Animal Physiology
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Lecture - 06
Integumentary System – I

Welcome back to the 2nd week up to the coming Physiology course. So, in the first week we talked about the basic framework of anatomy and physiology and different level of organization; the molecular level, the cellular level and the tissue level.

So, from today onwards the 2nd week, we will be starting with different systems. So, where we really start? It always remains a very tricky question on me that where I really should start because you know you can pick up any system, but then this time I decide it. We will start with something which is very close to us, very near and dear to us.

So, every morning we wake up, we brush our teeth and get ready for our work. One of the foremost thing we do, we take care of our hair. Is not it? We put different kind of lotions or creams on our face, on our skin, but before that while taking shower or brushing our teeth, we use face wash in order to you know to look nice. So, this is one part of the body which throughout the day except when you sleep, we take care.

This includes your nails like and if you remember during childhood, you use to go to this whenever we used to go to this, when we used to go to school that in the choir or in a new task. So, your nails, you know nails, hair, skin, these are some of the very simple at most fascinating structures, the structure which covers our whole body, the structures on which you spend lot of hours starting from manicure to pedicure, to taking going to the hairdresser, using different creams and lotions and not only that, there is a lot of biasness and prejudices about the skin colour.

Some are darker skins, some are brighter skin and you know those who are brighter skin propagates like you know brighter skin is the best way whether it is movie, whether it is anything which is a big time biasness because those people who propagate such thing to a blunt honest on their face, they do not believe biology, they do not believe genetics, they do not believe anything except I go, but keep that aside. What these are skin, hair, nails, all these things and we spend money on this. All of you will agree with me on this.

This falls under our weight per system what will be dealing this week apart from it is called Integumentary System.

So, this week our outline of discussion will be integumentary system and the system which forms the framework of our body, the skeleton mostly, we will be concerned with bones. So, these are the two systems we are dealing with and today's class and the next class, we will be dealing with integumentary system.

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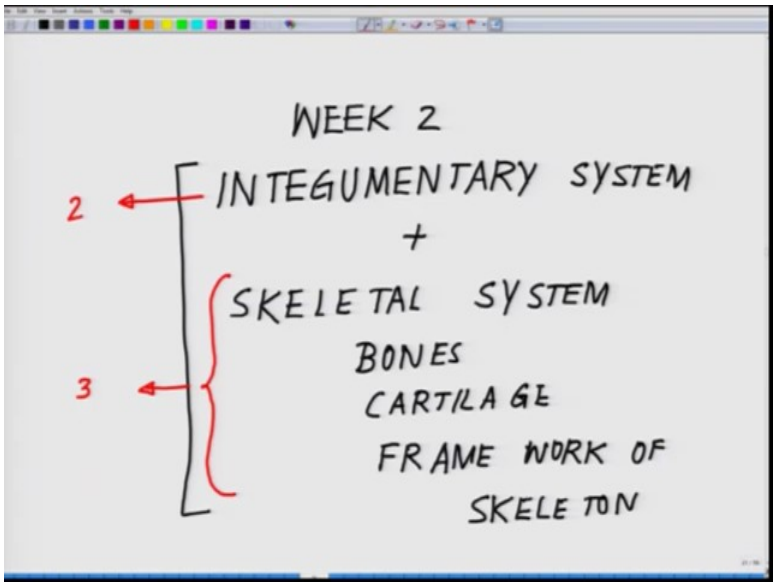

So, let us start this week. So, we are in to week 2 and our framework is this is, what we are going to cover, Integumentary System and plus Skeletal System, where our thrust area will be bones cartilage and the framework of skeletal on which a whole body kind of you know structured itself framework of skeleton.

So, this is what we are going to cover in the next 5 classes, where we will be spending 2 classes here and we are spending another 3 classes here which will cover up I am not going to. So, let us start our journey with Integumentary System.

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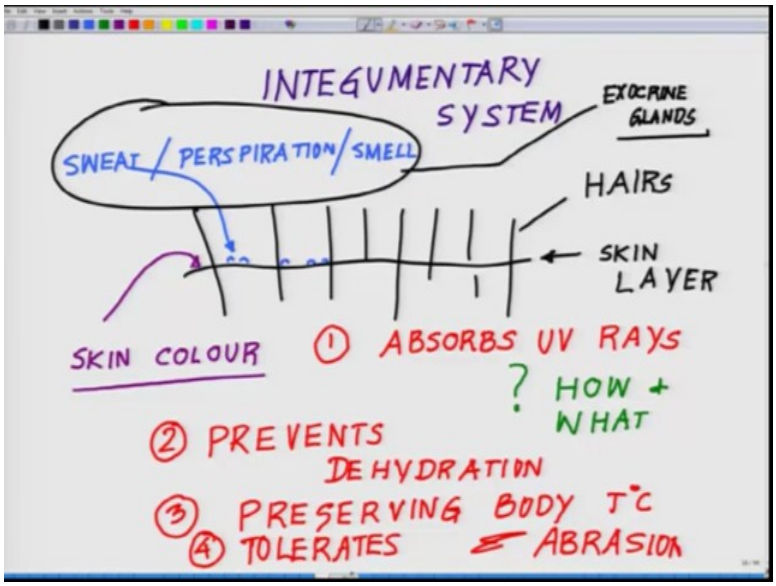

So, whenever I talk about integumentary system, I have already introduced we will talk about skin, we will be talking about hairs, we will be talking about nails. So, even before I get into the tissue details or any of those very finer detailed structure which can be seen in the microscope, what all we know about skin.

So, we know one thing there are skins which peels out easily, specially skins in your special in the back of your toes. We sweat, right. All of you will agree you are above sweat and we deodorants or something, all our skins have hairs on surface on top of it, right. So, if I have to draw a skin, the first thing I will draw, I had to keep my skin like the first thing will be these are the hairs and this is the skin layer, right and second thing we know that from this is skin, at times we see sweat and perspiration and not only that this sweat also has some of us have smell on the sweats, some of has do not have a smell on the sweat. Apart from it, what we know about skin? We know it has a certain colour preferences. Even within one individual, there are certain parts of the body where skin is brighter say for example, think of this situation.

So, look at my palm. This is very bright, right; this is very bright and now looks at here. This is dark complexion. Why is it? So, why this part is so bright and this part is so dark as compared to? If you see these two things, they are different, right. So, the third aspect, this is not even you have not even open the microscope. You do not know anything. Just by looking at it, these question should strike you the skin colour. So, we look at it. Even

without getting into any technical details, you can see that we already have number, a bunch of things which needed to be answered.

So, overall if you look at it, just to start of it as layman, what all skin does I mean if I just have to you know kind of you know number them on enumerate them. So, some of the things which at least your parents or somebody, your grandparents somebody will tell you the skin absorbs UV rays. Now, one of the thing which parents will always tell you that come on go out early in the morning. In the sun you will get vitamin D, that kind of stuff, right. We all have heard this at least once for sure. What does that mean? Why in the early morning you have to go out and you get vitamin D? From where vitamin D is coming? It is kind of very ambiguous. Is not it? We will talk about it as what does that mean, but definitely remember your skin does absorb UV rays.

So, when we talk about that your skin absorb UV rays, it means for something to absorb and electromagnetic radiation which is light. Of course, here UV rays you need some molecule to absorb it, right. It cannot happen in ether; it cannot happen in an empty space. So, there has to be something on your skin, right. So, this is how I was telling you in the previous week, you have to develop your analytical skill. You have to think rationally. There has to be something one to one correlation in nature, right. So, what will be absorbed? Absorbing thing there has to be something which we will put as you know question mark how and what promotes this UV absorption. We will come later in to this.

How UV is getting absorbed? This is point one. The second thing what we know is for sure it prevents dehydration like you are walking in the sun, it drink water, but it is not that immediately all the water is evaporated from your body. That means, that the barrier this layer does not allow excess water to be lost from its surface, but think of it just for a minute. We will think of it. Your whole body is huge amount of the skin, right. If it allows the passage of water from your body outside without any clear cut mechanism or obstruction, then we will get dehydrated every minute. That does not happen. Why that does not happen?

We will come back to this about the structure of the layer, the epithelial tissue which is forming this layer and how it prevents, it point 2.3 to come back for all the functions. It does helps in preserving the body temperature. So, depending on the season whether you

are in the winter month or whether you are in the summer month, your skin behaves differently. This you must have observed where a skin completely have a different black pattern, how it behaves and we will come back to all these points which is top of my head and kind of you know picking up.

Next point what I wish to highlight here is, it tolerates all sorts of abrasions unless you really damage your skin, tolerates all sorts of abrasion in a sense suppose whom I think will like this or you know like there is an abrasion, there is a frictional force like this, ok, but it does not get damage unless otherwise I really go to a bad surface and you know hit myself. It generally never get damaged. It means this tissue layer prevents all forms of abrasions. These are generally looking at it, looking at your own skin. You can really figure it out. So, now what we will do? We systematically differentiate what all is there that is skin.

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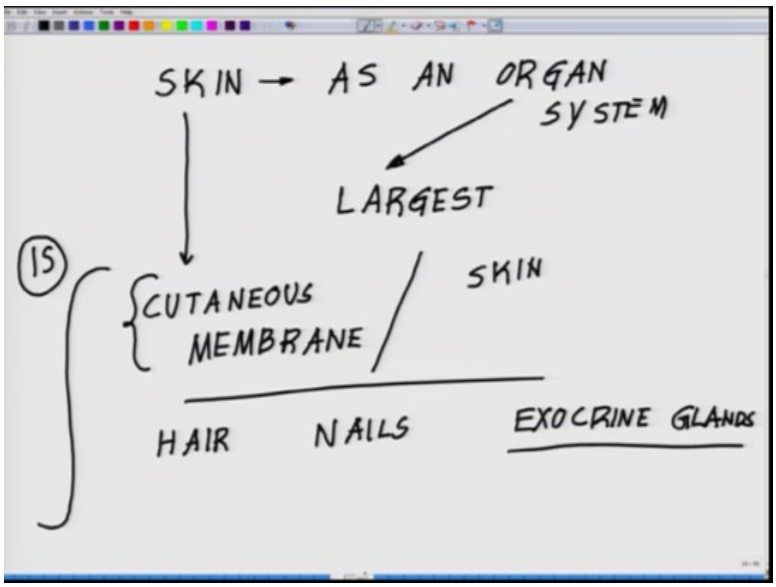

As I was saying the amount of body coverage, it is considered as an organ system and as a matter of fact, this is one of the largest organ system of your body and not only that the skin consists of which is also called a cutaneous membrane and you know there are different kind of companies, where we have used this word to sell products like cuticura powder, body powders and all otherwise you do not see in the market, but these are some of the old stuff which is also called this cutaneous membrane is called the skin.

So, what all putting an integral sign to tell what all makes this integumentary system have the hair, nails and certain exocrine glands. Now, when I see this exocrine gland, this will bring you to think about sweat and perspiration. That happens because of those exocrine glands and we will talk about the structure of those exocrine glands and how they look like. So, coming back, overall the integumentary system I am putting it as is integumentary system consists of skin, hair, nails and exocrine glands. These constitute the whole structure of the integumentary system.

Now, from here what we will do? We will move on to the next slide, where we will just classify them in two parts. So, that will be very easy.

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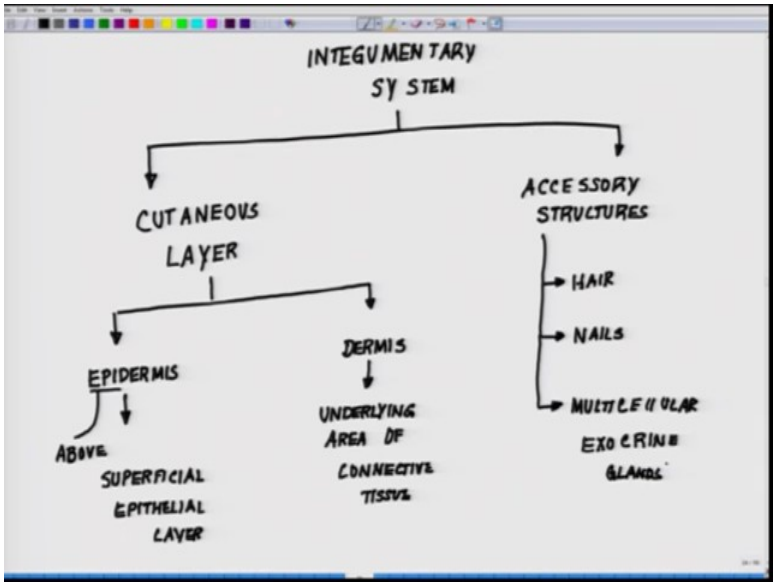

Then, we will go into the structure of each one of them, integumentary system. So, they are classified into two groups. What all I will name? I will just now put a formal classification. One is called the cutaneous layer; the other one is called accessory structures. Now, in the cutaneous layers, you divide it into two parts. One is called the epidermis; the other one is called the dermis. Epidermis is the above ap means above and it is the superficial epithelial layer. We will come to that. What does that mean? Superficial epithelial layer where as dermis which is the underlying area of connective tissue, soon I will just let me enumerate all these accessory structures and I will come to that. You will have hair as I mentioned, you have nails, you have multi-cellular exocrine glands.

So, now we will look at my surface, body surface, the upper layer. What you see this is that upper layer which is your epidermis, ap upper layer just underneath this layer justify just kind of open it is the dermis. These are the nails, the accessory structures, these are the hairs and all those sweat and everything which comes out where you see it is most profoundly. If you forget it that is the exocrine gland that is, these are the five things which you have two kind of you know develop.

We look at your body. This is what constitutes your integumentary system. Now, we will talk about how these layers. So, the next level is the microscopy. So, if I take a section of this, how this will look in microscope because the top you know I have already drawn for you, right. So, this is how the tops look like. So, now we will go on to slight microscopy details to know about it. So, next goal will be to talk about the microscopic image of the skin.

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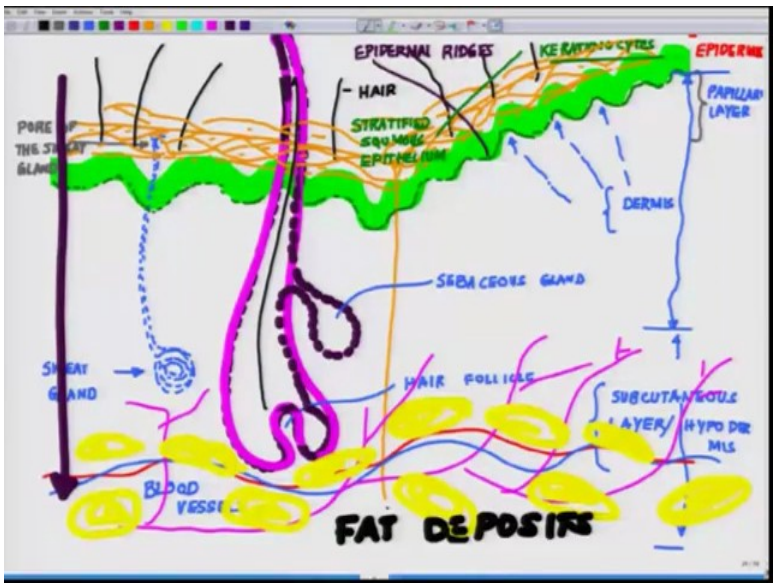

Now, let us draw this. So, this is how the section I will be putting for you. So, this is the top most layer what I am drawing. I am drawing troughs section of the topmost layer.

We will talk in detail about these epithelial cells lining which is covering it up. So, very tightly packed layer of epithelial cells and it is this layer which prevents any form of dehydration, any form of unnecessary water loss and not only that this is this layer which prevent microbial infection to be kept at bay. It does not allow the fungus or microbial to enter your body. This is the topmost layers which extend on top like this and on top of

that what you see are the hairs. These are the hairs. So, this is what you directly see now underlying this layer. If you take a cross-section, you will see something very interesting underneath this layer. You will find something like this; so very rigid thorough kind of a structure.

So, out here if you bit of a microscope, you will see pore like structures which are coming out and these pore like structures are something like this and we will name later. Now, if you follow one on these hairs, it will be something like this. Let me pick up a colour like this is for the hair, this is not of course the colour of the hair, but just for your understanding sake this is how the hair will look like of course, I have picked up a pink colour which is not the color of the hair, but just for your understanding sake what you see is, we will come to that what is that extra invagination which I drew. So, this is how the cross-section will look like.

Now, let me name each one of them which will be very important. So, this is what you see is a regular hair. What you see here now this is the pore of the sweat glands, this is what you see out here is this is how pore of the sweat gland. Now, underneath you see this under leaking layer. So, this layer is divided into two parts. This part what you see is called the. So, before this just let me make a small correction, this part up to here to here that is called the epidermis or the topmost layer all the way, where you see this vagination of structure.

So, up to this where I am now putting the dotted line, this layer is the epidermis, the topmost layer and you see there are rich nipples like protrusion from the next layer. That is called the papillary layer. So, let me put it this is called the papillary layer which is papillary layer and this papillary layer is part of the next layer which is called the dermis layer. So, the dermis layer extends from here all the way, all most up to this. This is the dermis and here you having the papillary layer and followed by the papillary layer, you have the next layer which is the subcutaneous layer or a epidermis. So, the subcutaneous layer or dermis is underneath it all the way which is essentially not part of the screen or bordering the skin layer, subcutaneously layer or epidermis layer.

So, one important thing what I wish to highlight here is, you see the papillary layer, you see the dermis layer and the papillary layer is part of the dermis and this is what you see is the sweat gland. These are the hairs and this is called the sebaceous gland. This is

where you see the hair follicle, this is those nipple like projections of the dermis what you see which helps it to increase the surface area. These are called the epidermal rich ridges, these are called the epidermal ridges and this part what you see are the epithelial layer which is called the stratified squamous epithelium.

We will talk later about this. What these are stratified squamous epithelium? This is a type of a epithelial tissue which is very tightly packed and these cells of a stratified squamous epithelial are called keratinocytes which forms the upper layer of it and these are very tightly packed and underneath here, out here in the subcutaneous layer, you will see a wide range of blood vessels which are traveling this is where you are having the arteries and veins shown in different colours. The veins are shown in green and the arteries are shown in red and out here, you will also see a lot of those nerves ending out here.

So, whenever you must have heard about this, the subcutaneous injections in all these things. So, subcutaneous injection means that the needle which were being used for giving injection has to reach all the way down out here, that is what happens in the subcutaneous injection system. So, you can make this structure way more complex and we will make it little bit more complex later apart from it. Out here you will see something very interesting. This zone out here which I am drawing in yellow, these are the fat deposits.

These fat deposits which are present here are very important to safeguard the blood vessels which are travelling. So, these are the fat deposits or adipose tissue adipocytes which are present there. So, I tried to make this structure simple, so that you know you kind of get it very clear. So, this is where the hair follicles and this is where the hair glows, each one of those hairs which you see in your body. So, this is the overall geometry of the cross section of the skin what you deal with.

Now, what we will do in the next class, we will talk about within this epidermis. There are five different layers, four to five depending on which power of the skin we talk about. Here four to five different layers, we will talk about them. We will talk about the function of each one of those layers and then, we will talk about the dermis and then, we will talk about the special structures like hair and the nails.

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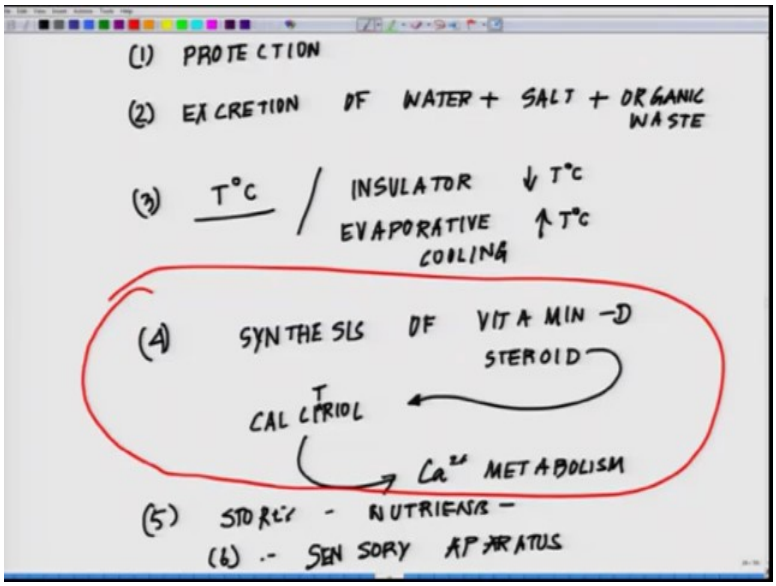

So, let us summarize some of the functions. What are the functions, what skin does if biggest role is for the protection, it is the biggest surface protection of underlying tissues of abrasion and chemical attack.

Second thing that is in the excretion of water in the form of sweat, salt and organic waste in other word, it is integumentary system is also an excretory system. It gets rid of all these unnecessary things from your body. Third, as we have already discussed, it helps in maintaining the temperature dry acting either as insulator during the winter months when the temperature is low. When the temperature is high, this upward arrow means temperature is high. It promotes evaporative cooling which helps to keep the temperature. This is the fourth one, synthesis of vitamin D steroid in nature. Vitamin D is in steroid in nature which is converted into an hormone called calcitriol which has a profound role in calcium metabolism and apart from it, it stores nutrients in the lipids or the adipocytes and last not the least, it acts as a sensory apparatus.

So, talking about this part, we will come later on this is what exactly is happening essentially what happens when you go early in the morning and we get the vitamin d and vitamin d is actually needed. To get this UV in early in the morning, that UV is actually needed for the synthesis of the vitamin D. It procures off as it is already present in the skin. It is produced in the skin.

So, with this we will conclude the first class of the second week, the introduction to the integumentary system.

Tomorrow we will finish it off by talking about the layers of the integumentary system; especially the skin and then, we will talk about basic anatomy of the hair in the next.

Thank you.