Animal Physiology
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Lecture - 38

Welcome back to the NPTEL lecture series on animal physiology. So, we are in section twelve. So, today we will be starting with lecture four of section twelve, were will be in the gastro intestinal of physiology and will be talking about intestine and pancreases pass full will do the lever. So, as if now, we talking about, we first of all, lets have briefly recap for few minutes. So, the initially I will give the whole outline of from mouth to anus how the food is passing through. So, initially in the mouth we chew the food using our teeth then they are taste buds along the tongue and it is out there.

The salivary gland place its role, its secretes a series of enzymes, which helps in softening the food and then through prostatic movement the food travels down to the stomach. In the stomach it is exposed to a extreme acidic environment and in that acidic environment series of chemical reactions happen the proteins get denatured they got broken down and then food is further crumbled down into very smaller pieces. From there the ball has or the hole lump of food moves to the small intestine, is in the small intestine were the maximum absorptions takes place.

So, while we take about the cross section of the stomach, we saw how the brush bottle like structures were there. A very similar kind of structures indeed exist in the intestine, but much more higher surface area and the cell types, which involve in it at different. So, what we will do essentially the same way, we did for stomach, I will draw the whole an autonomy and from there, we will talk about the cross sections and we will talk about the different cellular structures which helps in the absorptions process.

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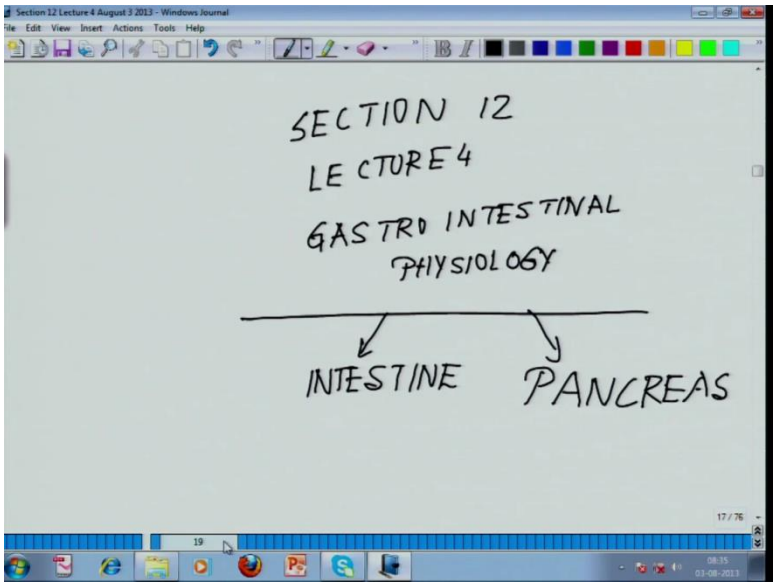

So, getting back, the slides. So, we are into sections twelve. So, we are talking about now, intestine and another thing what I am going talk about today will be the pancreases. So, if you people remember while we talked about endocrine system I told you that. There are series of hormones, which are secreted by the pancreases and we will discuss those in the digestive system or in the gastro intestine of physiology. So, I think now, sense we are doing the gastro intestine of physiology once I finished the intestine, we will move on to the pancreas. So, these are the two step, what we have to needed today, to start up with small intestine.

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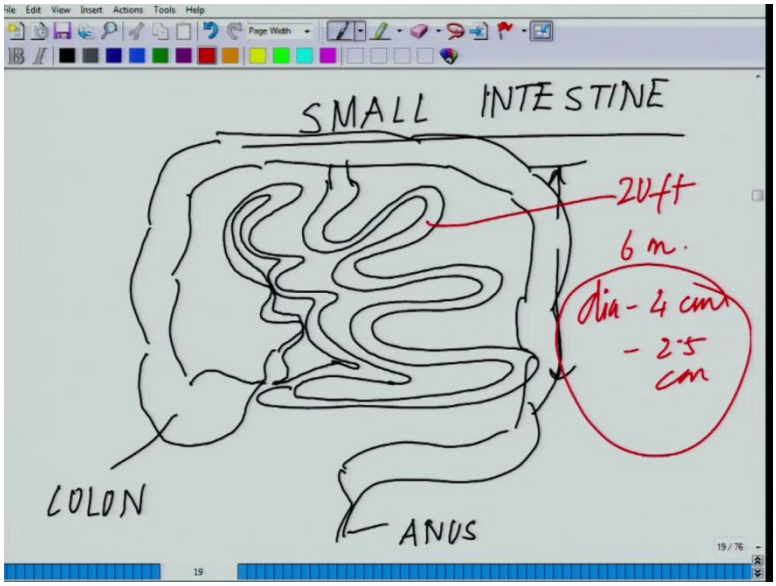

The anatomy of a small intestine, if you look at it. So, the food from the stomach move and then there is series of structure like this. It is a long loop like structure, which is kind of you know, something like this. So, this is a huge loop structure and of course, when it leads to the large intestine which kind of you know, is really bigger diameter which is surrounding it, which is also called a colon before the food is kind of you know excreted out through anus. And here is the colon and this zone what you see the this whole tubular structure this is almost 20 feet long or which is almost interms of 6 meters and the diameter range from 4 centimeter to 2.5 centimeter. So, these are some of the logistics and this whole small intestine is divided into several parts.

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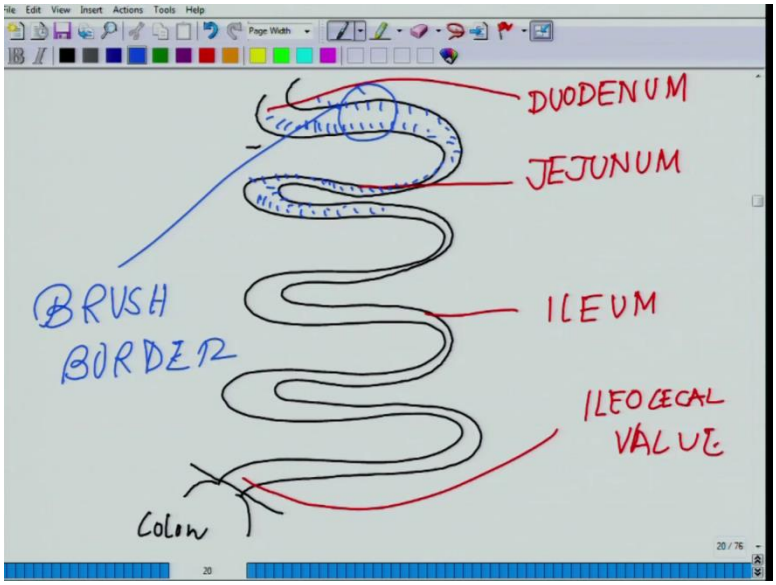

So, I redraw this it is something its look like. So, you have the entry port from where it is entering closes to the stomach that is called duodenum then you have next port, which is next part is called jejunum then you have slight mistake oh sorry, just just just there with me, this is I just made a mistaken. So, let me redraw it then remix about science. So, from here the food is coming entering from the stomach and now, it is travelling all along the small intestine out here. Now, it is moving on to the large intestine out here from here starts the colon ok.

So, in the first part is called duodenum then we have the jejunum then we have ileum and then we have ileocecal value. This is the overall an autonym, if I have to say how the intestine is divided? Intestine is divided into four parts, duodenum, jejunum, ileum,

ileocecal, spinster or ileocecal value. From where the food moves on to the colon, it is a huge tube and this whole tube, if I have to kind of give an analogy this biology the whole tube has borders like this all over, inside something like this, hairy border all over. And this border is essentially what is termed as the brush border and those projections like a structure what you see like this, which are projecting out; those projecting structure are called villi.

So, if you look at this. So, essentially what is happening? So, suppose of food comes the food particles are moving like this all along the villi. So, you are enhancing the surface area many many many poles by creating the villi like a structure and this how the biology designs its structure. So, that in a very limited space, you can maximize your output. So, coming back now, what we will do after giving you know this an anatomical features, I will move on to give you then idea about the histological aspect of it. So, will take cross section of this and will talk about the histological parameters ok. So, coming back to the slides now, so this is how its look like, if you look at the cross section of one of this is how it looks like.

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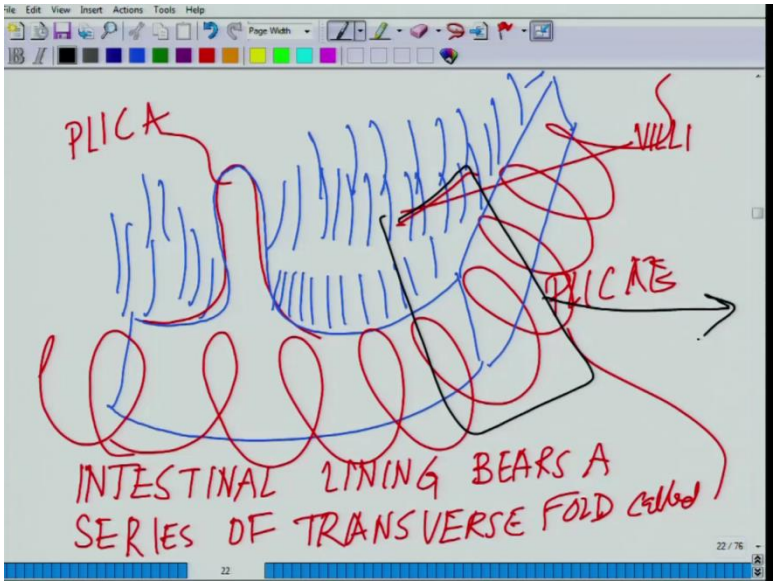

And what you will you see essentially lot of and if I could draw it in three dimension, it is something like.

So, we will see all over the place there are brushes, just like your tooth brush you see, just like a tooth brush you will see lot of these structures. And these structures are called villi, which is the brush border and this whole raise the structure is called plica.

So, what essentially is plica, if I going by the definition the plica is basically the intestinal lining, basically the technical definition of plica is intestinal lining bears a series of transverse fold called plicae. So, it is very similar to the structure what we have explained in stomach, which is called riggy. If you remember that the structure in the intestine have showing you in one of the slides that surface is called riggy. And then in the case of intestine is called the structures are almost same.

But it is just they are functionally different from each other, because at this state the whole idea is to absorb as much nutrient as possible that is a major. So, automatically when you have to absorb. So, you can understand, if you look at the picture. So, this whole thing will have lot of blood vessels all around it likewise. These blood vessels are continuously absorbing what serve and nutrients, which one is kind of you know going through the intestine.

So, this is continuously getting absorbed from the blood vessels and it has to be transported for in a synthesis of different kind of molecules. Now, coming back to the slides and move on to the next slides. So, now, what I will do? I will draw the detailed structure of I showed you this. Now, what I will do? I will just take one cross section out here, from here. One section and in the next slide, I will show you the how that looks like.

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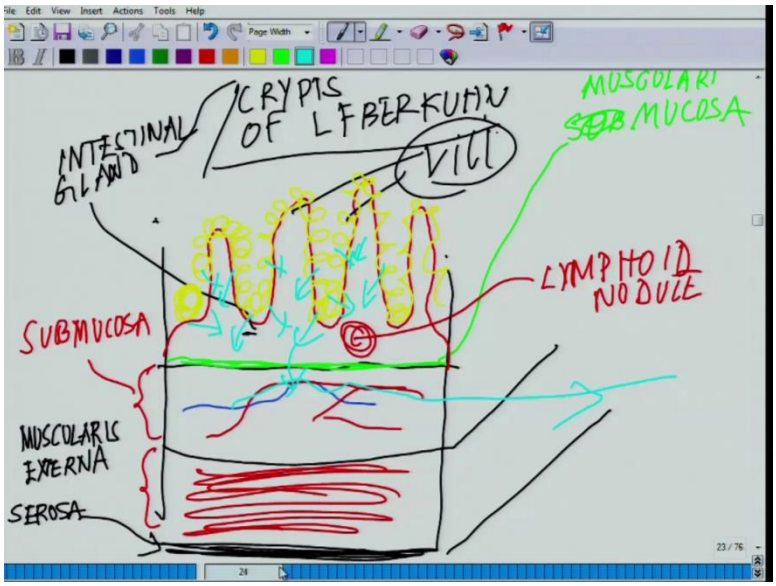

So, something like this. This stroke again. So, this is the bottom most layer, which is underneath also there is a layer, which is called serosa layer, this black what I am, this base layer is called serosa. On top of serosa you have muscular externa and muscular externa is something like this, this layer is called muscular externa. Next layer on top of that you have the layer called submucosa.

So, here I am into the submucosual layer which is so how about we give different colors to them so you can identify. So, now we are entering into the submucosal layer. So, submucosal layer has the blood vessel all over the place. This is submucosa on top of submucosa we have something called a layer very thin layer, which is called submucosares submucosa, muscolaris sorry, muscolaris mucosa. On top of this you have villi like a structure likewise.

So, this is the total cross section of it and underneath we have something called lymphoid nodule and you have out here the intestinal gland or this is also called crypts of lfberkuhn, there are two names for that this base region. And now, what we will do and these are the individual villi. Now, what we will do after giving the outline of this structure of the cross section of the intestine what I will do? I will give you the individual villi, how the cross section of the individual villi looks like and where are the blood vessels how the blood vessels are pulling then it trains from individual villi, because these individual villi so what is essentially happening. So, if you look at it. So, the food

is lets we present food with yellow. So, the food particles all over the place this is moving, the food particles are travelling all along like this. And at these zones all the absorptions is taking place, all the different kind of all the nutrients, which has to be absorbed we are getting absorbed here likewise. And once they absorb they are further transpited through the blood vessels which are present here.

So, now, after this we move on to the next slide, where I will draw the structure of the individual villi and we will highlight all the different structural features into it. So, move on to the next slide ok. So, now, let us look at the cellular structure. So, the overall structure is one second, overall structure is clear to you people and now let me.

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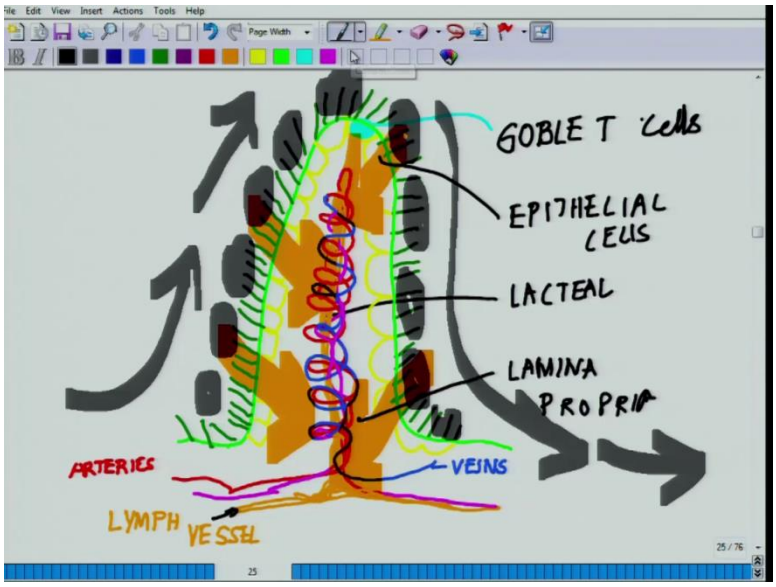

So, this is what you see? What I am drawing now, is the lymph vessels, which are on parallel to the blood vessels. You saw the lymph vessel which I was drawing. So, these are lymph vessel and this is all surrounded by the blood vessels so they comparable to them. So, there is blood vessels are out here like this, there all surrounding them. In continuation you have the veinuels, which are the veins, which are in blue they running in parallel and ok.

So, that red ones these are the veins and here we have the arteries. Now, is the cellular layer, which is in different kind of color for that, the cellular layer could see could be just using a slightly lighter color out here so that I can. So, this is how the cellular layer is and on top of that green, what you are saying in the lining that is why it started all the

brush borders. Now, what I am drawing now is just like your tooth brush, if you look at it, this is how brush borders structure looks like ok.

So, the cells what are the different termologies for the different cells out here some of these cells which are at the top what you see these are called goblet cells. Then we have the epithelial lining so most of these are epithelial cells. Then you have this part of lymph vessels is called lacteal vessels.

Lacteal network this is the capillary network and this part is called lamina propria, but in this process you must have observed that, I have highlighted in one thing at that is the nerves, because nerves, because it is invocating it is innovated very thoroughly by the nerves. So, the where the nerves are presents. So, now, let me introduce the nerves they are all over this. So, these nerves are moving all along like this, these are the nerves all the sympathetic parasympathetic what you say. So, these are the nerve index.

So, these how complex individual villi are and there are thousands and thousands and thousands and villi all along the small intestine. And the food particle just like this where take this thing, the food particle is moving like this out here on these surfaces, these are the food particles. So, they are following this root moving like this, moving like this each one of them. And in that process what is happening essentially is the all the material what has to be observed are getting absorbed here and there are been taken up by the blood vessels and used for energy production. So, this is how the complete profile of the intestine looks like and this is how the intestine is absorbing all the different kind of material along its surface.

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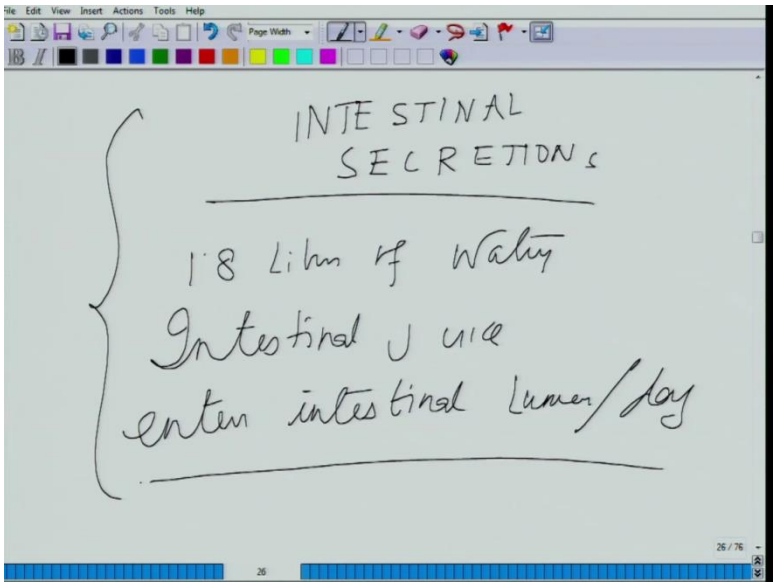

So, now, let us get back to the slight and try to tell you the some of the different intestinal secretions. What are the different intestinal secretions which are taking place? And so roughly one point eight liters of watery intestinal juice enters intestinal luman per day and much of this being is used for in a breaking up the like in a sorry, for promoting the movement of the food and all other things ok.

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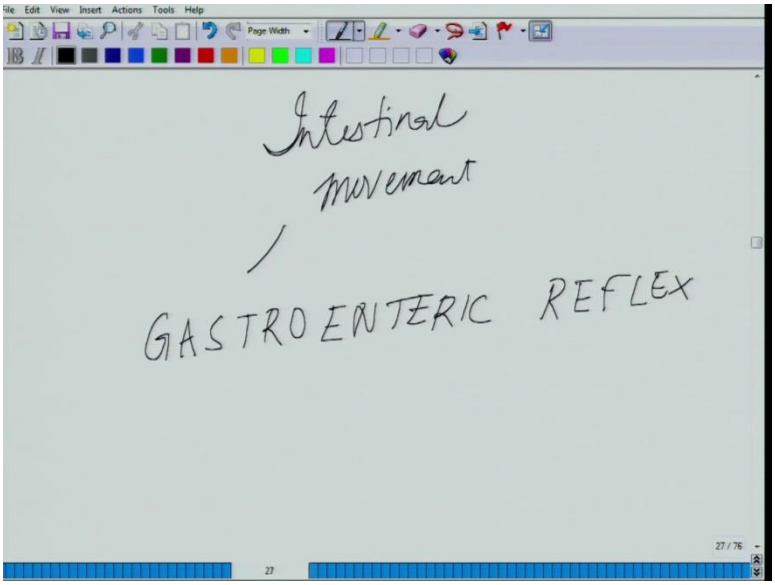

And the intestinal movements includes there are two sets of movements which are involved in intestine movement. One is called gastro enteric reflex, which is regulated by

the nerves, reflex and I have talked about the reflex circuits already to you. And there is something called gastro villi reflex. So, these are the major intestinal movement, which is taking place in the intestine. So, this is the overall understanding of intestine, what I expect you people to get, from here what I will do, I will move on to the structure of the pancreases what I told you ok, I want to say. So, again with pancreases will do the samething, will talk about the, first of all the position of the pancreases, where exactly it is located and will talk about the secretion made by the pancreases and the role played by pancreases in the process of digestion.

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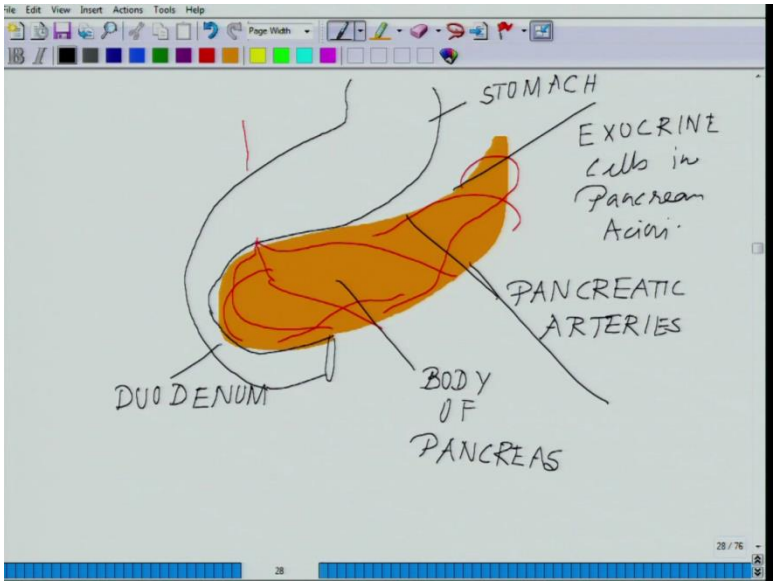

Let us get back to the slight stuffing about the pancreases. This is the stomach, from the stomach out here and here its starts duodenum. So, this is stomach and here starts the duodenum or the part of the intestine, small intestine. So, the pancreases lies somewhere here it is a. So, organ like this constitute the pancreases. So, the structure the way I have drawn it is welled similar to that it is kind of, if you take pepper and you cut it. So, the top part it is almost like that, it is kind of inside a groove.

So, what the pancreases does? Let us come back to the slides. So, if you look at the pancreases. So, this is very, very well innovated by the blood vessels, which are coming all over and mind it this is also have a lot of endocrine functioning it has to take care of. So, this is the body of the pancreases. Then you have the pancreatic arteries, these are called pancreatic arteries and out here are the right to do the cross section are the

exocrine cells in pancreases, which are also called acnes and those acnes are something similar to let me draw the acnes in the next slide, acnes are very interesting a structures.

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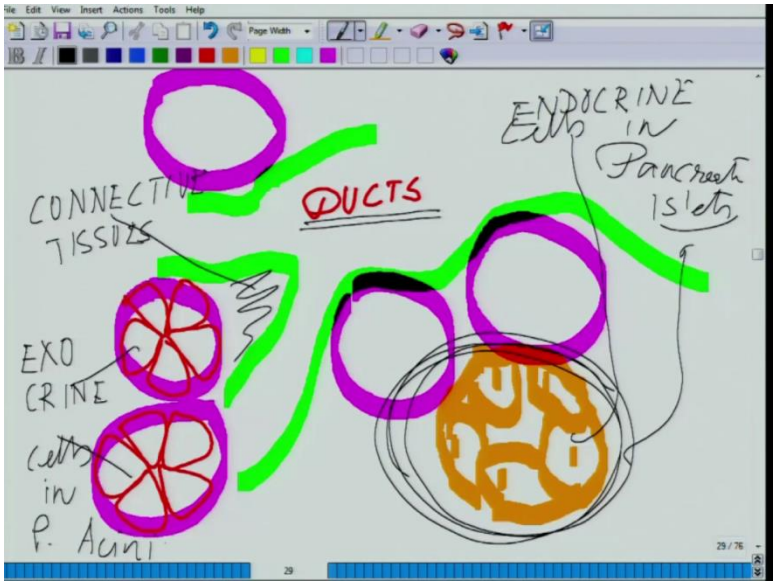

So, these are structures like you know. So, there are vessels all along likewise and within those vessels you have circular structures like this. Draw it and will make it more sensitive you people like this. And these are further have the cells, which are arrange like this. They have these ducts which are attaching. So, all of them have something like this. I will come to the labeling and everything.

So, these are the ducts and these are the exocrine cells in pancreatic islets ok. And so out here there are some series of cells, which are more like this. They have their own vessel and so these cells which are present these are the ducts what I have already drawn and you have the connective tissues in between, which all over the place. These are the connective tissues and you have the exo, so these are the exocrine cells in the pancreatic accenting these are the exocrine cells in pancreatic accenting.

And you have the endocrine cells, which are these ones, which are the endocrine cells in pancreatic islets, which are also called islets of langerhand cells. So, these are the cells the one which I have drawn in yellow or slightly muddish yellow other ones, which are called islets of langerhands or pancreatic cells, which are involved in the secretion of a whole series of different factors, which have been in the digestion.

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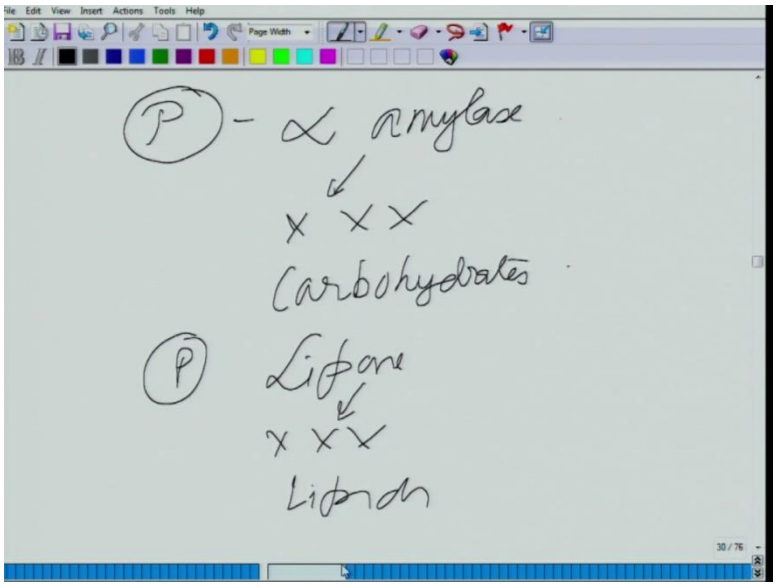

So, what all pancreases secreting. So, one is so p stands for pancreatic, alpha amylax is carbohydrates, which is basically this is breaking down the carbohydrates. Then you have pancreatic lipase, which is essentially breaking down the lipads.

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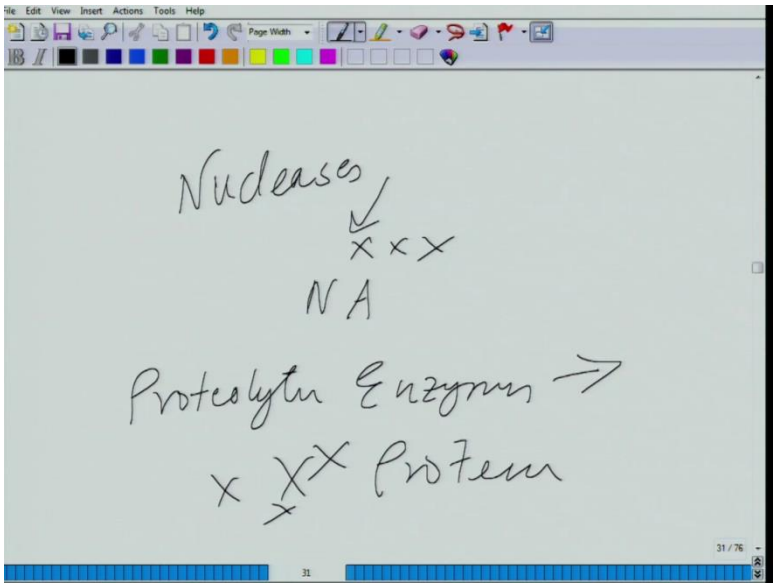

Then you have nucleases, which is essentially bring the breaking of the nucleic acid. Then you have proteolytic enzymes, which is taking care of all the proteins and peptides, breaking all the proteins and the peptides. So, if you look at the pancreas, I have told you, I have given you at least four different enzymes, which is taking care of the fats

lipids, carbohydrates, proteins and the nucleic acid, apart from it also it has the endocrine function also. So, now, what we will do, we will enlist or enumerate all the endocrine secretion, which are made by the pancreas. So, that includes and this so these are all the proteolytic enzymes we have talked about ok.

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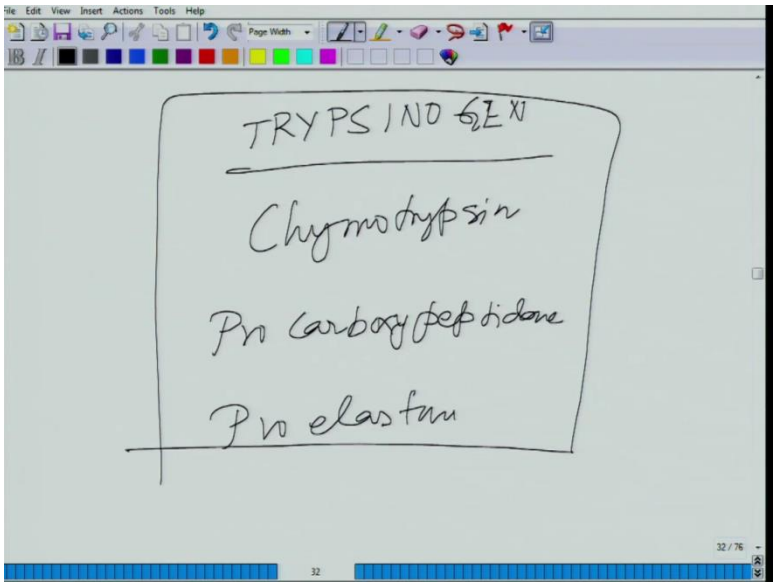

So, now, we will talk about a few other enzymes before we get into that. So, one is trypsinogen, chymotrypsin, pro carboxypeptidene, pro elestas and these are the series of additional enzymes, which are secreted among the under the major class of one, which you would be breaking down all the different proteins ok.

So, after this you are left with few other aspect or which pancreas is going to secrete which helps in the digestion of the food. So, let us just go through what all we have covered. So, we talked about the intestine and in the intestine we talked about the structure of the villi, where the all the absorption is taking place then we talked about the anatomical location of the pancreas and we talked about the major secretion made by the pancreas and the histological structure of the pancreas. So, what we will do in the next class we will talk little bit more about the pancreas about its endocrine roles. And then we will move on to the liver we will finish off with the liver and then we will move on to the large intestine.

Thanks a lot.