

>> It's February 22nd all day 2016. Today our first system, our first impressive organ, the organ is the skin, the system is the integumentary system. And I don't think it's an exaggeration to say that this is your favorite organ. It's mine. What does that mean? When was the last time you cared about your skin? It was probably sometime earlier today when you looked in the mirror. When was the last time you thought about your spleen or spent any time thinking, caring or spending money on your spleen? No. More money is spent on this organ than any other organ combined. We care about the skin because it's what others see of us. It's an impressive organ so largest organ in the human body by weight and by surface area. That white board over there is about 20 square feet and that's about the size of your hide, H-I-D-E, if we were to strip it off your skin, about 18 to 20 square feet. It can weigh anywhere from 6 to 10 or even more pounds. They can be very thick. Where is it the thickest? You know, palms of hands and soles of feet. It's very thin on your eyelids, I think you'd agree. Thinnest location is actually the eardrum which is a very thin piece of skin stretched over the bones of your inner ear. There are three layers of the skin, three dissectible layers and the layer that we see is superficial most and most of this is that its complete name is epidermis. Epi means upon, dermis a Latin or Greek term for skin. In fact you know this, what's the medical specialty devoted to diseases of the skin? Dermatology so epidermis as a word simply means that skin which is upon the dermis. At least at the surface it begins as stratified squamous epithelium, but as you move down through the five layers of the epidermis, it basically becomes cuboidal, cuboidal epithelium. The entire epidermis in most locations is no thicker than seven sheets of notebook paper but again it can be very thin up to a quarter of an inch thick on the palms or the soles of the feet. So let's talk about the layers of the epidermis, all of which are avascular. So that means if you cut yourself and you get blood, you know you've gone below at the epidermis because the entire epidermis is avascular and has very few nerve endings. They can be very thick or very thin in the examples that we just gave. The layers that we're going to now encounter from superficial to deep are called strata, S-T-R-A-T-A. Strata means a layer. And the first which we see and care about is the stratum corneum. The word corneum means horny, not in the way that you might be thinking, but horny as with the horns of an animal because it is very tough. It's maybe 27 cell rows deep especially in the palms and soles. It's completely dead. These cells are dead. They're totally dehydrated and they're filled with a protein called keratin which is a tough, waterproof protein which makes this layer very impervious and indeed that's the function of the stratum corneum, to protect against abrasion, to protect against trauma and therefore that explains why it's so thick where? Where is this the thickest? Palms and soles of your feet which of course you walk on or otherwise use to manipulate objects. It's constantly shed. In fact, 75% of the house dust in your house is not from the outside but the people and pets that are living in there. It's stratified squamous epithelium. So later as you walk through your house, you're raining off the cells, perhaps you know it by a term exfoliation, to exfoliate, something that happens all the times. And these cells drop to the carpet where dust mites enjoy a nice little meal. So, the stratum corneum is certainly important as a seal, S-E-A-L. Deep to that is the stratum lucidum. The word lucid means clear because under the microscope at least, this layer is kind of translucent, transparent and so these are clear, not yet fully keratinized epithelial cells. This layer is only found in what? The palms and the soles and the lips.

[Inaudible Remark]

Lucidum? Yeah, L-U-C-I-D-U-M. Lucid means to be clear. Perhaps you use that word. You say, "He's being very lucid," meaning clear in his speech. Nevertheless, this layer is not that thick, maybe six or seven rows deep. Deep to that, stratum granulosum. It's called that because, again under the microscope, these cells which are now more cuboidal are basically granular in appearance, that is they have speckles in them. No, they're not really speckles, they're basically the nuclei which are disintegrating. What does it mean to disintegrate? To break up, so the nuclei of these cells is breaking up and so it's fair to say that this is the layer where the cells are actually dying and they're totally dead from this layer up. Deep to the stratum granulosum, another shallow or thin layer called the spinosum, full name what? Stratum spinosum. These cells are very polygonal, that means they have sharp corners like pieces of a jigsaw puzzle, they fit very tightly. And the assumption here is that this tends to create a tight fit, F-I-T, so that this layer is fairly strong and doesn't just come apart easily. Actually, the cells in this layer are further reinforced by protein filaments which actually span between cells of the stratum spinosum. Now you could argue that the most important layer of the epidermis is the deepest one, number five, it's called the stratum germinativum. What's the idea of that word? To germinate, to germinate. If you put a seed in soil, it will germinate. So, the idea here is that these cells are dividing and indeed replacing these cells which are flying off of the surface. So this is the deepest layer. It's also sometimes called the stratum basale but I like germinativum because at least it tells you that this is where all of the cells that are superficial to this are originally formed. So this is an actively dividing multiple zone, multiple layer, of basically stratified cuboidal

epithelium. Now down here, we also have some cells that never move up, that remain always in this layer. And their function is quite different from those that will move up and these cells go by the name of melanocytes. As you know, the suffix cyte means cell so apparently these are cells that produce and distribute a pigment, a protein pigment called melanin. Now, what color is melanin? Nobody knows? It's black or brown, black or brown. And so obviously, melanocytes are responsible for skin color. Do we all have melanocytes? Well, everybody in this room, because I checked it out, and there are no albinos in here. But do all of us have the same number of melanocytes? Do all of us produce the same amount of this pigment? No. So, naturally skin color varies from light to dark based upon the distribution and the synthesis of this protein pigment called what? Melanin. Here's a look at the epidermis, and just to repeat a bit, these cells at the surface are quite flaky. That layer was called the stratum corneum. And remember those cells fall off all the time and populate your house where you have living in your carpet these dust mites which you might not know but you have to get down and really look for them but they are there, they are loving it, they're loving those epithelial cells. Stratum corneum, deep to that the clear area called the stratum lucidum, deep to that, granulosum, then spinosum and finally the deepest, so called stratum germinativum. There's a mnemonic that a student actually invented. A mnemonic is a nonsensical saying. And she said, I use this, germinate spiny granules of clear corn. Now that might be silly but what's the use-- what's the advantage of that mnemonic. The deepest layer is germinativum. Above that? Spinosum. Above that? Granulosum and so on. Actually, it takes about 27 days to move from the deepest to the most superficial so if you don't like your skin, wait how long?

>> A month.

>> Wait a month, it's brand new. Some people can't wait, some people can't wait so they pay to have what? [Inaudible] surgery. They pay to have acid washes and dermal abrasion, this is called exfoliation. None of you are watching QVC because that's basically what QVC is all about, you know, exfoliating skin, I'm joking. But anyway, these then are the layers of the what? Epidermis. And cells that don't move up, cells that remain in the stratum basale, those that produce melanin are called what? Melanocytes, responsible for not only skin color but also hair color. These then are melanocytes. Are they found in all of us with equal distribution? Where do you not have melanocytes in your skin? You know this, take a look at you palms, take a look at the soles of your feet. You don't have pigment there. And that goes to the function. Yes, this is brown but why does a brown pigment serve any function? What is the value of pigmentation? Protects from ultraviolet light. It absorbs UV radiation. Therefore it prevents damage to the skin below, it absorbs ultraviolet light. Sometimes, these cells are victims of the very light that they absorb and so isn't there a condition that many people suffer from especially those who pay money to expose their skin to ultraviolet light? Now, I know this sounds preposterous but there are places in town where you actually shell out huge coins of money to sit under ultraviolet light so that your skin can be prematurely aged. Now, so I don't quite get that but it is a popular thing. Now, here's a group photo. Which person in this crowd apparently doesn't have any melanocytes? Aha! Now, is this person at an advantage or a disadvantage?

>> Disadvantage.

>> Disadvantage. And so, he, she is obviously going to have trouble perhaps with skin cancer or at least be very sensitive to sun. Speaking of that, here's two people, both exactly the same age. Which one you think spent most of his time outdoors? And which one hardly ever sell the day? That one. So, if you want to be prematurely aged, here is what you do. You smoke cigarettes and you spend a lot of time outside so very interesting. And here's a fascinating photo. This is a truck driver who drove a truck for 30 years. Do we have some evidence there?

>> Wow!

>> Is that by night and day? Because what side is severely wrinkled and damaged is left side and that faced the incoming sun if you're driving a truck. All right. So, some people don't believe me. They say, "Oh no, that won't happen to me." There you go. So, sun damage is a serious problem which leads to premature aging and skin cancer. And why skin cancer on the rise in our society because we have people who worship at the sun and actually pay money for it to be exposed. Here's someone that went on the deep end. This is another wise Caucasian person. This is before she decided to go off the deep end and in fact she got a lot of attention on YouTube and so forth. So, a little bit overdosed on the ultraviolet light. She really got into trouble because you can do this to yourself if you want but she also dragged her 14-- 15-year-old daughter in which is something of course that shouldn't be done. But anyway, people do that. Here's an

interesting case. This is the world's oldest person up to recently. She died a number of years ago but she lived to-- you can see the fine print, 100 and what? 122 years. She looks pretty good. That's really not a very flattering photo but I love the story. She-- Born and raised in France. On her 90th birthday, she decided to sell her flat, her apartment, to somebody for full cash value provided they wait until she die to actually occupy it. Now she's what? 90. And she lives what? 22-- 32 years longer. And the guy that bought it died before then. So, she really scored on that, interesting. Here's a product that you can consider. It's called sunblock 2000 which of course is a cartoon but you should wear sunscreen naturally and I actually tried it. I went to the beach. I didn't bring along a sunblock 2000 but I found this to be very effective. It limits your mobility a bit but it does block ultraviolet lights. So wear hats, wear sunscreen or otherwise, you know, pay the price. In fact, these slides are not very good because the light in this room is too light basically but these are identical twins and this person, this twin, same age was a smoker and here, this person spent a lot of time outdoors and not so much. So, two things can age your skin, ultraviolet light and the contents of cigarettes. So, if you see anyone that looks older than their age would suggest, it's because of those facts. Now, let's go down to the second layer. How many layers that we say there were? So this is the second layer. It is the true skin and so its name is just that, dermis. Dermis means skin. The dermis is not epithelium because it's not in contact with the outside, the epidermis lies on top. So it's a thick layer of connective tissue, mostly dense irregular connective tissue. It contains a lot of important elements, receptors, that is receptors for touch and pain and temperature. Also contains hair follicles and two very important exocrine glands, sweat glands and sebaceous glands which we'll discuss. This layer, the dermis, has two layers of its own. And the superficial layer, which is right up against the epidermis, is called the papillary layer. The word papilla means like a nipple and so this is very reminiscent to an egg crate mattress, ever seen an egg crate mattress? So, a lot of ridges and valleys and these are called dermal papilla. This then is the most superficial layer of the dermis right up against the stratum germinativum. It's basically made of areolar tissue as you can read. It's the first layer that has blood vessels. So if you cut yourself and you get blood, you know you've gone down to at least, what? The papillary layer. Do mosquitoes get blood from you? Obviously, they have to drill through what layer? Epidermis. That's why you never get mosquito bites in your palm because it's way too much trouble for them, way too thick, so they go down into the papillary layer and here's a mosquito doing just that. Aside from that, this layer is very convoluted, that is ridges and valleys, ridges and valleys, and this convolution or wavy pattern is transmitted to the surface because remember the epidermis is on top of this layer. So if this layer is wavy so then is what we see at the surface. And this creates something very unique and especially important in the fingers, palms and on the soles, these are called friction ridges. Of course you probably know this by another name, friction ridges are finger prints and you might that that's just for forensic science or for criminal investigation but actually friction ridges are just that. They are ridges which provide what? Friction, so that we have better manipulation, better grasping of things which are otherwise slippery. So friction ridges are found on the fingertips and of course throughout the palm and soles. Friction ridges, this of course give us opportunity to identify people because you probably know that no two people on this planet have the same what, fingerprints, even if they are identical twins, always different. Now deep to this is the thickest layer of the dermis which is called the reticular layer. The word reticular we've used before means net like, N-E-T. That's because this is made up of, as you know, dense irregular connective tissue. This is the thickest layer of the dermis. It's the thickest layer of the skin. It's the strongest layer of the skin. And do we as a society use layer for practical purposes? What's this that I'm holding up? It looks like a piece of leather and it is and it's made from the dermis, what, the reticular layer of a cow's dermis. Is this flexible? Yeah. Is it strong? Yeah. Is it durable? Yeah. So this is obviously the most important barrier to invasion, by that I mean microscopic invasion, and also physical assault or trauma, that is it provides a pretty tough barrier but it's no match for bullets and it's no match for sharp knives I'm afraid. The reticular layer provides strength and flexibility. What's the protein down here which you know makes up this dense irregular connective tissue? Collagen. Collagen is flexible but yet not, E word, not elastic. There's also elastin down here so does the skin have strength and durability? Yes. Does it also have elasticity? Yes. What do you think happens to the production of collagen and the production of elastin with time, with age, with exposure to ultraviolet light and cigarette smoke? What happens to your skin? Does it become more or less thick? Does it become more or less strong? Does it become more or less elastic? Less across the board. So, I hate to do this, but I can take my skin off the dorsum of my hand and pinch it up like that and let it go and it rather pathetically resume shape. But yours, do it, grab it, let go, bam! It's down there in a microsecond isn't it? So that's because you're all young people for the most part. So, I wish I was back there. I used to be able to do this and say, "Mine is just like yours," but that was four years ago. Interesting, do people get collagen injections? Yes. Does that improve the appearance of the skin? Yes. Permanently? No. So you better have a good plan, that is a good insurance plan. This probably doesn't look like anything but this is collagen. Collagen is a tough, strong protein that gives the dermis its strength and durability. And as we said, what happens to the amount of collagen and the amount of elastin over time? And the cells that produce this are the fibroblasts which become less active with age. This

is collagen later in life, it's become crosslinked and much less numerous. So, is the skin of an elderly person thinner? Yes. Is it more fragile? Yes. Is it less elastic? Yes. All of these things are wonderful things to look forward to. And again if you want to hasten the appearance of your skin, that is if you want to get prematurely aged then spend some time outdoors. Here is a 40 what? 40-year-old and looks like she's had, well, shall we say a lot of sun exposure. You say, "Well, I've been to the store and I've seen this, it's Swiss formula collagen and elastin and it's actually invented by an R.N." so that's cool but this comes from animals, elastin and collagen. If you rub this on you skin, is it going to make it down to this reticula layer? No. If you think so, go ahead, give it a try. Someone is going to be happy that you bought the product but not a big deal. Now, collagen injections, different story. This is a person who had collagen injections and it does tend to smooth out the wrinkles at least on a temporary basis. The reticula layer, does this move up? Traces are yes or no? No. So if we put anything in the reticular layer, will it move up, will it be cast out or otherwise found its way out? No. What's the most popular thing we put down there? Tattoos, ink, and this is really, really popular. Never mind tanning booth. I mean, it's like, whoa, another tattoo place, OK, great. And, you know, I think that's great, you know, have fun, it's your skin. This person decided to go full monty and, you know, essentially do everything. My only advice here is that you-- this is permanent. So, when you have tattoos, be sure you get spell check on this. This says, "I'm awesome." which I don't quite get in the first place but that's not how you spell awesome. And this says sweat pea which have to do with urine that's got glucose in it. I don't quite get that either. So, in the words of Jimmy Buffett, and some of you don't know what I'm talking about, but he says, "Tattoos are a permanent reminder of a temporary feeling." So anyway, have fun. Now what's below the dermis? We said there are three layers. This is the hypodermis and technically this is not the skin because by definition it's below the skin but it is often considered part of the skin. In fact, it's sometimes called the subcutaneous layer for exactly that reason. This layer can be very thin or can be very, very, very thick and why is that? Well, this where you have the areolar tissue which you saw when you did the dissection of your rats. But they're also is a storage site for lots of adipose which can be as thin as almost nothing to 12, 14, 15, 16 inches. I know you probably browsed through channels and you came to that program, My 600-pound Life, don't say you haven't.

>>Yeah.

>> I think you should go right through that because it is not very pleasant but can this layer be thick? Needless to say. And this person is not quite 600 but nevertheless has a lot of adipose. Where is this adipose? It's in the subcutaneous layer. Not quite to his credit, he decided to stop eating and so he has lost his adipose but what's the status of his skin? Did that shrink back? No. So now he's got a problem with just too much skin so he's going to be a donor to a skin bank and they're going to cut it out, throw it in the dumpster or whatever. So, naturally, this is just a reflection of the ability of this area to store adipose, but with that said, let's be clear. What's the purpose of adipose here or anywhere?

[Inaudible Remark]

Well, yes, it stores fat but that begs a question, what's the purpose of storing fat?

>> Energy.

>> All right, potential energy. Very often students will say, well, it's for padding. No. If you need padding, carry a pillow around, it's just as effective. Actually, it's what? Storage of energy. And which gender has more adipose subcutaneously? Females, why is that? Which gender gets pregnant, stays pregnant, gives birth? Well, all right, it's an energy source for getting pregnant, staying pregnant and providing nutrients to the offspring. Now, anything else, not padding, anything else that fat does? Insulation, thermal insulation. It prevents heat loss. So if someone is in the wilderness, a cold environment, more adipose, less adipose? What's the apparent advantage? Who would survive better in the cold outback? People with more adipose for two reasons. One, they have more calories, second of all, they have thermal insulation. So, not to diminish this, this is a great layer, but you might want to take it easy on the adipose here. Now moving out of the skin and talking now about what we call skin accessories which sound like an isle in maces or something but these are parts of the skin which provide quite distinct functions. All of these that we're about to list are situated in the dermis but actually made from the epidermis. That might be hard to understand but let's say this piece of paper is the epidermis. If we put the epidermis like this, would it dive down deep into the dermis? Would it be in the dermis? Yes, but it's actually still part of the epidermis, so all of these are epidermal origins. Certainly, a fascinating and interesting accessory are your nails and by that I mean fingernails and toenails. These are basically squamous

epithelium that's very keratinized, becoming very hard, very tough so these are keratinized plates of flat epidermal cells. Your fingernails grow maybe a millimeter a day, toenails grow quite a bit slower than that. What's the function of these nails? They help you grasp things, help you manipulate things and also give you better dexterity and a certain degree of physical protection of your fingertips anyway. Ironically, some people totally defeat all of those functions. Oh, what's that mean? Well, women especially, OK. Never mind tanning booth, never mind tattoo places. What is the next most common thing that we throw tons of money on?

>>Nails.

>>Nails. And so we got to put plastic things on there, we got to paint the Mona Lisa on there, we got to put lots of bling and so on. It's great but does that help or get in the way of grasping? I don't know, a little bit difficult. Here's a person that had quite a bit a notoriety. She was of her time the world record holder, she had the longest fingernails. Her thumbnail was 48 inches long. She was on a lot of talk shows and of course YouTube and probably made a decent income but here's the sad story. She was riding in her car, don't ask me how she got a driver's license but all right, she's driving her car and she gets into an automobile accident and of course she gets ejected because she couldn't wear a seatbelt. So anyway she gets ejected. She's OK but sadly her nails got completely destroyed. So after, you know, six or eight years of doing this, she had to start from scratch. So, anyway, interesting case in point. So, nails. Now, a nail then is pretty much like a piece of cardboard but it's made of cells, it's made of keratinized squamous epithelial cells. What if we could take a nail, a fingernail, and fold it or roll it into a tube, would that still be flat epithelial cells? Yeah. But now instead of a nail, what you have is hair. Hair is basically the same thing as a nail except that it's rolled up into a tube and as such is a hair, keratinized. Hair of course will be pigmented perhaps. And what's the pigment that gives skin color? K word. Keratin. So, if you have keratin, your hair is going to be what? What color? Brown. If you have less keratin then it's going to be less brown. And if you have no keratin then it's going to be white, OK. And of course we have all sorts of purples and greens now but basically hair color is a function of that pigment. What's the pigment? The pigment is keratin, made by? No, I'm sorry, not keratin, sorry, melanin. I'm sorry. Melanin gives skin its color, gives hair its color. So, OK, hair is just that keratinized tubes that are pigmented with melanin and that pigmented cortex, cortex is the outer part, is what determines hair color which varies of course from black to brown to blonde or even white. So this is a section through the hair, magnified, and you can see it is just as I said, it's a tube, T-U-B-E, and the surface is called the cortex and that's where we find the pigment which is melanin, at least if it's there. Now hair grows from a bag, B-A-G, which is invaginated into the dermis. The name of that pouch or bag is a follicle which is made of epithelium and obviously the hair is growing constantly as you know. At the base of the hair follicle, there's a sensory nerve and every hair follicle also has a piece of smooth muscle seen here called the arrector pili. Not skeletal muscle, what? Smooth muscle which reacts to temperature especially cold temperature. And so when this muscle contracts, the hair follicle is pulled upward and the hair then sticks out more than it otherwise would. When have you noticed that happening, when your hairs tend to stand up? Of course, when you're chilled or when you're scared and so this is a curiosity. It has no function for Homo sapiens, you or I, but it does help other animals look more menacing and they're also tends to trap more air so it's a better insulator for some animals. You ever seen a cat do that? Have the hair stand up? Definitely more threatening, I'm going to get back even though it's just hair. Where do you find hair? Tempting to say everywhere but no. You don't find them in the palms of your hand or the soles of-- if you've got hair there, I want to see that one, get in on YouTube right now. No hair here, also not on your lips. You might say, what about a mustache. Well, what about a mustache, that's not on your lip, that's the hair above your lip. So, where is most of your hair, the highest density, except in me? Right here, that is scalp, very high density. And with all that said, what's the function of hair? Here it is, thermal what? Insulation. It prevents or minimizes heat loss and it does that for all mammals. Are we mammals?

>> Yeah.

>> Are apes mammals?

>> Yeah.

>> All right, so you get the picture. I asked this question on an exam once and I always throw it out because it's so funny. I said, what's the function of hair? And the student said, "It protects your brain from ultraviolet light." I thought, whoa, that's why I'm demented. Apparently, light is going through my skull and affecting my brain. Well, let's be clear, it doesn't protect your brain from ultraviolet light. What does it do? It provides thermal insulation and it does protect

your skin from ultraviolet light but if your brain needs protection from hair, you've got a very thin skull. Moving on, two types of glands are deep within the dermis. And I want to make it clear, these are totally different but they're both exocrine. What does that mean? Exocrine, they secrete to the outside by way of ducts, D-U-C-T-S so they're made of epithelia, mostly cuboidal epithelium. The first are known to perhaps as oil glands but their correct name is sebaceous glands because they produce an oil called sebum. Sebum is liquid down in the skin but as this comes out to the surface, is the surface cooler or warmer than deep in the dermis? We're divided. So, deep down, warmer or cooler than the surface? It's warmer. So as this oil comes to the surface, it cools off and becomes a waxy coat, a waxy coat, which coats the stratum corneum, also the hair. These sebaceous glands are actually part of and secrete into the hair follicle. They produce an oily compound especially in response to sex hormones and what? Stress. Now, when do your sex hormones hit the fan and when is stress a big part of life? Well, I'm talking about adolescence, right? So, what, do sweat gland-- excuse me, what are these? Sebaceous glands and they become really active in adolescence. So now all the sebum is pouring into the hair follicle and a lot of cells, cuboidal cells, are coming off at the same time. So this creates a plug, P-L-U-G and bacteria get in there and they enjoy that. So the next effect, the overall result is something called acne, right, which is basically an infection of the hair follicle which is aggravated by what? Aggravated, meaning promoted by or at least made worse, by sex hormones and stress. So the function of sebum however is not acne. The function is to coat and seal the skin providing a chemical barrier to toxic or noxious agents. Not only does it coat the skin, it coats the hair. So if your sebaceous glands are overactive, how would you describe your hair? Oily, greasy. And if your sebaceous glands are underactive, how would you describe your hair? All right, and what's chapped lip? What's dry skin? It's all a matter of inadequate what? Sebaceous gland activity, which is somewhat ironic because people take a shower of course, we all do, and they scrub off all the sebum and they get out and they say, "Man, my skin is really dry." So, they slather on sebum from some other animal, that is-- and so, basically you washed it away then you put it back on so you can't win. Sebaceous glands. Now, these are attached to and part of the hair follicle. Quite separate and have nothing to do with sebaceous glands or sweat glands. These are also called sudoriferous glands. And before we get there, where do you find sebaceous glands? We just said. Attached to hair what?

>> Follicles.

>> Follicles. So where would you expect to find most sebaceous glands? Where ever you find a lot of hair and conversely. Interestingly, you don't find hair where?

>> Palm.

>> In your palms but you also have sebaceous glands there and also on your lips where you don't have hair so there are some exceptions. But OK, let's move on to sweat glands. Sweat glands obviously produce sweat. It's a no brainer. These are coiled epithelial tubes separate from and not related to sebaceous glands. They produce sweat which is not oil at all but mostly what? Water. Now, it does contain some NaCl which is salt but it's mostly water. It does contain some metabolic waste but it's mostly what?

>> Water.

>> So what's the purpose of secreting water on to the surface of your skin? You've all gotten out of a shower and you have water all on your skin, right? Does that water evaporate? Do you feel cold or warm as a result? So, when water evaporates from your skin, it takes heat. So, sweating is not designed to heat you up, it's designed to cool you down and it does that of course in response to hot temperatures. So not surprisingly, it responds to warm climates but it also, that is these glands are also sensitive to psychological factors. Do you sweat more when you're nervous? And incidentally, that testifies to where sweat glands are. That is are they everywhere? Well, maybe so but where are they especially abundant based on your experience? Where are sweat glands most abundant? Don't say armpit. Axilla and this area above your eyes we can call that the forehead, OK great. But do you have sweat glands in your palms?

>> No.

>> You do. In fact, it's practically a catch phrase, isn't it? Sweaty palms which is associated with some degree of nervousness. And have you ever noticed that when you're nervous, your socks get wet? You never notice that? OK. Again, sweat glands secreting on the dorsum of-- I should say, on the plantar surface of your feet. So the function of

sweat glands is quite different from sebaceous glands. They are designed for evaporative heat loss. They respond to temperature, that is increased temperature and psychological factors. All right, we're on the home stretch. Get five or six items here. Question?

>> I have a question. In regards to sweat, why does it sometimes have like some people have morbid odor when they sweat and [inaudible]?

>> Good question. And you'll find that in your book. Not to divert or not to make little of your question but let's be clear. Most sweat is what? Just here, water, NaCl, and some metabolic waste. What makes sweat stink is not sweat but the bacteria that get growing in there because they love it. So naturally we raise our arms and we slather on antibiotics. Yeah, that's what we call a deodorant. It's not really deodorant, it's killing the bacteria and therefore you don't have to, you know, be worried about offending somebody. And again, huge, you know, aisles and aisles of deodorants and antiperspirants, it just amazes me. Oh, wow? That's \$10, that's \$2. That must be better. Anyway. All right, sorry. Thermoregulation which means controlling body temperature. Is the skin involved in that? Big time. Exactly how? Well, first of all, we have sweat glands which we've already talked about. But we also have blood vessels in your skin, in the dermis of your skin or in the papillary layer of your dermis. And these blood vessels can assume various status, that is they can be dilated like that or they can be constricted like that. When a vessel is constricted like that, does it allow more or less blood through? And does blood contain heat? So if the vessels are constricted, that's going to bring less heat to the surface therefore you're going to conserve heat. Vasoconstriction then tends to conserve heat. When you want to liberate heat, what happens to these vessels? They get wide, that's called vasodilation. That makes your skin pink if you're a light skinned individual but it also makes it warm. So vasodilation and vasoconstriction definitely control or help regulate body temperature. And then there is sweat glands but let's be clear. Do sweat glands warm you up or cool you down? Cool you down. And they can only do that if the water evaporates. So, if you're sweating in the-- I don't know, in the New Orleans marathon. The humidity there is already 95. Is that sweat going to evaporate when you're in a humid like? So you just don't feel comfortable because you can't get cool. You're sweating like a pig but-- and I guess pig sweat but anyway it doesn't work if the environment is humid. Absorption. Does skin serve to absorb? Yes, but not so much. In other words, it's not really designed for that. Absorption is limited because the surface is very waxy, thanks to sebum and also the stratum corneum which is made of this protein called keratin. So on balance, is the skin a good absorber of stuff? No, not at all. So limited, very limited absorption and here only a small percentage of some gases and also some drugs, some fat soluble drugs. Perhaps you know that there are patches you put on your skin like scopolamine for motion sickness. So, can medications be put on the skin and reach or otherwise get into blood vessels? Yes. So, this is exploited with nicotine patches and testosterone patches and so forth. Number three, in no particular order, hydroregulation which means just that, regulation of water. On balance. Do we suffer from or worry about dehydration or overhydration? Dehydration. So, this guards against water loss but also water gain. And specifically once again, it's the sebum and the keratin which provide for that function. So, an opportunity to remind you, never memorize a sentence if it means nothing to you and if you can't explain what that means and how it's actually brought about. Protection, and that's everybody's favorite, and does the skin protect? Yeah, but what? Protects against dust? No, I don't think so. So, let's be very explicit. Skin has two mechanisms to provide protection. It has a chemical element which is sebum, keratin and melanin. Be sure you know the difference between those. Sebum comes from sebaceous glands. Keratin manufactured by cells of epidermis and melanin of course manufactured by melanocytes. Then we have physical aspects of protection because, is the skin fairly thick? In fact, what is the thickest layer of the stratum corneum? Thickest layer of the stratum corneum is right here at the top which provides a barrier to abrasion and injury. And indeed, if you play guitar or a string instrument, what happens to your fingertips? They get calloused which means a buildup of what layer? The stratum corneum which provides more, P word? Protection. Protection against abrasion. So, protection, protection against abrasion, protection against friction, protection against UV which stands for ultraviolet light. And also what? Chemicals that you might spill on your skin, certainly bacteria. With all this said, if you damage your skin, and for that matter, what is the most common, dangerous cause for serious injury to the skin? Well, cuts maybe but much more serious is a burn, B-U-R-N. Now, I'm not talking of sunburns, I'm talking about third-degree burns which basically charge your skin right down to the hypodermis. Is this going to kill you? Yes. If you have sufficient third-degree burns, nobody can do anything for you except make you comfortable in the last hours. What's the cause of death with massive third-degree burns? You're going to have issues with what? Infection, number one, then dehydration, and then of course all sorts of other complications. So, physical protection is pretty important. The skin is an organ of reception. Everything we feel, from the human touch to temperature sensations and so forth, is really a function of sensory nerves. Do you respond to cold? Do you respond to heat? Do you respond to pressure? So all of

these are receptors found in the dermis. So, it enables the reception of temperature, touch, pressure, and even pain. Finally, I guess, number six, the synthesis of what?

>> Vitamin D.

>> Vitamin D. The skin is the only organ that can do this. And it does this only upon exposure to what?

>> Sun.

>> Sun. So those are irony. You know what I mean? Is sun a good thing?

>> Yes.

>> But is it a bad thing?

>> Yeah.

>> All right. So, you don't have to say, "Well, I'm going to go to the tanning booth so I can get my vitamin D." You can get that on your way out to the parking lot and it's free. So, synthesis of vitamin D. That said, what individuals would suffer most from a lack of vitamin D?

>> Albinos?

>> No. Actually dark skinned individuals because dark skinned individuals have a lot of what?

>> Melanin.

>> Melanin which absorbs and prevents the penetration. So, actually dark skinned individuals have more trouble with vitamin D. But it's really not an issue because do we have food in our food chain that contains vitamin D?

>> Milk.

>> Milk. It didn't get there accidentally. It's the government so you can go home and write a letter of thanks to the FDA. Thank you for putting vitamin D in my milk. All right. Well, sorry about my throat, real hoarse. Hope you picked up some information there. We'll see you next time.

[Inaudible Discussions]

Because I frankly didn't have time to print out a new one.

>> OK. Some OK then? All right.

>> OK.

>> All right [inaudible].

>> I'll try to get to it tomorrow.

[Inaudible Discussions]