Animal Physiology
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Lecture – 08
Integumentary System – III

Welcome back into the third lecture of the second week. So, in the first 2 lectures we talked about the basic structure of a skin is a part of the integumentary system. So, today what we will do; we will cover 3 topics small bits in pieces. The first thing we will talk about one of the very popular aspect for all the youths is the skin color. So, there are (Refer Time: 00:46) all over the television and different media and you know you can make your skin brighter much more glowing and all this kind of things what is the truth behind it is it really possible, but even before we know the truths and everything. We have to understand why certain people are having dark complexion whereas, other people are having brighter complexion or a lighter complexion what is a science behind it.

So, today's topic the first topic what I am going to deal with will be the skin coloration followed by the stretch marks or the wrinkles which appears in your skin through the ages or during some injury or in the case of women during pregnancy the abdominal stretch marks and everything what are the genesis or what is the genesis of those kind of a stretch marks and third we will we will be talking about little bit about the structure of the hair and the sebaceous gland and the gland which help in secretion of sweat apocrine and the merocrine gland the sweat gland and will be concluding with the structure of the nail to start off with the skin coloration. So, whenever we talk about skin coloration. So, colors are nothing, but pigments. So, whenever you see anything irrespective of what I am teaching you in this course you have to realize it must have a pigment some pigment must be involved.

So, now if there is a pigment from where this pigment is coming and if you understand from where it is coming the next level where come the biochemistry in to play the chemistry in to play is how this pigment is being synthesized, what are the ingredients or is it genetic driven and likewise and so on so forth. Of course, will not go into that detail out here we will only talking about why we are having different kind of a skin color and

the second thing will talk about what is the genesis of it why is it. So, in order to explore this question lets go back take a reverse gear and again revisit all the layers.

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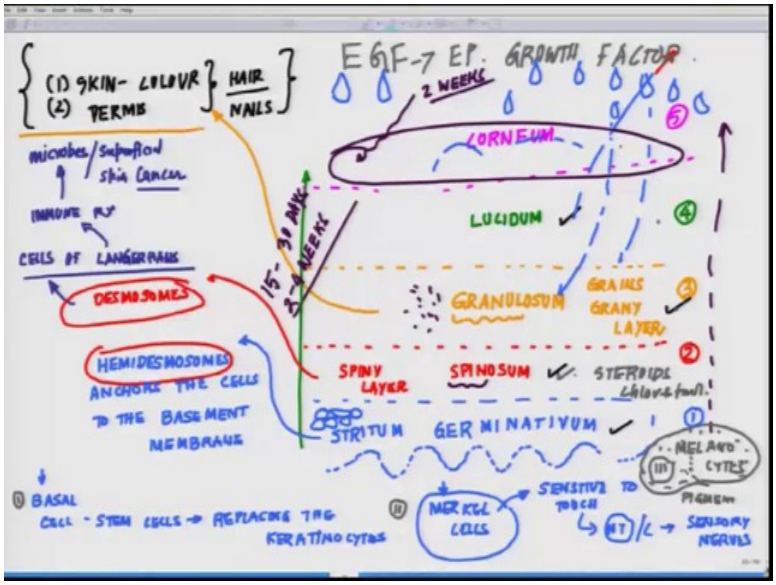

So, the layers if you remember your lowermost layer which is stratum germinativum is the lowermost layer spinosum, granulosum, lucidum, corneum.

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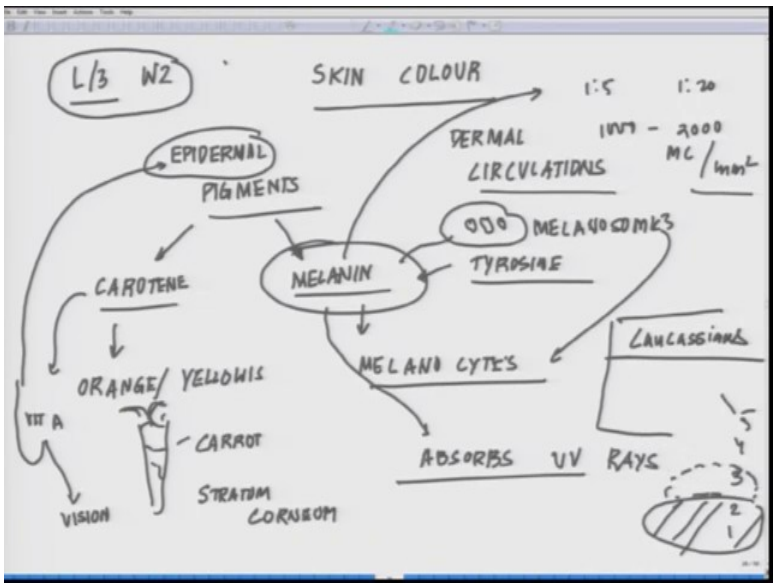

So, we are having these 5 layers. So, now, talking about skin color, this is the topic what we are going to deal today again this is your lecture 3 and week 2, l 3, w 2 today. So, this skin color is a function of 2 parameters the pigment cells which are present in the

epidermal layer and the blood vessel underneath it is in the dermal layer. So, let us enumerate those 2. So, it is basically epidermal pigments and dermal circulation because they give a contrast because of the blood vessels which are present underneath the epidermal layer and within epidermal layer there are 2 pigments which are pronounced one is the carotene pigment we must have heard about beta carotene the other one is the melanin pigment.

So, carotene pigment is mostly if you forget always remember about carrots is basically orange yellowish which is the color of the carrot just for your kind of you know remembering at this is how we used to remember and these are present in the cells of stratum corneum; stratum corneum. Now carotene is help in the synthesis of vitamin a will be talking later about it and this is also involved is vitamin a apart from its role in vision is also involved in maintaining the epidermal layer healthy epidermal layer is being maintain.

So, what we see here carotene has 2 function it offer certain coloration to the skin and second thing what it offers is it maintains the healthy skin. So, that is why they say it is good to eat carrot and food from nature which are rich in beta carotene and essentially it is a long chain which get split up and form vitamin a. So, the next pigment which is involved in it is the melanin. So, the melanin on the other hand is synthesized from an amino acid call tyrosine kindly look into that structure and tyrosine is the key molecule from vermilion is synthesized and it is synthesized in the cells of melanocytes you can go back and check it where melanocyte are present, if you remember the very first lecture in the integumentary system.

I told you this is where the melanocytes are present in the lowermost layer now melanin as a molecule is a very interesting one melanin absorbs UV rays and it is a very very; I should say a very very strong UV; UV absorber and these melanin pigments are packed in small vesicles like this which are called melanosomes and these melanosomes are present in the melanocytes and melanocytes has a ratio they in the lowermost layer this melanin as I told you in the lowermost layer germinative layer germinativum layer. So, the ratio is around 1 is to 5 to 1 is to 20. So, around thousand to 2 thousand melanocytes MC, I am just putting melanocytes per millimeter square this is the kind of number of melanocytes which are present.

Now, if you look at the people who are from the Caucasian rays. So, those who does not know what I am meant by Caucasian rays is the people who anthropologically have origin from the Caucasus mountains which is the current day Russia what is see somewhere for the northern part of Russia is the Caucasus mountains. So, those rays which is originated from the Caucasian mountains are called Caucasian rays and most of the Caucasian rays people are brighter skin fairer skin very brighter skin and there is another interesting thing you can remember the Caucasian rays will talk later about it they have higher concentration of alcohol dehydrogenase gene.

In other word they can with stand more alcohol in their body. So, this is a catch on the country we are not from the Caucasian we have from different rays from origin we have lesser amount of alcohol dehydrogenate. So, we cannot consume lot of alcohol as compared to the people with the Caucasian rays will talk later about all this things, but just to give you catch about it. So, the Caucasian rays people who are fairer and brighter skin if you look at them so, the distribution of melanocytes. So, in their case the melanocyte remains. So, if I put the layer from the bottom 1 2 3 4 5. So, in the case of Caucasian people you will see the melanocytes are concentrated in the first 2 layers from the bottom. So, this is the uppermost layer where as people in India and all was slightly more darker complexion or even more darker complexion have the melanocyte concentrated on the third layer. So, you are much more upper and its very interesting thing you will realize in these cells which are carrying the melanocytes if you see these cells.

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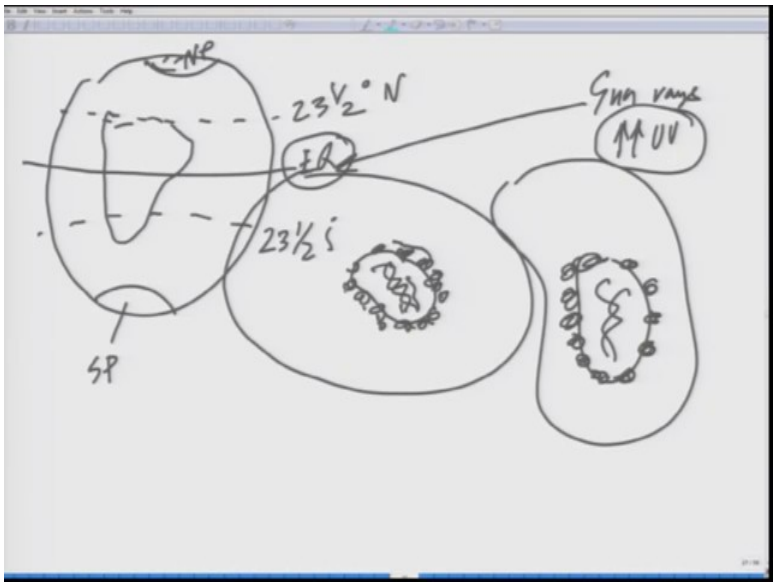

So, you will see most of the melanocytes are concentrated close to the nucleus did you wonder why these are the melanocytes and when did the melanocytes here is the nucleus of the melanocytes and here you are having the melanosomes concentrated.

The 2 question I will ask you think over it first the first question I will ask you why is it. So, that we are having a darker complexion if you and most of the people from the Caucasian rays will have a much way more brighter complexion than this why these 2 words and in every language in Hindi we call it [FL] and [FL] and I mean in every language you have darker and fairer voice. So, I told you the reason, but then why is it.

So, I told you that you know darker skin people have on the third layer the melanocytes are concentrated first your catch lies you draw the map of the world this is the world here you are having the north pole here you are having the Antarctic which is the south pole. Here you are having the equator here you are having the tropic of cancer here tropic of Capricorn at twenty 3 and half degree north twenty 3 and half degree south and here you have the equator EQ.

So, this is where if you look at it the maximum sun rays are falling here you have the lesser amount these are very cold places. So, where you are having maximum sunrise is maximum sun rays will have maximum amount of UV rays. So, in order to protect if you are closer to the equator you will be exposed to more and more UV rays, so, the continent the Dark Continent Africa which has all the 3 rolling. So, you have like this

Africa if you look at it. So, the closer you are to the equator chances are you are have a chances are unless there is a migration and settlement or within that you are living at higher attitude chances are you will be of darker complexion because through ages through millions of years your skin has to adapt to the horse UV rays and sunlight.

So, not only that you will see most of us are having very dark hairs we are having little dark hair and we have hair all over our body why is it. So, because these are protections and second question what I ask you why if you see this picture why all the melanosomes are located close to the nucleus they are close to the nucleus because just logically think of it the mutation takes place in the nucleus. So, in order to prevent any kind of mutations on the DNA the nucleus in an around is kind of you know protected by this melanosomes which absorbs the UVs and there is another interesting fact about this melanin pigment.

Melanin is a very good semiconductor material it is one of the prime organic semiconductor material and their people where working all over the world if you shine light on it, it generates the electricity. So, it is as photo voltage properties. So, whether that kind of role does it has any role its electrical activity does it has any role and specially when you shine UV light it generate higher amount of currents now whether that has any linkage to the biological phenomena which are happening sensation happening on the top of the skin we do not know there is no study as of now as been demonstrated to tell whether on absorbing sunlight these melanin pigments which are present in my skin tell something to the nerve cells we do not know that. So, so very open area of research and are there different kind of because light is an electromagnetic radiation right.

So, when these melanosomes containing huge amount of melanin pigment in them absorbs sunlight specially the UVs they generate currents. So, this is one un-exploded area which I wish to share with you people. So, these are the things. So, hence forth whenever you see a brighter complexion person or a darker complexion a person with respective yourself do not think otherwise just think is very logical from where this person is originated it has anthropological reasons it has a bio anthropological reason a why some of us are brighter some of us are darker it has absolutely nothing to do with your origin with your religion with your caste creed whatever you call it. So, get that thing in your mind.

So, now what I will do from here we will talk about another very interesting feature of this particular part. So, in this figured I wanted to bring to your notice this layer spinosum in this layer there is something very interesting in the spinosum layer you have a precursor of cholesterol related steroids which is which. So, you have these steroids present in the layer which are very similar to which is derivative of cholesterol. So, upon absorbing the UV that is why UV say walk in the morning. So, there is steroids transform into vitamin d or which is also called chole calcitroil.

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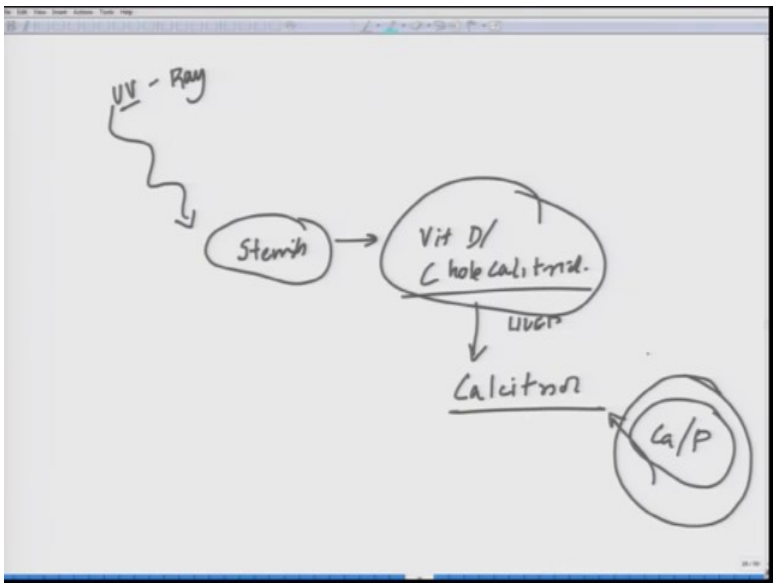

And this goes to the liver and calcitroil and calcitroil and this calcitroil is involved in absorbing calcium and phosphorus atoms.

So, you see the skin on one hand it not only protects us from UV rays it utilizes the UV rays by a different set of cells where vitamin d is being synthesized from the steroid molecules which are present there and these vitamin d eventually convert into calcitriol which absorbs calcium and phosphorus in your body. So, if there is a deficiency of vitamin d most likely will have a deficiency of calcium and phosphorus in your body apart from it that very layer what we discussed is involved in secreting one of the growth factor which we call as EGF epidermal growth factor epidermal growth factor epidermal growth factor has several roles in the body specially in the differentiation of the stem cells starting from that to whole gamut of activities it has not getting the details of it as we progress into the force with the situation comes. So, we will talk about epidermal

growth factor, but you knowledge remember the epidermal growth factor is secreted by this particular layers of cells.

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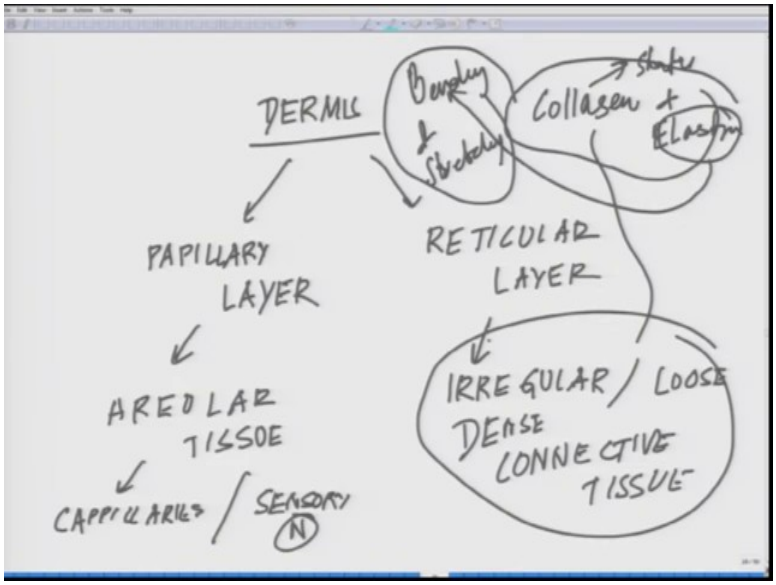

Now, after giving you this overall idea I move on to the next layer which is the dermis layer even talk much about it now let me talk about the dermis layer. So, dermis layer we talked about 2 things, if I divided it was the papillary layer if you remember it underneath the basement membrane of the fifth layer from the bottom and the reticular layer. Papillary layer consist of areolar tissues and they have these capillaries and sensory neurones where is on the reticular layer. It is a loose connective tissue irregular loose and dense connective tissue and these connective tissue are mostly (Refer Time: 19:26) with different kind of fibers mostly there are 2 kinds of fiber which are present there collagen and elastin fibers and this collagen and elastin fiber helps in specially this elastin collagen is very strict elastin helps in bending and stretching and where is collagen gets its a shape. So, this is how. So, collagen gives it is a shape where as the elastin and helps in the bending and the stretching.

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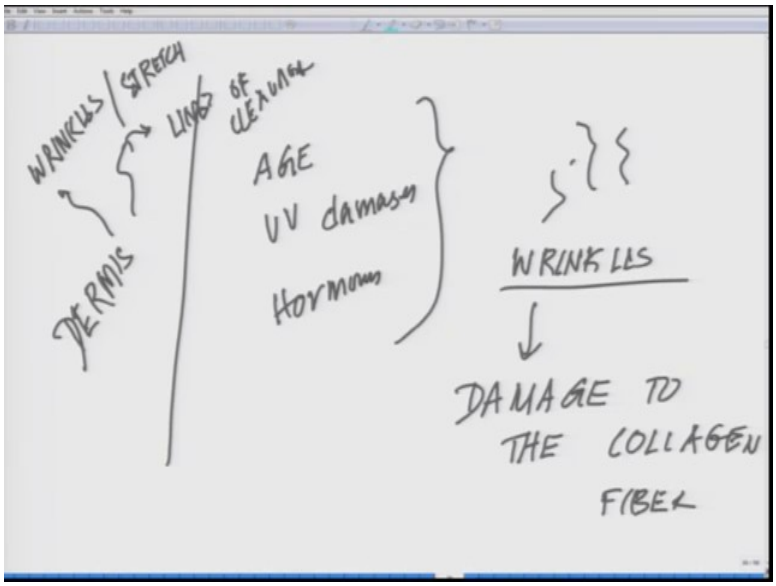

So, over a period of time as we age there are UV damages which keeps on adding up and there a change in the hormonal (Refer Time: 20:17) what you see the you get stretch mark on the skin in the USA; the wrinkles those wrinkles comes wrinkles comes because of the damage to the collagen fiber in the dermis. So, in other word this particular dermis layer as direct roll into your wrinkles due to aging and the stretch mark this is stretch marks are common which happens mostly in the women during childbirth in everything and in determining the lines of cleavage what does that mean I will come to that.

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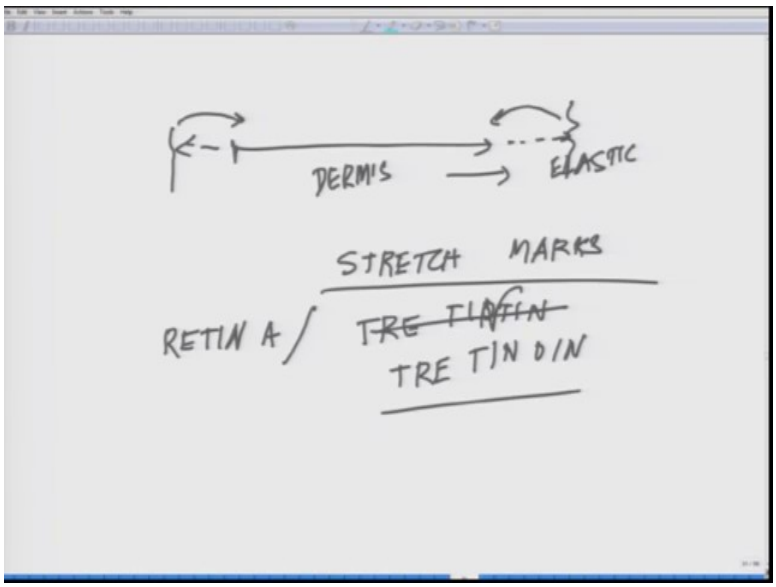

So, what happens essentially if you strip the dermis beyond a point? So, dermis layer has a stretching capacity based on its concentration of the elastin fibers. So, if you if you stretch it beyond it, it leads to permanent damage and extensive distortion and it reduces the capability of it increased if you increase is beyond the level of the dermis stretch capability it feels to recall back to its original shape and that what is leads to the stretch marks this is the genesis of the stretch mark and there are some medicine it will come across which are retin a or sometime they tre tiotin tre once again let me just corrected tre tiotin. So, these kind of medicines which originally was or were sold by pharmacological companies to remove the acne or the pimples in that kind of things it has been observed that these kind of medicine increases the blood flow in the dermis because dermis is rich in adipose like tissues and the blood vessels and the nerve endings.

So, apparently it has been observed that because of this added feature in these pharmacological agents retina they help in reducing the stretch marks. So, there are people use it, but what are the other side effects we are not aware of because increasing blood vessels may come at a cost or increasing the blood flow comes at a cause. So, we will do not know that part.

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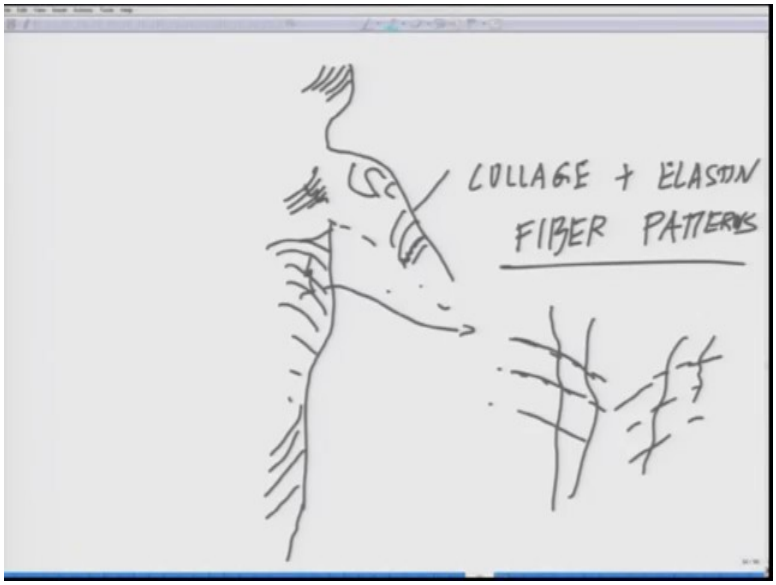

So, apart from it there is another thing which I wish to highlight one to talk about all this collagen fibers in the dermis layer. So, there arrange in a fashion. So, something like this.

So, if this is the side I am just putting the side view just for here. So, these if you look at our body the collagen fiber the dermis layer are in a range in a very unique fashion like this they follow a particular pattern now say for example, as you go down now these are nothing, but the collagen plus elastin fiber patterns.

Now, what I wish to highlight here is that these collagen elastin fiber pattern. So, say for example, dermatologist or person wants to make an incision here or a incision here incision here depending on how they do the incision if they follow the line of this collagen fibers like this they do the incision like this they do the incision like this. So, then it will repair along it, but if they do a incision like this like this then it will leave behind a stretch marks. So, most of the surgeons who were really good surgeons they follow a particular pattern how they are putting the incision into your skin. So, remember that. So, this is this is all have to do with your dermis. So, this is what I want you people to know about most of about the dermis.

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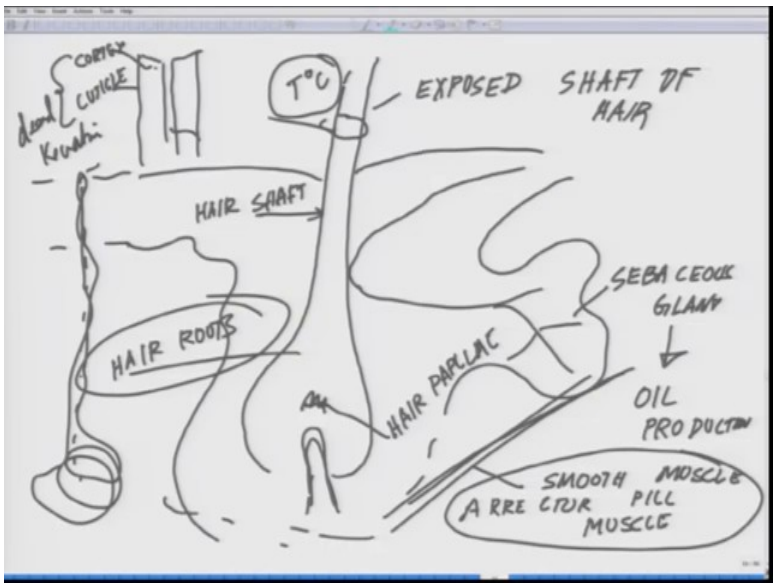

So now from here we will talk about the accessory gland specially we will talk about the little bit detailed structure of the hair. So, if you look at the structure of the hair the very first class when I drew it. So, it is something like this right and underneath you see and out here you will see some very interesting features like you have the just once you may have you see the sebaceous glands. So, this is the exposed shaft of here and here you have the sebaceous gland and on the side I drew a lot of those sweat glands and

everything. So, sebaceous gland is involved in oil production it keeps your skin oily and underneath the sebaceous gland you have a very interesting smooth muscle tissue will talk later about what is a smooth muscle in the muscle section.

But for the timing remember there is a smooth muscle call arrector pill; arrector pill muscle whenever you get scared or something you have seen you get Goosebumps you know all your like you know hair kind of straighten up that actually happens because these muscles get activated they lead to the all those Goosebumps what you see now this is the expose part of the hair and this is the hair shaft. And if you look at the structure of the hair in a cross section you will see that 2 parts the one is the core part where you have the soft carotene molecules which are present along with the melanocytes which are melanosomes and melanocytes and melanin pigment which determine its black color and then you have the bordering zone which is the cuticle and the cortex part the cuticle. And the cortex part which is rich in dead carotene molecules and out here underneath out here what you see is the hair papillae from where the regeneration takes place and these are the hair roots this is the overall geometry what I wanted you people to remember about here.

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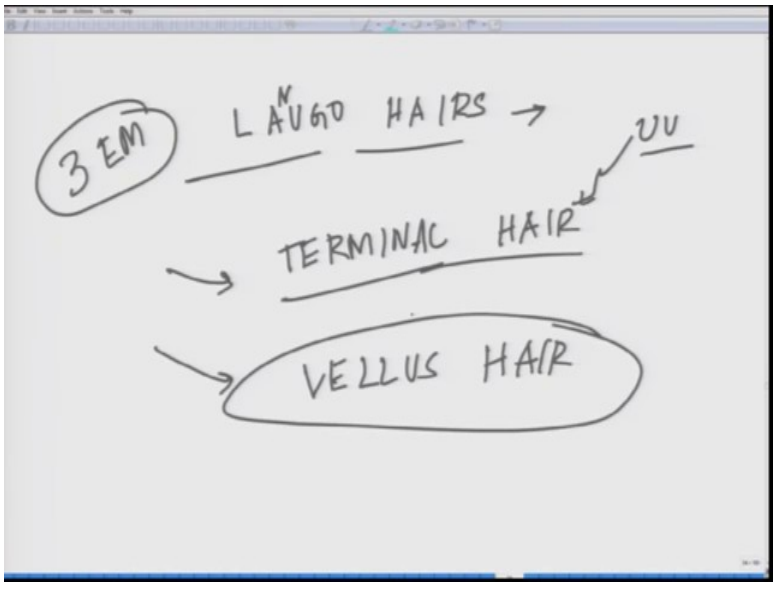

Now, there are at least 3 different kind of hairs you will be surprised to known the hair development actually starts at around 3 months during embryonic development the very first year baby develops in the mother (Refer Time: 28:28) those there is a word for that

it is called lanugo hairs these hairs are sets. So, 3 embryonic months e m stands for embryonic months this where shaft as soon as the baby is born later there are 2 kinds of hairs which develops one is called the terminal hair which you see in your head. These are very dark pigmented hair and they absorbs lot of UV rays where as there is another set of hairs which are called the vellus hair they cover all over your body, but they are lesser pigmented. So, this is what I want you people to kind of understand about hair and this gland which is the sweat gland this is apocrine and merocrine in nature at this stage I am not getting into the detail of the apocrine and merocrine because we talked about in the endocrine system.

So, they secrete the electrolytes water to maintain the balance. So, we have already talked about the UV protection role of the hair it has very close in sensory connections which ensures that whenever you pull our hair get sensation their animals were they control the temperature by having a court of war, and apart from it in your nostrils in your ears you have hairy lining which helps in capturing the different kind of dust another particles.

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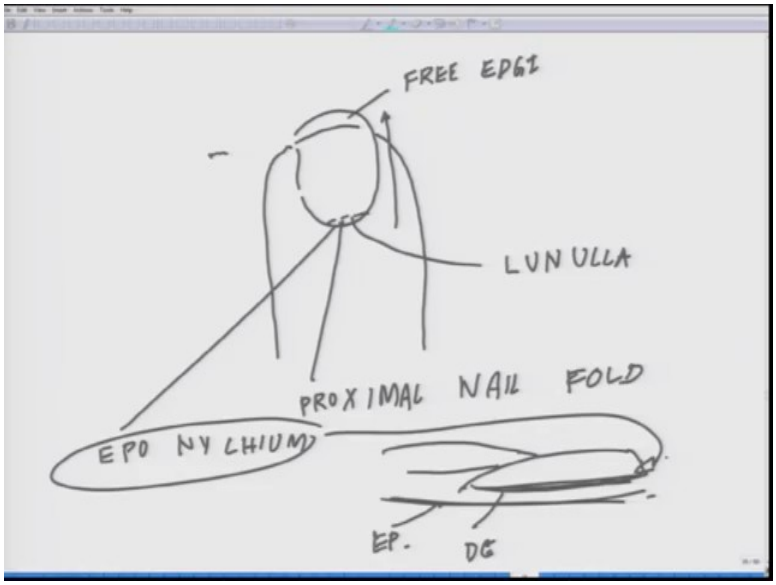

Now the last thing which I will be very briefly dealing next 2 minutes will be the structure of your nails. So, this is how your nail grows. So, this is the free edge of the nail and this part of the nail this is called lunala and this is a free edge and this is the proximal nail fold and this part the lower most here is called eponychium.

So, now if you see a side view if I hold the nil like that is and you take a side view the side view is much more interesting if you look at the side view. So, side view here you see the epidermis EP here you see the dermis and they are you see the eponychium which will present there. So, it is kind of a modification at certain parts of our skin where these kinds of accessory structures have developed. So, this is why for what we needed to understand our integumentary system, now the next 2 class of this second week will be dealing with the bones in the development of bones and the different kinds of bones in your body the skeletal system.

Thank you.