Briana Pobiner:
All right. Hello everyone, and welcome to today's program. The Evolution of Skin Tones: A Reflection of Human Adaptation and Health. This is part of our ongoing hot topic series. My name is Briana Pobiner and I'm a paleoanthropologist and educator at the Smithsonian's National Museum of Natural History. I'm a dark haired woman, wearing a black shirt, and I'm sitting in front of a Zoom background that has a volcano and an African landscape.

Briana Pobiner:
So whether this is your first time joining us or you've attended before, we're so glad to have you here. And before we get started, I just want to start with a few housekeeping notes. This discussion offers closed captioning. You can turn the closed captions on or off via CC button, which should be located at the bottom of the Zoom interface. As you have questions, please go ahead and submit them to the Q&A box, which is at the top or bottom of your screen. So we can sort through as many as possible. The Q&A really flies by.

Briana Pobiner:
The Q&A box is also where we'll share any relevant links during the program. So keep an eye out there. We'll start with an opening presentation by our speaker, Dr. Nina Jablonski, and then I'll join her here to take your questions. Now, I'd like to go ahead and introduce our speaker. Dr. Nina Jablonski is Evan Pugh University professor of anthropology at the Pennsylvania State University. She studies primate and human evolution in relation to environmental change.

Briana Pobiner:
Trained originally in paleontology and comparative anatomy, she has documented the evolution of numerous lineages of old world monkeys, including the Gelada of Ethiopia and the golden monkeys of China, and described the first fossil chimpanzee. Fascinated increasingly over the years by the important but unheralded roles of skin and skin pigmentation and evolution, she focused her research on the origins of mostly naked human skin and diverse human skin colors.

Briana Pobiner:
In 2000, Jablonski and her collaborator husband, George Chaplin, put forward the dual cline theory or vitamin D-foliate theory for the evolution of human skin pigmentation, that accounts for why dark skin evolved under conditions of high ultraviolet radiation in the tropics while lighter skin was favored under conditions of lower ultraviolet radiation near the poles. She and members of her lab continue to study many aspects of the evolution of the integrant in humans, including the effects of skin pigmentation on human health and psychosocial wellbeing, the evolution of hair and hair texture, and the development of skin color and hair texture as racialized traits in human preoccupations.

Briana Pobiner:
Her work on the history of color based races has identified key events and figures in the European enlightenment as being instrumental in creating misleading and inaccurate classifications of humans that continue to influence human thinking and actions to the present day. Jablonski is also an elected member of the National Academy of Sciences and the American Philosophical Society, an elected fellow of the American Academy of Arts and Sciences, and of the American Association for the Advancement of Science.

Briana Pobiner:
She's written two popular books for adults, Skin: A Natural History in 2006, and Living Color: The Biological and Social Meaning of Skin Color in 2012, as well as a book for children, Skin We are in, in 2018. A dedicated public scientist and science educator, Jablonski received an honorary doctorate from the University of Stellenbosch in South Africa in 2010 for her contribution to the worldwide fight...
against racism. So I'm particularly excited to welcome Nina Jablonski to the screen to give her presentation today. Thank you, Nina.

Nina Jablonski:
Thank you so much, Briana, for that lovely introduction. Welcome everybody. I'm really delighted to be with you today, and we're going to talk about the evolution of skin pigmentation. Here we go. We know that people have thought about and captured skin color for decades, actually centuries. And in the recent past, one of the artists to do this most persuasively is the Brazilian artist, Angélica Dass, who in the last 20 years has compiled these beautiful photographs of individuals from her native Brazil as well as individuals from many other countries, and matched them with pantones skin colors.

Nina Jablonski:
Her goal to show that there is no sharp demarcation between colors, but rather you could order these in a complete gradient from dark to light and light to dark. I'm interested in the same phenomenon. Why does human skin come in this gorgeous array of colors? I'm interested in this from an evolutionary perspective. And so today we're going to talk about why do people have different skin colors? What does skin color have to do with race? And lastly and briefly, how does skin color affect our health? All of these things warrant a whole lecture in itself, but we'll just do a compressed version and we'll see how far we get.

Nina Jablonski:
Now, we evolved under the sun and our ancestors lived under intense sun where ultraviolet radiation was particularly strong year in and year out. It's important to recognize if we look at some of the most important sites where we find ancient members of the human lineage from millions of years ago, and all of our ancient relatives come from Africa, so when we look at the map of Africa here, relative to the equator, you can see where all of those red dots are really quite close to the equator and most of them fall within the tropics.

Nina Jablonski:
So what this means is that our ancestors, including members of our own species, Homo sapiens, the earliest modern people lived under intense sunlight and particularly intense ultraviolet radiation. So, this is a really important primary fact. Now, one of the things that we've been able to do, and my husband and collaborator George Chaplin has been particularly instrumental in helping develop this, is we've been able to take NASA satellite data on ultraviolet radiation of the Earth's surface and create a series of visualizations, just like the one you're looking at right now on your screen, that show the intensity of ultraviolet radiation.

Nina Jablonski:
This is an annual average map, but we could show many other depictions. What this shows very clearly is that close to the equator are the hottest colors, the pink and the dark red. There are also cooler colors on this map, especially as we get closer to the poles. But also the cooler colors of purple and blue are in more humid areas where there's more cloud and humidity. But one of the most interesting things about this map is that it shows that much of the Northern hemisphere receives relatively little UV compared to the Southern hemisphere. And this turns out to be a big part of our story later on.

Nina Jablonski:
So we've been able to use this data from NASA satellites to be able to compare the skin pigmentation of living people to ultraviolet radiation. And it turns out that there is a very, very high correlation. Ultraviolet radiation accounts for more than 86% of the variation in human skin color. So, what happened in our evolution? I'm going to start with this familiar and beautiful skeleton who will be familiar
at least to some of you, a beautiful reconstructed fossil from Western Kenya that shows an early member of our lineage, the genus Homo, aged just short of 2 million years ago.

Nina Jablonski:
And what's so striking about this guy is that basically he was very modern in his body proportions. And from what we can reconstruct about his mode of walking and running around, he was really quite a bit like us, which means that he would've built up a lot of heat in the sun when he was running around. And in fact, this turns out to be extremely important. When we think about the whole history of human skin, I like to think about it and depict it in this, what I call the hairy timeline of human evolution, which shows that by about two to 1 million years ago, or about 1.6 million years ago, where we find the early members of the genus Homo, what we see is that we've lost most of our body hair, although we retained tiny little hairs, we've lost most of what are called terminal hairs. And our skin has become permanently dark.

Nina Jablonski:
This is really, really important. We lost most of our body hair in order to facilitate keeping our body cool through sweating, and we gained permanent pigmentation, because we need some protection from ultraviolet radiation. In our primate relatives and in most mammals, the hair on the body protects the animals from strong ultraviolet radiation. When we lost most of our hair, we compensated in a way that is familiar in evolution, the gaining of melanin pigmentation. So here's our guys, reconstructed our early members of the genus Homo looking beautiful and resplendent in their mostly naked, potentially very sweaty and darkly pigmented skin that is beautifully protected against strong ultraviolet radiation.

Nina Jablonski:
Now, what's so fascinating about eumelanin, the pigment that imparts most of the color to human skin is that it is excellent at absorbing ultraviolet radiation along with most wavelengths of visible light. That's why it appears so dark, almost black in its native form. So it's this really remarkable molecule that's able to absorb a lot of electromagnetic radiation and also neutralize some damaging products in cells that are caused by the effects of ultraviolet radiation. So it's a really, really widely used molecule in evolution, not just in our skin.

Nina Jablonski:
So, UV induces a lot of damage in biological systems, some of which I'll talk about in just a moment, and eumelanin protects against much of it. So in our work, what we have done is try to identify exactly what eumelanin protects us against. And it turns out that the most important function is to protect us against the breakdown of an essential vitamin. This is vitamin B9, known as folate to most people. Folate is an absolutely essential vitamin for everything to do with DNA and cell replication in your body. So DNA duplication, DNA modification, DNA repair, all of these things, which are normal and essential for reproduction and for continued health.

Nina Jablonski:
These all depend on ample supplies of folate, and it turns out that folate itself is sensitive to ultraviolet radiation. So you see where we're going here. The primary reason for the evolution of darkly pigmented skin was actually to protect against depletion of essential folate. So here's our beautiful guy again, looking beautiful with his lovely eumelanin pigmentation that protects him and the rest of his species from the untoward significantly deleterious effects of ultraviolet radiation.

Nina Jablonski:
And what we now know is that this process is actually driven by a series of genetic changes, that my colleagues who work in genetics and genomics and bioinformatics have been able to characterize over the last 20 years. There's been tremendous scientific activity in this space. So we know a lot about the genes that have been involved in this process, as well as other pigmentation processes. It turns out that there are literally dozens, possibly hundreds of genes that are involved in the production of normal skin pigmentation in people. It's really fascinating.

Nina Jablonski:
So, we have part of the story that we've told, in modern people, we have darkly and lightly pigmented skin, and we now understand at least part of the story of why we evolve darkly pigmented skin in high UV regimes, particularly equatorial Africa. But we now need to think about why there are light lightly pigmented people and people with all sorts of intermediate skin pigmentations because this is the story of the beautiful sepia rainbow of human skin.

Nina Jablonski:
So, when we go back to our nice UV map, let's look at where humans began. Our species, Homo sapiens originated about 300,000 years ago from preexisting populations of the genus Homo living in Africa. And for most of our history, for most of our species history, we've lived in Africa, undergoing a lot of anatomical differentiation, cultural evolution, technological evolution, linguistic evolution. It was an absolute fiesta between around 300,000 and 100,000 years ago, we were undergoing this explosive, exciting revolution that made us truly modern.

Nina Jablonski:
After that, a few populations of modern people started to leave Africa in pursuit of living, in pursuit of food, they didn't have any particular goal in mind, they just needed to eat. And so we see some populations moving into the Afro Arabian Peninsula into Eurasia, some into Southeast Asia later, and later still, into Northwestern Europe, Northeastern Asia, and much later into the Americas. And what you can see is that, what was a mostly tropical species, what we were for most of our history, some of these populations are no longer living in the tropics, they're living in areas with much lower and far more seasonal levels of ultraviolet radiation. So, this is where the rest of the skin pigmentation story comes in.

Nina Jablonski:
And it's important to remember that humans in pre-history didn't travel much. Although we're talking about these very long distance dispersal, these happened over the course of tens of thousands of years. During individual lifetimes, we might have traveled maybe a few dozen or at most, perhaps a few hundred kilometers a year, but not very much, especially compared to what we do today. And we spent most of our time outdoors without any sewn clothing or without any real built shelters, we might have sought shelter in a rock shelter or a cave, but we didn't have the ability to create shelters until much later in pre-history.

Nina Jablonski:
And lastly, in the places that we lived, we were outside without clothing, and we were exposed to varying levels of UV. So, the skin was really the main event, the main barrier between us and the environment. That means it was subject to the forces of evolution, primarily natural selection. So, here what caused and here my exemplar of light skin pigmentation is my husband, George shown against one of our wonderful colleagues in Ethiopia, Habib, a few years ago. Why did George's skin color evolve to be, or what did his ancestors skin color evolve to be light compared to Habib's? This can be explained on the basis of ultraviolet radiation alone.

Nina Jablonski:
It turns out that light skin is actually depigmented skin. It has lost most of its
eumelanin pigmentation. It's lost most of its natural sunscreen because that has made possible the continued successful production of vitamin D in the skin. Vitamin D is produced under the influence of ultraviolet B radiation under strong sunlight. If you have a lot of eumelanin in your skin, you produce it at a much slower rate. So people living under lower and more seasonal UV conditions really had to reduce the amount of melanin pigmentation in their skin in order to be able to continue to produce vital vitamin D in their skin.

Nina Jablonski:
And vitamin D is super important. Some of you have probably gone to the doctor in the last few years, and they've told you're vitamin D deficient, and that you have to somehow redress that problem. Vitamin D turns out to be massively important throughout your lifespan. It's really important to kids in the creation of a strong skeleton and teeth, because it regulates calcium absorption from the gut, and this function persists throughout life. So if you don't have enough calcium being absorbed by your gut as a result of being replete in vitamin D during your life, you could end up as this poor individual on the left did with a serious case of nutritional rickets, which in serious cases on the right in females can actually preclude normal childbirth. This is evolution in action.

Nina Jablonski:
When normal birth is actually precluded as a result of a force like this, this is natural selection in action. But we also know, as a result of immunologists and epidemiologists working in the last 30 years, that many other functions of vitamin D are just as important as the classic functions, and those that we single out very, very importantly these days are those concerning the immune system in the human body. Vitamin D is essential to maintaining your immune system in good conditions so that it can fight infectious and chronic diseases. So, we really can think of the primary selective force for the evolution of depigmented or lightly pigmented skin as the promotion of UV induced vitamin D production.

Nina Jablonski:
And when we look at the genetic architecture of this, this turns out to be another fascinating case of many genes being involved, and what we have recognized, and here I'm using the royal we, because many geneticists and genomicists not me, but many wonderful capable colleagues have worked on this problem over the years, have identified that the genes contributing to lightly pigmented or depigmented skin in Western Europe and Eastern Asia are mostly different genes. In other words, there has been parallel evolution of depigmentation under the influence of low ultraviolet radiation. This is something that evolutionary biologists just love to discover because it shows the strength of natural selection.

Nina Jablonski:
Now, one of the fascinating things that has emerged in the course of this work also is that, just like lightly pigmented or depigmented skin has evolved multiple times, so has darkly pigmented and highly tannable skin. This has evolved multiple times independently in different sub lineages of modern people as they dispersed into Polynesia, for instance, with the woman on the left and into Southern Asia as the woman on the far right, in addition to the woman on the far left, who is from equatorial Africa. So, this is a wonderful case of the same appearance evolving independently many times with different genetic foundations.

Nina Jablonski:
So, similar skin colors evolving independently under similar UV conditions, absolutely cool as anything. And so what this means is that when you try to think of well, skin color is a product of evolution, it's a really excellent adaptation, but it's not unique to any particular group. And so it can't be used as a unique marker of identity or race grouping.
Nina Jablonski:
So, it's important too, to recognize that skin color evolved mostly independently of other traits. Now that geneticists have looked at the basis for skin color, hair color, eye color, hair texture, and myriad other traits that create the beautiful, visible appearance of modern people, we recognize that all of these traits are dictated by different sets of genes, and they don't travel together throughout evolution, they assort largely independently of one another through evolutionary time.

Nina Jablonski:
So, thinking about skin pigmentation, we can really think about it as a beautiful evolutionary compromise between the demands of photo protection, protection against strong UV at the equator and photosynthesis, which needs to be emphasized, photosynthesis of vitamin D that needs to be emphasized in human populations, living closer to the poles. I like to think that if Charles Darwin were around today, he would consider this a really good example of natural selection and perhaps write about it himself.

Nina Jablonski:
So, let's think now about what modern people are doing, because whoa, we've changed things a lot. In recent history, people have moved around a lot, and by recent, remember I'm an anthropologist, an evolutionary biologist, by recent, I mean, tens of thousands of years. In the last few tens of thousands of years, people have started to move around at increasing rates, especially in the last 500 years, when humans have had all sorts of different animals and conveyances, including ships and airplanes, we've been able to migrate to different places at a much more rapid pace than we did tens and hundreds of thousands of years ago. And what this means is that we've changed the basis for evolution entirely.

Nina Jablonski:
We also, in the last 10,000 and especially the last four to 5,000 years, have started living in cities. In other words, we have to really look at the rules of the rule book because we're no longer living as we did in pre-history, things have changed a lot. So, when we think about some of the major trans locations of people that have occurred, one of the biggest is the movement of nearly 14 million people from equatorial Africa to parts of Europe, the Caribbean and North and South America through the transatlantic slave trade, an involuntary migration that depleted much of the population of Africa.

Nina Jablonski:
This brought people who were mostly darkly pigmented, inter regions that had variable, but much less UV for the most part. Also, when we think about recent voluntary human migrations, we have people moving around at great speed by ship and plane all over the world from areas with low UV to high UV and from areas of high UV to low UV. So, people are now mixing and matching and finding themselves in areas remote from where they lived or where their ancestors lived. And also, we now take vacations, not everybody in the world and over the last few years with COVID, well, maybe you didn't take a vacation, but everybody's getting ready to take a vacation now.

Nina Jablonski:
And what we do in these vacations is often get on a plane and go look for sun. Especially if we live in a cold snowy place, or even if we just want some sun in our bodies. And what this means is that we often have dramatic rapid changes of skin condition that cause our skin to be suddenly damaged by strong ultraviolet radiation. So these are untoward, unexpected effects that would have rarely occurred in our evolutionary history when individuals, for instance, with light pigmentation, would've spent most of their time at high latitudes.
Nina Jablonski: So the rise of what I call intense episodic sun exposure, often referred to as the vacation effect, has had real effect on our health, and a negative effect by causing a lot of predisposition to skin cancer, as a result of causing intense damage, not only to folate in the body, but also to the DNA in skin cells and DNA damage accumulates like a bad debt in the body that is hard to get rid of, especially as you get older.

Nina Jablonski: Now, the other side of the coin is that people and many of us live in cities, or if we don't live in cities, we live and work in indoor environments. Most people today live indoors in cities, they work indoors, they go to school indoors. We live under artificial lights. Very few people actually experience the daily fluctuations of sunlight on their body. This has enormous consequences for our health and wellbeing. We also wear concealing clothing, something that our ancestors never dreamt of.

Nina Jablonski: So, what we find in modern human populations, and this is a problem that is worse in darkly pigmented individuals and populations, but afflicts everyone, every modern person on earth is that we have an increased predisposition to illness and even death resulting from vitamin D deficiency and many physiological problems related to it. This is something we now need to compensate for. So we have to recognize that we evolved under the sun. Right? Naked skin was our primary interface with the environment. This was our resting condition for hundreds of thousands of years, really until about 50,000 years ago, when we began using concealing clothing and building shelter, and especially in the last 15 to 20,000 years. But before that, skin was the main event.

Nina Jablonski: So today we need to be aware of this, that we're working with these old several hundred thousand year old model bodies trying to live in a modern environment. How can we maintain our health and wellbeing? Well, we need to recognize that we have to protect ourselves from intense sun exposure through various kinds of sun protection, wearing chemical sunscreen, wear mineral sunscreen, and protective clothing and hats and sunglasses. And we have to be mindful when we're out of the sun for a long time of the need for vitamin D supplementation. Always consult a healthcare professional about this, but it's important. We are no longer the prehistoric people who were living outdoors, who were well adjusted to their native UV levels. We're modern people who for the most part are couch potatoes.

Nina Jablonski: So, let's think about everything about skin pigmentation differently. It evolved as an adaptation to levels of ultraviolet radiation. It bears no connection to race. And the concepts of race that have been created on the basis of skin color are entirely incorrect, ill founded and were created as it turns out historically by a few European individuals who had particular attitudes, especially toward people with darkly pigmented skin. So, we need to throw out race as a working concept for describing people at all.

Nina Jablonski: And also think about skin color in relation to human health. We have to recognize that each one of us has to develop a unique prescription for their own health and wellbeing, depending on our age and our preferred habits, including what we do during the normal course of our days, as well as what we do on vacation. So, we can do this. We can think about beautiful human variation differently. We can educate our children formally and informally differently about this beautiful sepia rainbow depicted by Angélica Dass and many others. We can do this people, we really can. And it's important that we do.
Nina Jablonski:
I want to thank everyone who's taken time to listen. I hope that you'll offer some questions. I want to thank the whole HOT Topics team, Angélica Dass and to my continuing collaborators, George Chaplin, and Tess Wilson. And you'll find I'm supported by many, many people and organizations, and I'm always available to take questions. So, on that note, let's switch over to the Q&A, and thank you very much.

Briana Pobiner:
Thank you so much, Nina. That was wonderful. And we already have a lot of questions that have come in. So, I'm going to jump right in and I'm going to start with a question about color from Judith who asks, "Why no purple, blue, green skin?" Does this ... which I love, that's creative thinking. Does this relate it all to our chemical composition as humans as a whole?

Nina Jablonski:
Yeah, wonderful question. It turns out that purple and blue are actually really hard colors, hard pigments to create in animals in nature. And mostly in nature, when we see blue and purple in animals, it is created as a result of physical interference of wavelengths of light. And so for many of the same reasons, in fact, the identical reasons as the sky is blue, that's why the nose of some monkeys are blue, for instance, but it's really hard to make blue pigment and purple pigment in a mammal or in a vertebrate. So, flowers and lots of plants can do it but much, much harder for mammals and vertebrates and the optical production, just like the blue sky, the scattering of wavelengths is generally how it's done for mammals.

Briana Pobiner:
Okay. Thank you. Here's a more evolutionary question. So Christoff would like to know what do we know about the skin color of Neanderthals and Denisovans?

Nina Jablonski:
Yeah. Wonderful question. There's been a lot of controversy about Neanderthals skin pigmentation. There is an indication from preliminary studies that they had quite lightly pigmented skin, which would accord with what we know of their fossil distribution in nontropical environments. And what's interesting yet again, is that the genes that appear to be linked with their depigmentation, the variants are different than those that cause depigmentation in modern European or East Asian people.

Nina Jablonski:
Denisovans on the other hand seem to have a wide variety of skin pigmentation. And there's every indication that there could have been some moderately as well as some darkly pigmented individuals. We now know that Denisovans were spread, oh my goodness, over much of Eurasia from Siberia to Tibet into Southeast Asia. So, we're discovering much more about them. And with luck, we'll be able to get some ancient DNA to be able to examine their pigmentation genes and reconstruct their likely pigmentation.

Briana Pobiner:
Thanks. Here's another question that is a bit related to evolution maybe. Rebecca asks, "So where ..." Or I guess the question might be, "How did freckles originate? Is there an evolutionary advantage to freckles?"

Nina Jablonski:
Well, I hate to tell you for all you freckled bearers out there, freckles are not a particularly good thing, because freckles are actually accumulations of the red/yellow form of melanin. Eumelanin is dark brown, almost black, but there's another form of melanin called pheomelanin. And in people with very lightly pigmented skin, they often develop these clusters of pigment producing cells that
manifest themselves on the skin as freckles. These pigment producing cells have created a lot of pheomelanin.

Nina Jablonski:
Now the bad thing about this is that pheomelanin doesn't protect you at all against ultraviolet radiation. In fact, it amplifies the negative effects. Freckles are generally a sign of damage from ultraviolet radiation. So please freckle bearers protect yourself from ultraviolet radiation. Those little freckles are actually little banks of precancerous cells, or at least they're indicative of your skin responding negatively to ultraviolet stress. So please take care. Freckles may be cute, but they're not good for you.

Briana Pobiner:
Okay. Thank you. Good information. Here's a question from Vicky. "It looks like the slide of Australia has pigmentation on the lighter side than African populations. Why then are Aboriginal people from Australia darker or as dark as people from Africa?"

Nina Jablonski:
Excellent observation. We now know that many of the most darkly pigmented people in the world are actually found in Northern Australia. They did exist also in Tasmania before the Tasmanian people were driven to extinction by European colonists, and they also exist in parts of Island Melanesia. Now what's so fascinating about all of these situations is that the populations live on the coast and nearly all of these people are fisher people who experience a lot of reflection of UVA and B from the surface of the water, and often also from the surface of light colored sand.

Nina Jablonski:
And it turns out that some of the most darkly pigmented people in the world are actually living under these conditions in coasts where they get not only a tremendous amount of direct UV, but also reflected UV from the substrates. And so we see the compound effect of multiple genes that are producing very dark pigmentation in these populations.

Briana Pobiner:
Oh, I see. Thank you. So here's a question from Jack who asks, "How does eumelanin and skin tone change with elevation? Is it similar to how it changes with latitude?"

Nina Jablonski:
Oh yeah, it certainly does. And we find that in high altitude populations in Tibet, in Bolivia and Peru, in other places, we see independent natural selection for genes that confer enhanced tanning abilities. And this is another case I didn't talk about in detail. This is another case where it makes a lot of sense. These people are being subjected to a lot of strong ultraviolet radiation as a result of being under a thinner atmosphere with less oxygen and Ozone protection. So, populations that have become established there have undergone rapid natural selection, favoring those pigmentation gene variants, that confer enhanced tanning abilities.

Briana Pobiner:
Thank you. Here's a question from Emily. "Why doesn't the skin of lighter skin people in Africa change over generations to darker skin?"

Nina Jablonski:
Yes. People in the last 500 or so years who have been moving all around are so effectively buffered from natural selection as a result of all of the things that we do for ourselves, we keep ourselves covered, we also keep ourselves cared for. We live indoors, we take care of one another when we get sick or have a sunburn or
any kind of infection or malady, basically humans are very caring. We take care of one another. We've created institutions like clinics and hospitals and doctors who take care of one another.

Nina Jablonski:
So we've exempted ourselves from much of the influence of natural selection, not entirely but largely. So, we're basically a very thoughtful species. We take care of one another now. And so lightly pigmented living in Africa or Northern Australia, they're subjected to very, very high UV loads, but through the offices of culture and all the things that we build around ourselves and clad ourselves with as well as medical care, we're able to basically get around, work around the deficiency of our skin.

Briana Pobiner:
So this is a great question that touches on evolution, but also like acclimation. So Virginia asks, "What makes an enhanced tanning ability different from darkly pigmented skin color?"

Nina Jablonski:
Well, actually they're very strongly related. Darkly pigmented skin, and when we talk about this from the human biologist perspective, what we think about is darkly pigmented from a genetic basis. So that if you looked at, let's say the upper inner arm of someone's body, that is the part of the body that receives the least sun exposure on anyone. If that skin is darkly pigmented, then we call that person darkly pigmented, or genetically darkly pigmented.

Nina Jablonski:
Now, that person will also have enhanced tanning ability, but many people with light to moderately pigmented skin also have pretty good tanning ability. And that varies greatly according to what complement of skin pigmentation and tanning genes that you have. It turns out that there are dozens of genes that contribute to tanning, and some of these actually we know that in Western Europeans and Eastern Asians, there are different genes that confer tanning abilities, albeit limited tanning abilities to people, so that the appearance of the tanned skin is slightly different, measurably different and the tans last for a different length of time.

Nina Jablonski:
So this is really cool that there are just so many genes and that in many populations where people live under intense UV year round in equatorial Africa, many parts of Melanesia and Northern Australia and in Southern and Eastern India, darkly pigmented skin is genetically darkly pigmented. You can find people will look darkly pigmented in the unexposed areas, but they also will have enhanced tanning abilities.

Briana Pobiner:
Interesting. Here's a question from Neils, "Have humans and he mean first peoples, not later, immigrants, lived in the Americas long enough to develop different pigmentation based on where we live."

Nina Jablonski:
Wonderful. Yes, they have. Basically when people started arriving in the Americas, probably know earlier than 20,000 years ago via a coastal route, people really traveled quickly along the coast and then gradually penetrated into the hinterland. What we can see based on the preliminary study of skin color, tanning abilities and skin pigmentation genes is that people indeed underwent natural selection, especially those who are living under really intense UV in Central America and in the high latitudes, sorry, high altitudes of South America.

Nina Jablonski:
But also we have to recognize that 15 to 20,000 years ago when people were making this last big dispersal along the coast, that they had a lot of stuff with them compared to people in previous epics. So they had boats, they had clothing, they had the ability to make shelters, boats, the whole kit. We say that they had a lot of cultural buffering potential. Right? They could buffer themselves from the environment to a greater extent. So, we see natural selection happening, especially in extreme environments, but not quite as much.

Nina Jablonski:
And one last thing I'll say is that in those populations that stay in or near the Arctic circle, the Inuit peoples, and many of the peoples on the Northwest coast of North America, these individuals develop actually an enhanced tanning ability to deal with the reflected UV from water, snow, and ice. And they have compensated very effectively by having a vitamin D rich diet.

Nina Jablonski:
So when you look at the diet of most coastal peoples in coastal Eurasia, or along the coast of Alaska or Northern North America, these people are eating vitamin D rich foods as their traditional foods. So they actually underwent evolution of enhanced tanning abilities and it didn't hurt them at all.

Briana Pobiner:
So, since you mentioned diet, I'm going to ask this question next from Mary, who says, "I read somewhere that lighter skin may have developed when we took up agriculture and got less vitamin D from our grain diet. Is this something you've heard?"

Nina Jablonski:
Yes. There is a lot of evidence to indicate that the final phase of depigmentation in Eurasia, so we're talking about the extremes in Northern Eurasia, both in Northwestern Europe and Northeastern Asia, that this was due to the adoption of agriculture. The actual genetic basis of this has been established quite nicely through some genetic work that has been done on ancient DNA of peoples in Northern Europe itself, including the British aisles.

Nina Jablonski:
So this is exciting, but importantly, this process of depigmentation was not an all or nothing thing. And it wasn't just due to agriculture. It happened over the course of many different genetic steps with the final phase of it, at least in some populations being due to the adoption of largely grain focused diets and a reduction in the amount of vitamin D being consumed through food stuffs.

Nina Jablonski:
But what's really important is that when you look at some of the people in northernmost Scotland who have some of the most highly depigmented skin, they can only maintain their optimal health if they eat a lot of vitamin D rich foods. So, even though the last phase of depigmentation occurred after the inauguration of agriculture several thousand years ago, people living that far north under that weak of sunlight have to also have a lot of vitamin D rich foods to stay healthy.

Briana Pobiner:
Thanks. So diet plays a role in some respect, it seems like.

Nina Jablonski:
It does. And what's also important here is that very few foods that we eat normally are naturally rich in vitamin D. Milk is fortified to have some vitamin D, but on average, quite low levels, it'll prevent you from being frankly deficient, but not a lot more. And there are relatively few fish that have a lot of vitamin D. You have to eat a deliberately oily fish, some forms of wild salmon, other Cod fish,
and so forth. Macro oily fish can impart vitamin D, but your regular fish stick fish is not going to cut the mustard as they say.

Briana Pobiner:
Okay. We'll keep that in mind. Here's a question from Sophie. And she says, "I am mixed race, and my skin color is between the tones of my White and Black parents. If both my parents had been dark skinned from different origins on earth, so with different genes, could my skin have been darker than either of my parents?"

Nina Jablonski:
Yes, it's possible. It depends what the mixture of genes would've been. And what we now know is that, pigmentation genes can interact with one another so that they can actually produce progeny, offspring, that are darker in some cases or lighter in some cases than parents. And we don't understand fully how this happens. This is a super active area of research in pigmentation genetics, but yes, what you described is possible.

Briana Pobiner:
Wonderful. Thank you. Interesting. Howard says, "Since melanin helps protect from UV rays, can you discuss the possibility of sunburn in people with very dark skin?"

Nina Jablonski:
Yes. It happens all the time because people want to go on vacation, and people with very dark skin who are indoors most of the time, if they go into a high UV environment, and many of my friends do this, they go to the Southwest US, or they decide to go to Mexico for a vacation. And they write to me and say, "Nina, I have this terrible sunburn." Of course, because your skin gets used to whatever levels of ultraviolet radiation that you're accustomed to day in and day out.

Nina Jablonski:
And if you're mostly indoors going to school or work, and you live especially at a moderate to high latitude, where incidental sun exposure isn't going to really activate the melanin producing cells in your body, then you really have to protect yourself against strong episodic sun exposure. So what I advise people is, "Hey, take your good sun shirt or chemical or mineral sunscreen with you and use it at least for the first several days, so that your natural ability to make melanin can catch up with your location."

Briana Pobiner:
That's good advice, I'll remember that the next vacation that I go on. We only have time for one or two more questions. This next one is from Heather who asks, "How long did it take for enough mutations to accumulate to create the full variety of skin colors we see today?"

Nina Jablonski:
Oh, wow. Yeah, it's so interesting. We used to think that it took thousands and thousands of years for this to happen, but in the course of human evolution, people have dispersed from one place to another, and these dispersal events, and even if we're talking about, let's say 70 or 80,000 years ago, they involved small numbers of people. What that resulted in was what we call a population bottleneck with reduced genetic variation. We now know that the very fact of having reduced genetic variation means that evolution can take place faster in these dispersing and isolated populations.

Nina Jablonski:
So, we now think that this process of skin pigmentation evolution, first of all, there isn't one standard timescale and it can occur more rapidly than 10 to 20,000 years. It probably occurs over, let's say, the time scale of two to 4,000 years, or possibly even shorter. And the intensity of natural selection depends on how great
the difference is between the original environment and the new environment in which people are dispersing.

Briana Pobiner:
Thank you. All right. I want to end with this last question, because I think it's an important one from Ameit who asks, "I understand that race is a social construction, but as long as discrimination exists based on race, don't we have to use the concept of race in our society?"

Nina Jablonski:
What we can do is understand that the concept of race was created by people who had a social agenda of their own. Race has become a fixture of societies, and we have to understand that people identify with, and sometimes often positively with racial designations, but we have to recognize that race bears no relationship to our biological being or to our potential. So we have been given these labels, and importantly, we've been given these labels by White male racists of the European enlightenment.

Nina Jablonski:
So, my feeling is that race is something we need to recognize as an important historical construct to just dismiss it as a social construct is to dismiss its importance in our lives. It structures our social interactions, and it affects many of the ways in which we interact with one another today. What we must do is understand how it came about, understand who brought it about, and then combine that with the story of the evolution of skin color diversity, and say, "Hey, we can do better than this."

Briana Pobiner:
Thanks. I think that's a great way to wrap things up, which I will do now. And so this concludes today's virtual program. Please join me in thanking Nina for sharing her work with us. I also want to say there were a lot of questions we didn't get to and including several on hair variation in modern humans. So I wanted to just put in a little pitch to watch. We had a previous HOT topic program in 2020 with Tina Lasisi who studies human hair variation, and also has worked with Nina Jablonski and others at Penn State. So folks who are interested in hair variation might want to take a look at that.

Briana Pobiner:
I'd like to give special thanks to those who made this program possible. This includes our behind the scenes team who helps sort through your questions, our donors, volunteers, and viewers like you. And finally, to all our partners who help us reach, educate, and empower millions of people around the world today and every day. Thank you. This was our last HOT topic program for the spring of 2022. We're going to take a break for the summer and we'll resume in September. So stay tuned for announcements of our upcoming HOT topic programs then, check back on our website for more information soon.

Briana Pobiner:
We've put a link in the Q&A where you can find information about our upcoming programs and how to sign up for the museum's weekly eNewsletter. That's the best way to stay informed on upcoming programs and learn more about the museum's research and exhibitions. After this webinar ends, you'll see a survey pop up, asking for some feedback about the program. Please take a moment to respond. We're very curious to know what topics you might be interested in seeing for future programs, and we appreciate your input. Again, thank you to our participants, to our speaker, Dr. Nina Jablonski, and to you, the audience, we'll see you again in the fall.