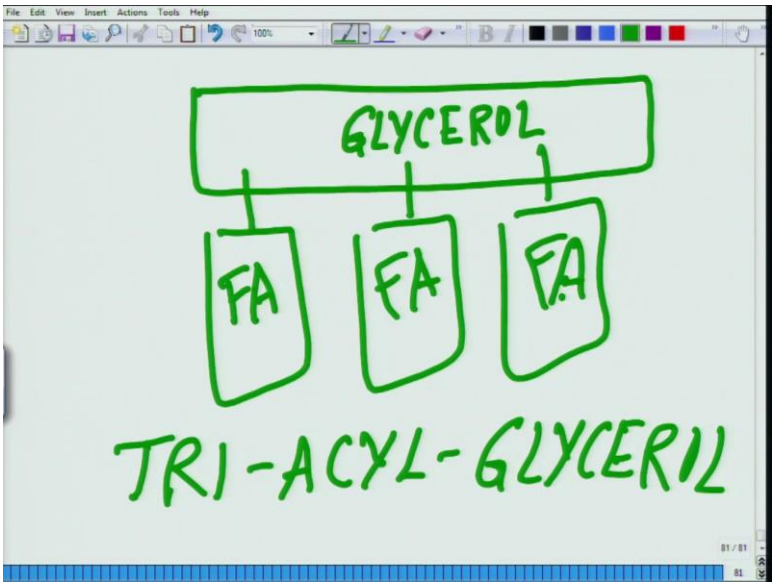

What we will get is a structure like this. Here is the glycerol and here, you have three fatty acids like this, and this structure is called Tri; because there are three, Acyl Glycerol, where the fatty acids are becoming part of the main glycerol structure.

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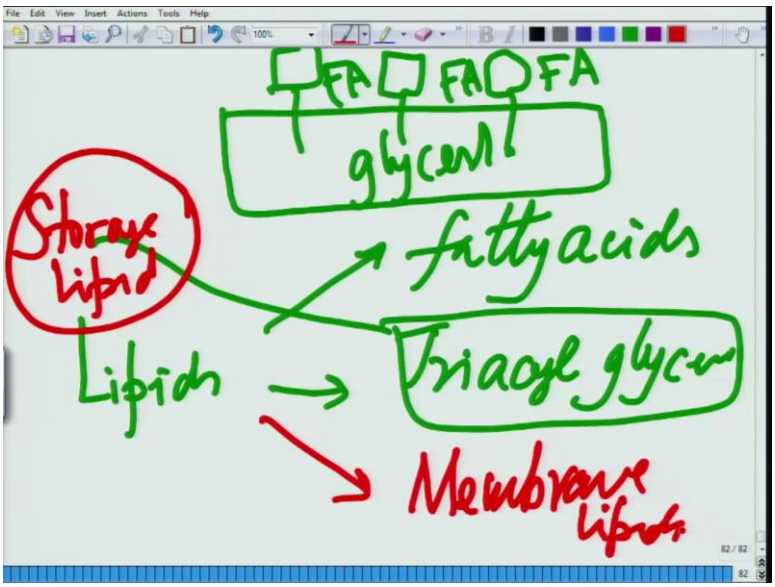

Most of these structures, what you see are used for the storage lipids. Lipids could be classified. Talked about fatty acids, then we talked about triacyle glycerol, where you see the modification of FA, FA, and FA. You have the glycerol out here. Most of these triacyle glycerol fall under the storage lipids. They help in storing energy currency.

There is third one, which are part of this are called membrane lipids. These are even more interesting. They have lot more modifications and if I have to draw that, one second.

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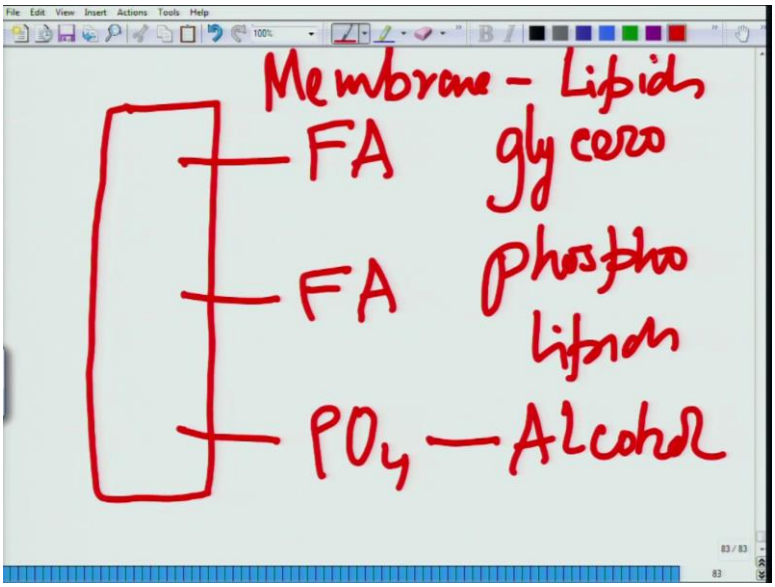

Membrane lipids have much more complex structures. Say for example, this a glycerol moiety out here, and you have fatty acid here, fatty acid here, and you have a PO4 and you have alcohol attached here. These are called glycero phospho lipid. These are called membrane lipids and there are many more classes on the membrane lipids, which I will be coming once, we will start about the membrane.

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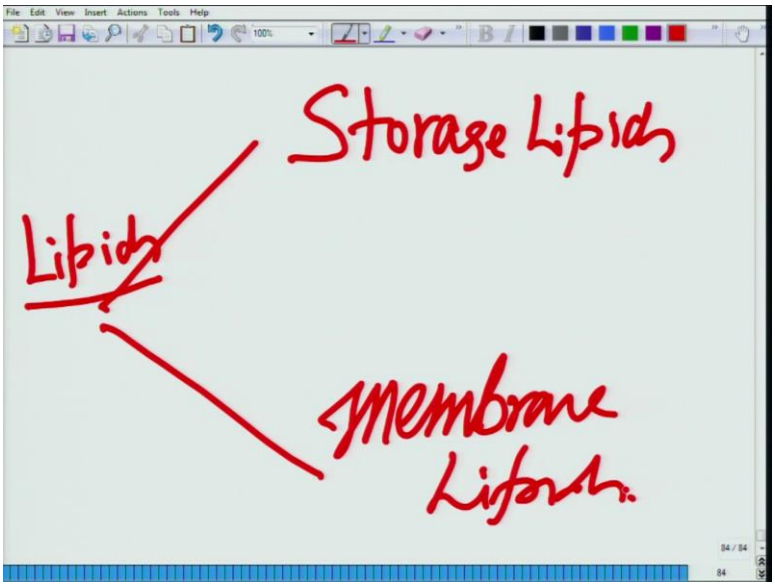

Broadly speaking, lipids could be classified in terms of their position, as storage lipids and membrane lipids. This is broadly a classification of the lipids. From here, we will move on to the third set of molecules which are the proteins. We talked about the carbohydrates, gave you a basic idea about lipids. We will be coming back very soon. In our third lecture while, we will be initiating the membrane physiology of nerve and muscle. Now, we will talk about the proteins. What proteins are? Those are, in a simple language, those are the structural block of our body. Most of the structures starting from your hair, your nails, your whole body; they are nothing, but array of proteins.

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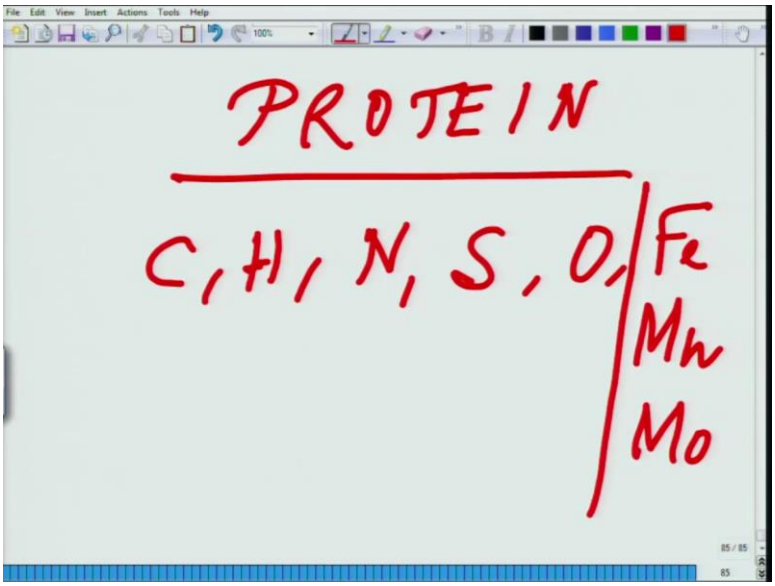

These are the molecules, which are made up of carbon, hydrogen, nitrogen, sulfur, oxygen and with few other metals, like few manganese and molybdenum, likewise. So, what is a basic unit and how we should study? Basic unit of protein; protein is just like, all of you have seen the necklace. Necklace is like, you have very small beats attached to each other, along a thread, which forms a necklace or some kind of mala. So, protein is exactly something like that, where there are small amino acids, and these amino acids are attached to each other, and form a long sequence, something like this.

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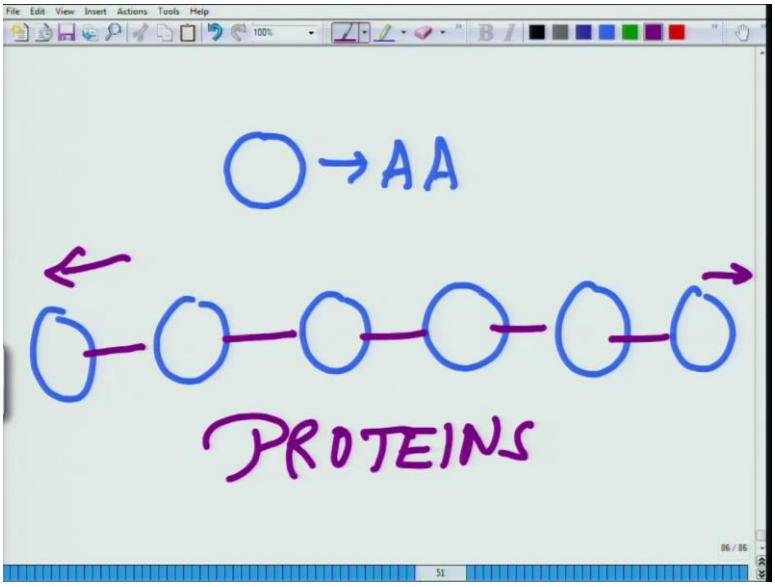

For example, if this circle represents amino acid AA; amino acid 1; amino acid 2; amino acid 3; amino acid 4; amino acid 5; amino acid 6; these amino acids are attached to each other and form a long chain. That is what makes a protein, and when this chain is small this is also called as peptide.

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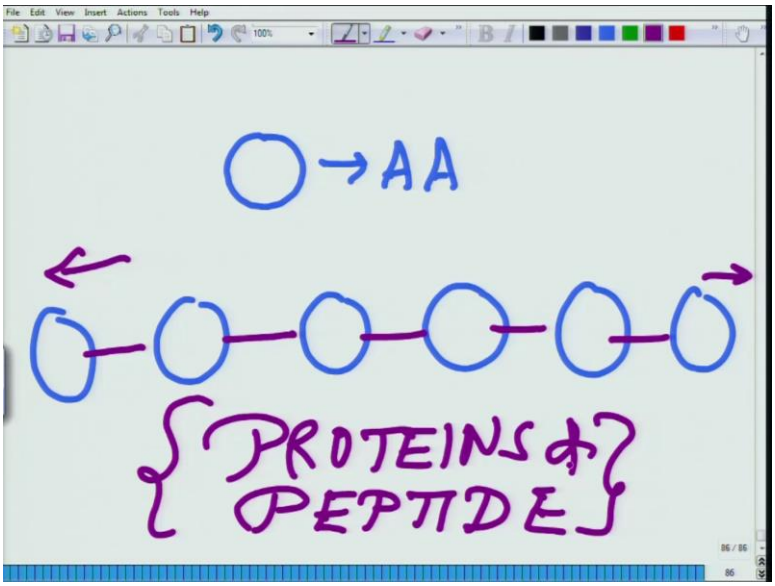

Sorry, this is also called peptide when the chain is very small. We will talk about different bioactive peptide, which plays a critical role in our system. How an amino acid looks like?

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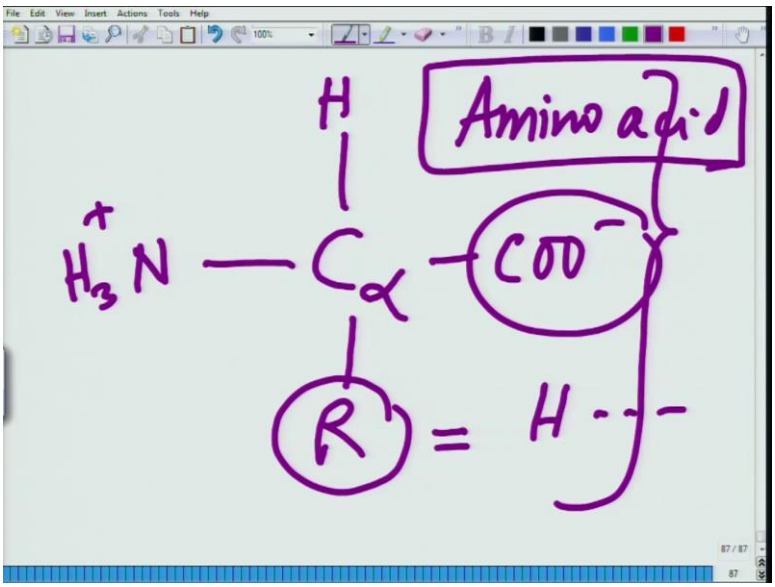

Amino acid looks like this. There is C alpha. There is a COO- carboxyl group. There is hydrogen here. There is an H3 plus out here and we have R group. This is R group could be starting from hydrogen to several other things, we will talk about it. This is the most fundamental structure of an amino acid. This is what an amino acid look like. It is an

acid because, you have an acidic group. Almost it looks like zwitter ion, because you have negative and positive charge on both sides.

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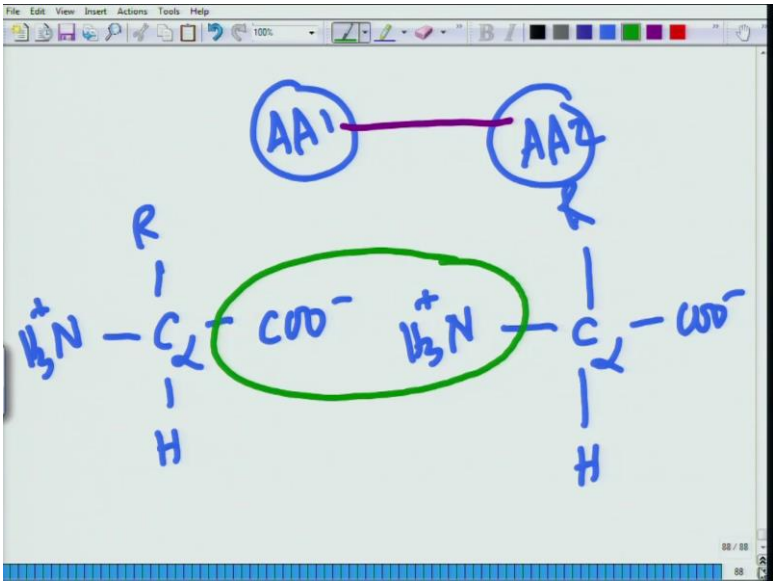

Now, how one amino acid, I drew that diagram for you. That is one amino acid here; there is another amino acid here; and they are forming a bond with each other. This is amino acid-amino acid, amino acid-amino; amino acid 1 and amino acid 2. This is how that bond looks like. How about we draw that structure? C alpha, put in the R group here, convenient. We have COO minus, we have NH3 plus. Let me draw another amino acid on the side by side. C alpha, COO minus, NH3 plus and H group. This bond takes place between these two. These two are involved in forming a very unusual kind of bonding, which is unusual, because of several reasons it forms like this.

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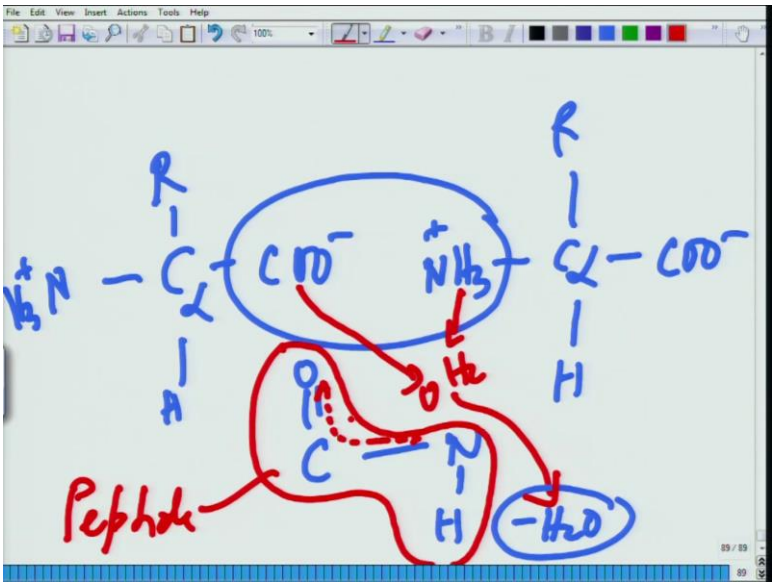

Again, let me draw it. C alpha, C, sorry, C alpha, R group here, H here, COO minus, NH3 plus. Let us draw the other molecule on the other side. C apha, NH3 plus, COO minus, R group and H. So, what is happening here is the bond. This is how it works; COO, NH and the output is minus water, because you have from here, H2 and you get an oxygen from here, and that leads to minus water. Then, this bond, this whole thing is called a peptide bond. There are some unique features about this bond, because here, what happens is electron delocalize along this. Because that is why, it is very stable kind of bond. It does not really move a whole. It cannot move, it is a planar bond. On this side, there it is something like, if this is the bond, if you look at it. If this is the planar bond you have. On one side you have this carbon, CC alpha, and the other side you have NC alpha, sorry on one side you have the CC alpha, and the other side, you have NC alpha.

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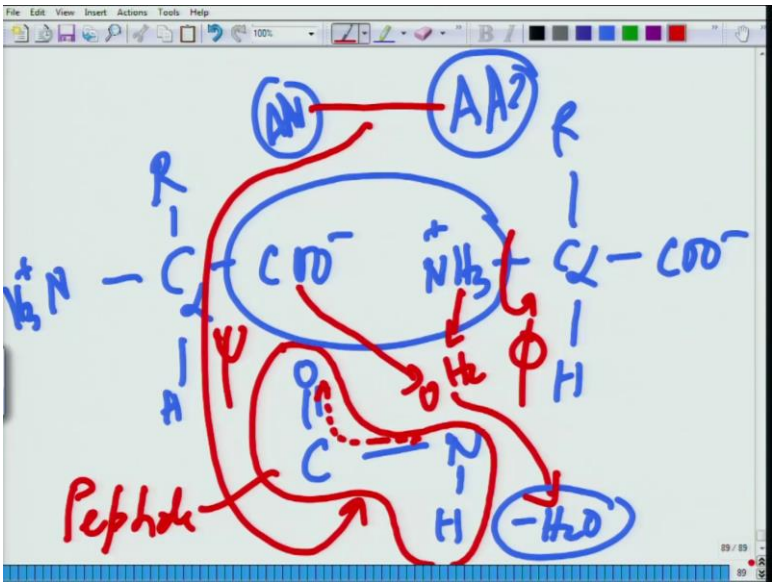

These two are termed as, this bond and, sorry let me, this form C alpha. On two ends, one is called the Phi, the other one is called a Psi. This bond is fairly stable. It is kind of a planar bond. This is what you see out here, that amino acid 1, amino acid 2 and you have a planar bond, which is this bond out here. So, this is how they form a long chain.

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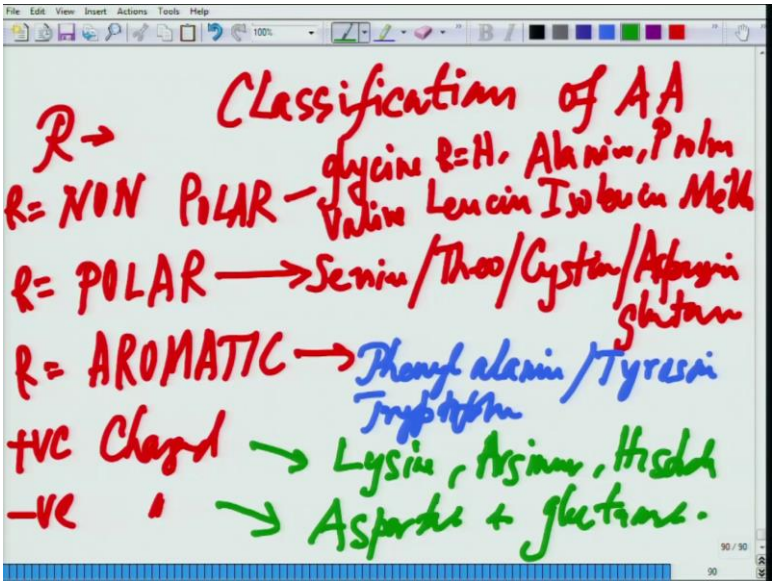

They form a long chain. Talking about the classification of amino acids; amino acids can be classified in several ways, but I will show only one classification of amino acids. They could be, the classification is based on the R group, showed you that R group

varies. Based on that, they could be non polar; one way. They could be polar; the R group is equal to polar; they could be, they could have R group equal to aromatic residue. This has the significance in terms of estimation of protein. They could be positively charged; they could be negatively charged.

Among the polar R groups, what we have; it is serine, therionine, cystine, aspergine and glutamine. Among the non polar, you have glycine, which is the most simplest amino acids, where R is equal to H, alanine, proline, waline, lucine, iso lucine and metheonin. Among the aromatic amino acids, you have, which has aromatic group, which includes phenyl alanine, tyrocine and triptocine. Among the positively charged residues, we are having lycine, arginine and hystidine. Among negatively charged amino acids, you have aspartit and glutamate. So, this is the broad classification of amino acids and what I expect that, please go through these structures that will be fairly helpful.

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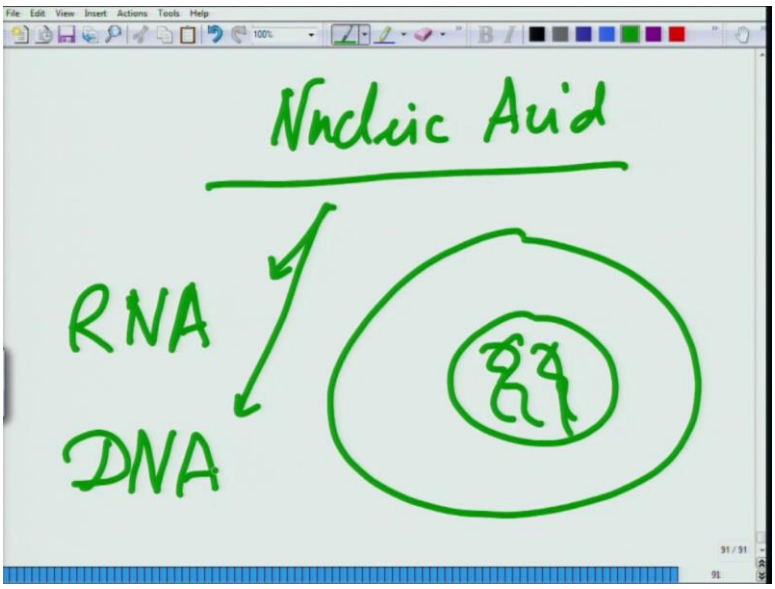

Now, the last thing what I am going to cover in this topic, is the energy rich molecules and the nucleic acids. We will not talk in depth about nucleic acids; there are two kinds of nucleic acids, we will come back to them, as we proceed with the course. They are present in the cell inside the cell. They are mostly present inside the nucleus, of course. So, we may represent outside, somehow for some reasons. These nucleic acids could be RNA; ribo nucleic acid or a DNA. We will not go into depth at this stage of it, but eventually will come back to this.

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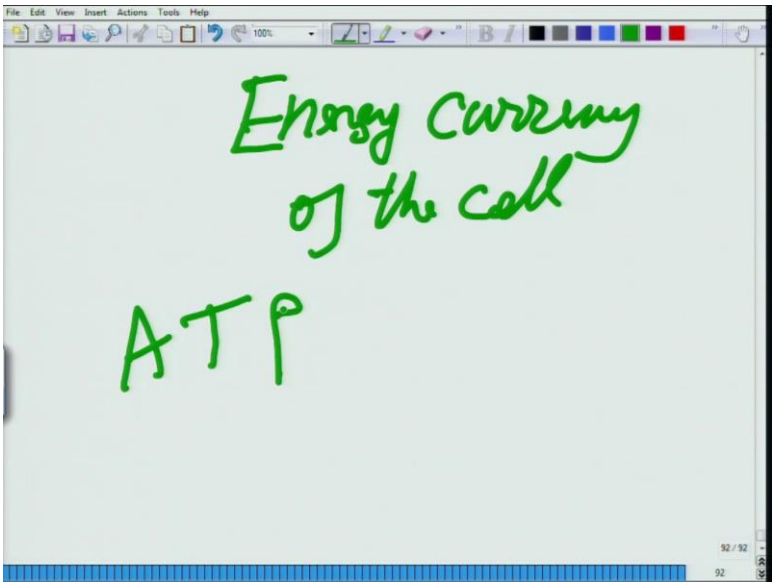

Then, you have energy rich molecules, which are the energy currency of the cell, which includes ATP molecules; adinocin tri phosphate and how they look like?

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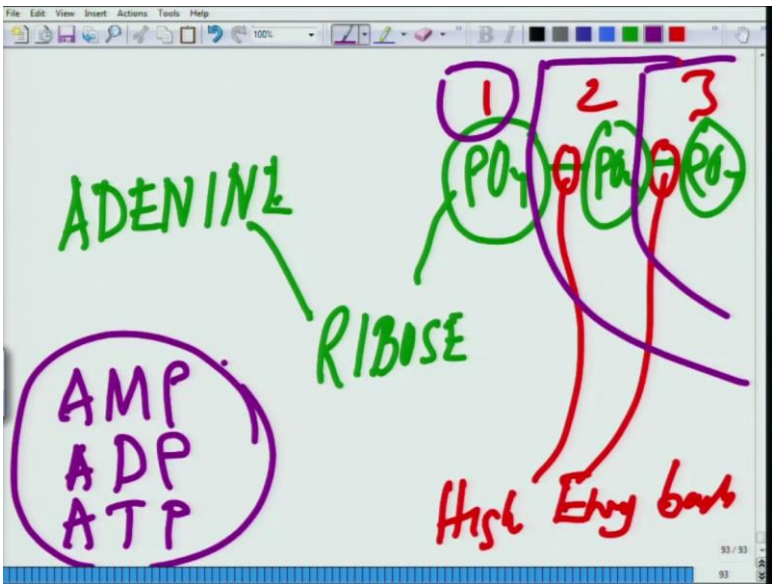

It is something like that you have adeinine base, which is attached to a ribo sugar and that is attached to PO4; phosphate group, another phosphate group PO4, third phosphate group. These bonds are the most critical bonds; this one; this one. These are high energy bonds and body uses these kind of bonds, bond braking energy for all the purpose. This is try phosphate, when there is 1, 2 and 3. This is adinocine diphosphate; ADP, when

there is this third one is removed, then it becomes AMP. When both these are removed you are left with only one, that is called AMP; adinocine mono phosphate, adinocine diphosphate; ADP, and adinocine tri phosphate; ATP. With this, I come to the last slide for you people.

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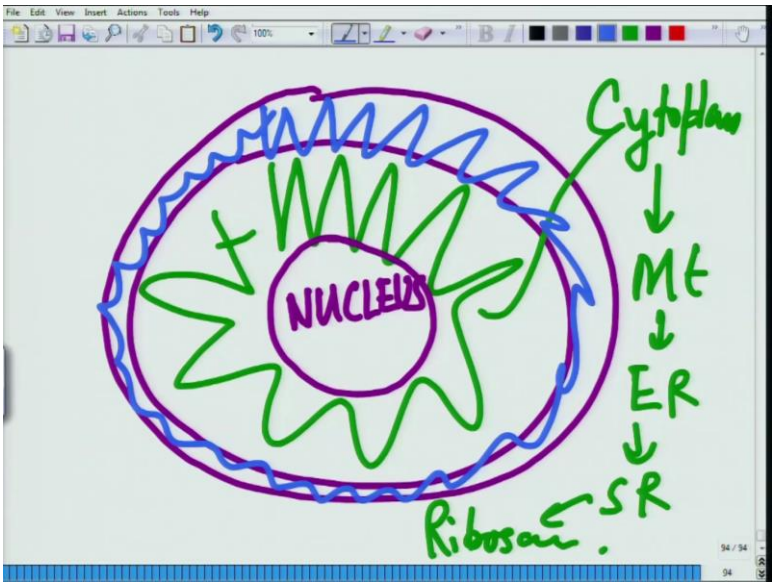

Again, recapitulating the structure of the cell. This is the membrane of the cell. Next, we will be taking about this membrane. Within the membrane, there is another organile called nucleus, which has the nucleic acid, which we haven't discussed. But, we will be talking about it and this part, this whole part is called as cytoplasm, which has all the different cell organiles, which includes cytoplasm; contains mitochondria; and endoplasmic reticulum, sarcoplasmin reticulum, ribozomes and so many and so forth. In the next class, what will be starting with the next section, we will be talking about this membrane structure, which is the beginning of all the phenomenon membranes of different cells and their features.

With this, our first part of introduction to physiology cell and general physiology, we are concluding. I believe to give you an overall idea; this is how the cell looks like, and this is how, we study the different physiological phenomenon. Basically, what happens is, these different cells come together and form organized structure called tissues. These organized tissue like structure, eventually, form organs. These organs have eventually, form systems. These different systems interact with each other to form an integrated unit.

By virtue of which, there are different control mechanisms like negative feedback, positive feedback, auto regulation, extrinsic regulations, PH control, how many stasis, buffering and all these things, which regulates our body and helps us to interact with the system all the time. With this brief introduction, in these two lectures, we will move on to our next topic, which will be the third lecture in the series, which will be membrane physiology of nerve and muscle.

Thank you.