Ask A Biologist Vol 056 (Guest: Nina Jablonski)

Skin

In celebration of the launch of the new Ask A Biologist website, Dr. Biology sits down with biologist Nina Jablonski to talk about our skin - the largest organ of our body. Learn some fun facts like - did you know you are not wearing the same skin from last year?

Transcript

Dr. Biology: This is Ask A Biologist, a program about the living world, and I'm Dr. Biology. For those of you that visit our companion website, you'll notice that we've made some dramatic changes recently. With a new grant funded by the National Science Foundation and the National Science Digital Library, NSDL, we've moved from our site of more than 12 years to a new home, new features, and a new look. You might say we have a brand new skin, which is perfect for today's show, because we'll be talking about our largest organ.

We expose it, cover it, paint it, tattoo it, scar it, and pierce it. As our intimate connection with the world, skin protects us while advertising our health, our identity, and our individuality.

I borrowed this description from the inside cover jacket of the book "Skin: A Natural History" written by my guest scientist today, anthropologist and paleobiologist, Nina Jablonski, who I know can let us in on the many amazing facts and functions of our largest organ. Welcome. Nina. It's wonderful to have you on Ask A Biologist.

Nina Jablonski: I'm really happy to be here, Dr. Biology.

Dr. Biology: I thought before we got started, because it does so many things, the best thing we could do is to have you read from your first chapter of the book, because I think it tells the amazing story of skin in these first few paragraphs.

Nina: I'd be very happy to do that.

It isn't good to take for granted something as important as skin. Take a moment and imagine the following scene. You're standing in the moist shadowy heat of an orchard in late afternoon of a summer's day. You are able to stand outside in comfort without overheating thanks to your skin's ability to regulate your body temperature and shield you from ultraviolet radiation. Only a few beads of sweat on your brow and upper lip betray the fact that your skin is working to keep you cool. As you flick away the fly that has tried to settle on your face, you don't give a thought to the way your skin is protecting you from microorganisms on the insect's feet and snout.

You have your eye on a peach, dangling from a branch above your head, and you want to pick it and eat it. As you reach up toward that lovely peach, you're distracted again by the fly and the back of your hand scrapes against the snag of an old branch. Thanks to your skin's fairly tough surface, the scrape isn't a problem. A welt starts to rise in a few minutes, but your skin is unbroken because its outermost layer is quite scuff-resistant. You reach up again and the elastic properties of the skin on your arm and trunk allow you to stretch it effortlessly until on tiptoe you touch the peach. As you grasp the fruit, you squeeze it ever so slightly and register its subtle softness through the exquisitely sensitive pressure sensors in the skin of your fingertips. It is ripe.

As you pull the peach off the tree, the temperature sensors in the skin of your hand let you appreciate its slight warmth. As you lower your arm, the stretched skin of your arm and trunk returns instantly to its resting shape.

You bring the peach to your nose and smell it, and then brush it gently against your cheek, enjoying the feeling of the soft fuzz against your face. Your sensitive facial skin, with its high density of delicate touch sensors, is transmitting information about the texture of the peach to your brain. Just as you prepare to bite into the fruit, an annoying tickle at your ankle disturbs your reverie, and you realize that a mosquito has just bitten you while you were so pleasantly distracted with the smell and feel of the peach.

Dr. Biology: You know, I've had those mosquitoes do that just about that time. In those very few paragraphs, you describe so many things that this wonderful organ is doing. Let's talk about a few of them. Let's start with protection. What's the skin doing to protect us every day?

Nina: The skin protects us from so many different things in our environment. It protects us from harmful parts of sunlight, especially ultraviolet radiation, and it protects us from water. Imagine if you didn't have skin, and skin with the properties that it does, if you went into the bathtub, you would leak. Your insides would go out, and the water would come in. So skin protects you from basically losing your body's integrity or from bloating in the bathtub. It's a remarkable waterproof covering. And yet, it does allow us to absorb some materials from the environment, so it's a very selective kind of protective covering. In addition to protecting us from water, it protects us from all these yucky as well as some useful bugs in the environment. It protects us from a variety of different parasites, from bacteria and viruses. It's the first line of the body's defense against the microbial world. It's incredibly important for that reason. It also protects us from noxious chemicals that may be dissolved in water or that we might come in contact with.

Finally, it protects us from abrasion, from scrapes. Although we do get cut, and if we fall down, our skin can be cut open and become scraped and bruised, it can be tremendously resistant to damage, so that generally knocking about, we don't get hurt at all. It's really an amazingly durable, protective, wonderfully colorful organ.

Dr. Biology: Right, and not only is it protective, and it does a great job with those small scrapes, even if you get a cut that does cause you to bleed a little bit, it repairs itself. I mean how cool is that?

Nina: The skin repairs itself incredibly quickly. Our skin's ability to repair itself through a cascade of really interesting biological reactions that allow us to zip up the problem almost before we know it. Dr. Biology: You were talking a little bit about the sun. We live in a desert here, and we're always talking about the sun and the importance of protecting our skin from the sun because of the possibility of getting cancer. Not necessarily even at a young age, but even later if you've gotten a lot of sun when you were young, you can have a better chance of getting cancer. What you're talking about is that ultraviolet radiation- and a lot of people hear UV, or UVR- what does the skin do to protect us against UVR?

Nina: The skin has a pigment in it called melanin. Some people have more pigment and have more darkly pigmented skin, and some people have less of this melanin pigment and have lightly pigmented skin. Melanin itself is a really interesting molecule because it's a natural sunscreen. Its

chemical structure is such that it scatters scatters and absorbs ultra-violet radiation, and so it does this amazing job when ultra-violet radiation touches the skins surface. It can actually reduce the energy of the ultra-violet radiation, so that it can no longer penetrate the body.

So it's like having a pair of sunglasses built into your skin. It's an amazing compound. So, skin pigment is different depending on the person. And generally people who's ancestors evolved close to the equator, where the sun is most intense, have the highest levels of melanin pigmentation, and the darkest skin. Those people that have ancestors that hail from more northerly, or far southerly latitudes, like northern Europe, perhaps event the tip of South America... Those people have more lightly pigmented skin, and has less sunscreen in it.

So we see this wonderful variation in the amount of natural sunscreen, the amount of pigment, that we find in human skin. And this evolved according to the levels of ultra-violet radiation.

Dr. Biology: Right, adapting to what the surrounding environment is like. So you talking about this pigment, and it really is a pigment -- like you think of paint, or something -- if you go out and paint the walls, it's like a pigment. It's produced in the really cool cells called melanocytes. But even for those of us that are in the northern or southern parts of the world -- if we go out very long, and repeatedly, our skin color will change. Right? We will get more pigment in it, and that's known as a sun-tan. Or, if you stay out too long, on any given day, you might get a sunburn. What's going on? Why does the skin change? Why do we get more pigment in it?

Nina: For most people, when their skin is exposed to ultra-violet radiation, the melanin producing cells will be activated to start producing more melanin. And so, they produce more melanin, the skin eventually becomes darker. This process actually takes a minimum of about forty hours to develop fully, and so we do become darker. But not everybody has this capacity -- there are some very lightly pigmented people, who go out in the sun and their malanocytes cannot be triggered into producing more melanin. They can go out in the sun and all they do is get sunburned, and these people are at great risk of serious sun-damage. And so, your point, Dr. Biology, that everybody gets a sun-tan -- well, it's not quite right. Most people have the ability to develop a sun-tan, but not everybody. And, even if you have the ability to get a sun-tan, it doesn't mean that it's a good thing. Because even if you have melanin pigment in your skin, the ultra-violet radiation is causing damage to you skin.

So there's no such thing as a safe sun-tan. There is always damage that is occurring when melanin is produced.

Dr. Biology: I agree. This is something we watch because we live in the desert, but no matter where you are -- if you get out in the sun on a regular basis -- there is something you can put on your skin. And I would recommend it, of course. It is sun-screen. That's basically a cream, or a lotion that you put on your skin that has a compound in it, that does what these melanocytes would do. And it helps to scatter and reduce the amount of UV that can get in and damage your cells. So you go out and you get these lotions, and these sun-screens -- the sun-screens are actually rated. They have SPF, sun protection factor. And they're rated, you know, anything from 10 up to even 50, you see them. And the larger the number, the more protection they have. But even with those, it's even better to use clothing that would protect you. So, for example, a white tee-shirt has an SPF factor, I think, of two. It's incredibly low, but if you go into some of your

sporting goods stores... For example, I just bought a long-sleeve white shirt, very comfortable -- but it's treated in a way that it actually has an SPF factor of 25.

Even though the skin is really good at protecting us from the harmful rays of the sun, it turns out that we need that sunlight for a very important vitamin, which is vitamin D. Let's talk about the skin, and its role in making vitamin D. More importantly, let's talk about what vitamin D does for us.

Nina: Yeah! Well, what's interesting is that the skin pigment levels in our body are a real compromise between our need to protect ourselves from ultra-violet radiation, and the importance of allowing a little bit of UV in, so that we can make vitamin D in our skin. Now, vitamin D turns out to be incredibly important for a variety of reasons. It's been known for years that vitamin D is important for building strong bones, and so if you don't get enough vitamin D as a kid, you don't make strong bones, and your bones can be very weak, and you can have all sorts of difficulties. So we know that. We also know now, that vitamin D is really important to maintain our immune systems, so that we can fight infections. So vitamin D is important for building our bones, for fighting infections, for keeping our brains healthy. It turns out that brain-cells and other cells of the nervous system require vitamin D, and just about every organ in the body has vitamin D receptors on it and need vitamin D, on some level.

So what we thought was a fairly narrow series of functions, now has been broadened tremendously, and vitamin D turns out to be of phenomenal importance. So we need to make sure that we get enough vitamin D. Now, the big problem, especially those of you living in Arizona -- you're so good about putting on sun-screen, that you often don't realize that you're preventing the formation of vitamin D in your skin. Now, I'm not saying: "Forget your sun-screen." I'm saying, get your vitamin D from somewhere and there are many places where you can get vitamin D in your diet, and the vitamin D that you get in your diet -- let's say from eating some oily fish, or through taking some vitamin D supplements, or by drinking fortified milk... That vitamin D is every bit as good for you as the vitamin D that you make in your skin. So, just make sure that you get your vitamin D one way or another.

Dr. Biology: Right, it's a really good point. If you go to your doctor, they can actually let you know if you are lacking enough vitamin D. Not a bad thing to ask them.

Well, I'd like to go back to what you read earlier in the book. And, let's talk about that peach, because not only is the skin helping us protect ourselves from the environment, it also lets us sense the environment. So let's talk about these sensors in the skin.

Nina: These sensors in the skin are incredibly important to us, because they tell us about the nature of objects we touch. Like the peach, we can feel if it's ripe, or if it's soft, or it has nice fuzz on the surface -- but, think about if we're trying to grab something like a slippery glass, or something on the surface of a table. It can tell us how much pressure we need to put on something so it doesn't slip out of our hand. The skin helped our ancestors who lived in trees to make sure that they didn't lose their grip on slippery branches. And so, that ability to sense the environment, to put enough grip onto something so that we don't slip, and to tell us what that object is all about is extremely important. The other thing that touch is extremely important for in primates, including ourselves, is that it tells us about each other. We touch one another. We communicate using touch all the time, and it's a really important part of our communications

repertoire. We think about humans looking at one another and throwing each-other a glance, or talking and having verbal communication, but we communicate a lot with touch. Just think about getting a hug, or shaking hands, or giving somebody a cuddle. All of these things are very meaningful ways of touch communication. And these turn out to be very, very very important to our fundamental physiological well-being. Because when we're touched in a loving way, our levels of stressed hormones are lower, we secrete more growth hormone, we have less stressful physiologies, we grow faster... Babies that are cuddled more grow at faster rates than babies that aren't cuddled more, so touch is something that not only tells us about our environment, but is fundamental to our biology and to our social interactions. It's incredibly important and it's one of the most important aspects of skin.

Dr. Biology: Does it also help us when we're grabbing something to know how hard to grab it? So, for example, we want to be careful with that peach, because we don't want to crush it. Right?

Nina: Exactly! We get tremendous amounts of feedback through our hands, especially. But also, if we're biting something our lips have a lot of touch sensory feedback. Let's say, if we're trying to grasp that peach with our teeth and lips, we would get a lot of feedback from those areas as well. So, yes, we get this very complex sensory feedback that then is translated into our movements, and the amount of pressure that we exert through our hands or lips.

Dr. Biology: Well, there's an interesting little fact that we have on Ask a Biologist. By the time you're twenty years old, you will have replaced your skin roughly two-hundred times. What seems like the same old skin, is not the same old skin. Along those lines, when we look at our skin -- you might think of it as a single layer, but in fact, it's a lot of layers. And the outermost layer, those cells aren't even alive. Let's talk a little bit about this anatomy of the skin.

Nina: Well, Dr. Biology, you bring out one of the most important points about skin, which is that it manages to do all these host of protective functions, and making vitamin D, and doing all of these things for us, while it's constantly replenishing itself. So this is amazing! It's constantly changing and yet it's able to maintain all of these different functions. The functions are maintained by the fact that it does have so many different layers. And the top-most layer of the skin if fascinating, because it's this layer of dead cells that is almost like -- well, it's not really like plastic-wrap that we put on top of a container -- but it's an inert layer that is highly waxy. It has a lot of protein called keratin in it, that protects from all sorts of damaging things in the environment. And that keratin really forms a barrier against all of the things that I mentioned earlier: moisture, chemicals, bugs of various kinds. It's remarkably good. And the top-most keratin layer is constantly replenished from below. So as the skin-cells -- the flattened dead skin-cells, wear off, new ones rise to the surface to take their place. And the character of the keratin, that forms this resistant layer, is unique to humans. And one of the most interesting things about human naked-skin, is that it has several unique types of keratin that are not present, not found in other animals. That evolved uniquely in ourselves as a result of the evolution of our nakedness.

Dr. Biology: Really, our nakedness? Well, let's talk a little bit about that. We're not really talking about not going out without clothes?

Nina: No, but our skin is mostly hairless. When we compare ourselves to our other primate relatives and other mammalian relatives, the most conspicuous thing about us is that we have a

few tufts of hair on our body, but not nearly as much as most animals do. And so, at one point in our evolution, we lost most of our body hair. And what has happened is that our skin has compensated for the loss of this body hair by evolving some new kinds of protective keratin proteins on the outermost surface, that help to protect us from all of these noxious things in our environment. It's really interesting!

Dr. Biology: What's the most amazing thing about skin to you?

Nina: The most amazing thing about skin to me is that it does so much, in such a small thickness. Because when we think about all of these multiple functions of skin, in just a few millimeters -- just a few tenths of an inch -- we have something that is marvelously protective. That produces vitamin D, that has blood vessels in it that allow us maintain our body temperature, that allows us to sense the environment and each-other around us. It's just amazing! So, I'm just fascinated by the sheer economy of skin that it does so much in such a small space.

Dr. Biology: When I got up this morning I was brushing my teeth and I was looking in the mirror -- and since we're going to be talking about skin -- I had to look at my own skin, and I have to say that there are some wrinkles there that were not there before. Why does our skin have more wrinkles, as we get older?

Nina: As we get older, first of all, we use the muscles on our face to make facial expressions. And this is one of the most wonderful things that we do to communicate with one another. We furrow our brow, we smile, we frown... We do all these things. And as we get older, the repetitive action of these muscles brings about creases in our skin. This occurs at the same time as natural aging in the connective tissues of the skin. So that the skin, itself, becomes naturally a bit damaged in the areas where we get these lines made by facial expressions. And eventually, those little creases become permanent creases, become permanent wrinkles, as our skin goes through the natural process of aging. It's just one of those things that happens. It's part of being a normal primate. One of the things that people get really excited about these days is trying to prevent wrinkles. Now there's only a certain amount that you can do to prevent these things. A lot of people go through great expense to try to prevent wrinkles, but basically you're only delaying an inevitable process.

And look at wrinkles as being a way of showing that you smile and frown and that you think about life. I like to think of wrinkles as, a sort of the reflection of all of the emotions I've experienced during my life, and I'm proud of my wrinkles.

Dr. Biology: Right. It just means that your skin's been working hard.

Nina: Yes!

Dr. Biology: While we're talking about wrinkles, this is a little bit different. It's not quite wrinkles. One of the really popular questions to a biologist is, when you go swimming a long time, or you're in the bathtub for a really long time, and you look at your fingers, in particular the tips, they get that wrinkly kind of prune surface. What's up with that?

Nina: Well, the surface of our skin, especially on the tips of our fingers and toes, has these fingerprints on it. You know when you look at your finger you can see these little fingerprints.

And the skin over those fingerprints has slight, slight indentations. Now, when we get into the bathtub and we sit for a long time, the dead skin cells on the surface of the fingerprints absorb water. A bit like the kitchen sponge absorbs water. It absorbs it just temporarily, but what it does is that the skin cells actually puff up.

Interestingly, the water doesn't go through the skin cells and cause a blister, rather, the skin cells just puff up and may turn into these sort of wrinkly ridges, and you look really funny cause you've got this funny sort of all wrinkly hands and feet that are all puckered up.

And then, when you get out of the bathtub, you can watch as your skin goes back to normal. After about a half an hour, the excess water in your spongy surface skin will evaporate and your skin will go back to normal.

Dr. Biology: Excellent! Now, the next three questions are ones we ask all our guests on 'Ask a Biologist'. And one of them can be a little challenging, for some of our scientist, but they're all fun. So let's begin.

Was there a time, in your life, you remember, that you knew you were going to be a scientist? Was there an "aha" moment?

Nina: It's interesting when did I first know that I wanted to be a scientist? I think, I never didn't know it. I was always interested in the natural world. I couldn't imagine doing anything else. Ever since I was a little kid I enjoyed picking up stones, enjoyed looking at animals and plants. And just observing the natural world was part of my life. Although I toyed with the idea of being a doctor, I quickly realized that, I just wasn't cut out for that kind of work. And that I much more enjoyed just looking at nature and observing nature and thinking about it. So, I guess I never really knew when I was going to be a scientist because I didn't think about anything else. It was just a natural part of my growing up. And I still feel like, I'm a kid.

Dr. Biology: Well, I'm going to take it all away from you.

Nina: [laughs] **Dr. Biology:** This is the challenging question. You can't be a scientist, what would you be or what would you do?

Nina: I like getting people to work together. And I like mediating disputes and dealing with human interactions. At one point in my career I thought I would just trash academics and trash science. I didn't want to pursue it anymore, and I thought I would become a diplomat. That I would enjoy helping people get along with each other. Because I think I'm fairly good at mediating human interactions, getting people to collaborate, see each other's points of view, and try to come to consensus. So I think if I ever did anything else, it would be in that vein.

So, it's not an outlandish question to ask. As much as I love science, I think I could have made a contribution in the arena of human affairs, had I had not been a scientist.

Dr. Biology: Well actually from the world of science, I think you could still have a good calling being the diplomat for scientists. We don't necessarily get our message out the way I think should. So maybe you could blend those two.

Nina: I try to do that. Actually, in my work as a scientist and scholar in a university, I try to blend those diplomatic skills with science. **Dr. Biology:** What advice would you have for someone who wants to be a scientist?

Nina: Be curious. Be diligent. And always go with what you want to do in your heart. Don't let someone discourage you and say "That's not cool. It's not cool to do it." You go ahead if you really want to study something, if you really want to study how mosses work, how monkey's move, how lizards make different colors in their skin, or how anything works in the universe. Just follow that curiosity. Don't be put off. These days, it's really easy for people to get distracted by various things and not follow through. It's important if you have a curiosity about something, to follow through. It will bring such rewards to you, when you begin to unveil new knowledge that you have turned up yourself, it's incredibly exciting. When you begin to tell people about it, it's even more exciting. There's tremendous reinforcement in a life in science.

Dr. Biology: Well in that note, Professor Jablonski, thank you for visiting with us today.

Nina: It's been a great pleasure, Dr. Biology. Thanks so much for having me.

Dr. Biology: Well maybe we'll be able to get you to come back on the show or maybe you could write a short article for Ask A Biologist.

Nina: Yes. Yes, if you ask me very nicely. [laughs]

Dr. Biology: [laughs] Could you please?

Nina: [laughing]

Dr. Biology: You've been listening to Ask A Biologist and my guest has been anthropologist and paleobiologist, Nina Jablonski. She heads up the Department of Anthropology at Pennsylvania State University. She's also the author of the book "Skin: A Natural History."

The Ask A Biologist Podcast is produced in the campus of Arizona State University, and is recorded in the Grassroots Studio, housed in the School of Life Sciences, which is a division of the College of Liberal Arts and Sciences.

And remember, even though our program is not broadcast live, you can still send us your questions about biology using our companion website. The address is askabiologist.asu.edu, or you can just google the words "ask a biologist." I'm Dr. Biology.

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