Brains On (APM) | Brains On! Sunburns: The why behind the ouch (and how to avoid them) 1QDE6EJT8VGFS04WRMZ404971G

SUNDAY: You're listening to *BrainsOn.* We're serious about being curious.

MOLLY BLOOM: It is a beautiful sunny day here in St Paul, Minnesota. And--

[KNOCK]

Oh, come in.

SANDEN TOTTEN: Hey, Molly, it is really, really nice outside. You want to go for a walk or just get outside or do something?

MOLLY BLOOM: I really wish I could, but I'm actually taping an episode right now.

SANDEN TOTTEN: Oh, right. Yeah, that's now. OK, well, here, I'm just going to grab some stuff that I stashed in the studio here real quick, and then I'll be gone. OK, so let's see. I got my sunscreen, got to have that. Oh, my sun hat. I've got my sunglasses. I need those, sun gloves, my sun bow tie, oh, my sun socks to wear with my sun sandals, and my sun cologne. (SNIFFS)

MOLLY BLOOM: Sun cologne? What does that do?

SANDEN TOTTEN: Oh, it actually-- I don't think it does anything. I just like to wear it in the sun because it smells nice. Anyway, that's everything I can think of, so I'm off for my walk. Have a good show. See you later.

MOLLY BLOOM: Well, *Brains On* producer, Sanden Totten, is definitely protected from the sun. But why do we need protection anyway?

SUNDAY: And how does it work?

MOLLY BLOOM: Answers to those questions are coming up.

SUNDAY: Keep listening.

[MUSIC PLAYING]

MOLLY BLOOM: You're listening to *Brains On* from American Public Media. I'm Molly Bloom, and here with me today is Sunday from Austin, Texas. Hi, Sunday.

SUNDAY: Hi, Molly.

MOLLY BLOOM: Today we're tackling a question about sunburn and sunscreen that was sent to us by you, Sunday.

SUNDAY: How do we get sunburns? And is it from light or heat?

MOLLY BLOOM: This is a great question. And like a lot of great questions, it came from staring out a window.

SUNDAY: I was in the car. I was looking out the window, and it was really hot out and barely anybody was out there. I said to myself, it's really hot out, so nobody's outside. And so I broke that out into different pieces. Since nobody's outside, it's probably because of the sun. And then I was like, well, then it's probably because the sun might give you a sunburn. And so I wanted to know, how do you actually get a sunburn?

MOLLY BLOOM: That is some excellently curious thinking right there. So we enlisted Sunday's help to interview Dr. Shani Francis, a dermatologist from Chicago. She's a doctor and expert in skin and hair.

SUNDAY: How do we get sunburns? And is it from light or heat?

DR. SHANI FRANCIS: That is a great question, Sunday. So believe it or not, sunburns are not due to light or heat. They're due to something we can't see and we can't feel that's called ultraviolet radiation, so UV radiation.

And the word sunburn and sunscreen come from the fact that most of this Ultraviolet or UV radiation comes from the sun. But it's not something that because it's hot outside, there is more UV radiation. It comes directly from the sun. So it's important to know that you can get a sunburn even in the middle of the winter when you're skiing or something.

Clouds help a little bit because they block some of that radiation, but they don't protect us completely. So just because it's not a bright, sunny day doesn't mean that you're not able to get enough UV radiation to cause a sunburn.

SUNDAY: I'm a Native American, so I don't get sunburns that easily. But I still wear sunscreen just in case I get a sunburn. Does it take the same amount of radiation to get a sunburn for dark skin than it is with light skin?

MOLLY BLOOM: The darker the skin contains a special chemical or pigment called melanin. And melanin is important because melanin helps our body when exposed to radiation, absorb that radiation, and get rid of it so it never reaches the cells to cause damage. So the darker the skin, the more melanin you have in your skin.

But it doesn't mean that you can't get damaged from the sun, and it doesn't mean that you shouldn't use sunscreen. So melanin works as an internal sunscreen in people with darker pigment. But everyone still needs to put extra sunscreen on for that extra protection.

There's a mechanism in place when we're exposed to radiation to increase our melanin levels so our pigment producing levels get stimulated by exposure to UV radiation. So if you're getting tan, that means you are getting too much UV radiation, and your body is trying to protect itself. So if your freckles get darker, if your skin gets darker, it's a sign that you're getting too much UV radiation, and your body is trying to boost up its internal sunscreen protection, which means you need more sunscreen on the outside.

SUNDAY: Are there other ways to protect your skin other than sunscreen?

DR. SHANI FRANCIS: What a great question, Sunday. So there are. They're better than sunscreen. I like to tell people that clothing is even better because if the sun light can't get through it, then that means the radiation can't get through it.

So like a white cotton T-shirt is going to do a great job at protecting the skin that's under that T-shirt. Hats can protect your head and the top of your forehead. Sunglasses can protect your eyes. So there's all kinds of ways to protect your skin without using sunscreen. But any skin that is exposed is not under these clothes and hats and sunscreen, sunglasses will need sunscreen.

MOLLY BLOOM: Thank you so much for talking with us today.

SUNDAY: Thank you.

DR. SHANI FRANCIS: Thank you, Sunday. It was a pleasure.

SUNDAY: Bye.

DR. SHANI FRANCIS: Bye.

[MUSIC PLAYING]

MOLLY BLOOM: Now we know the basics of how your skin gets burned and how it gets a tan. And in a minute, we're going to dive deeper to the cellular level to really understand how sunblock works. But first, we're going to dive deep into a mystery. It's time for the mystery sound.

[MYSTERY SOUND PLAYING]

SUNDAY: Mystery sound.

MOLLY BLOOM: Here it is.

[MYSTERY SOUND PLAYING]

Any guesses, Sunday?

SUNDAY: It sounds like-- you know those things where they shoot the rockets out of them?

MOLLY BLOOM: Oh, yeah, like, where they're like a little puff of air shoots them?

SUNDAY: Yeah.

MOLLY BLOOM: Yes.

SUNDAY: I think-- yeah, it sounds like that to me.

MOLLY BLOOM: That is an excellent guess. We will be back with the answer right after this. We are giving away a book this month that is stuffed with over 300 fascinating facts. It's called *No Way, Way Stinky Sticky Sneaky Stuff.* Here's one fact from the book that's related to today's episode. Slime acts as sunscreen for snails and slugs. That is just a taste of all the crazy tidbits found in this book. You can enter for a chance to win a copy of the book at our website, brainson.org/giveaway.

While you're there, you can also sign up for our newsletter and listen to past episodes. And you can always email questions, ideas, and mystery sounds to us any time at halo@brainson.org. And when you send us your ideas, you'll be added to the *Brain's* Honor roll. We started it to thank all the amazing kids who keep this show going, like Nyla in Detroit. She sent us this question.

NYLA KAREN: What is the farthest a human can see?

MOLLY BLOOM: Great question. What is the farthest a human can see? We'll be back with that answer during our moment of Um and the latest group to be added to the *Brain's* Honor roll all at the end of the show. And we're back. All right, Sunday, are you ready to hear the mystery sound one more time?

SUNDAY: Mhm.

[MYSTERY SOUND PLAYING]

MOLLY BLOOM: Any new thoughts after hearing it this time?

SUNDAY: No, I'm still on the rocket shooter thing.

MOLLY BLOOM: Excellent. Well, here with the answer is Bennett from Minnesota.

BENNETT: Hi, this is Bennett. That was the sound of my dad squeezing an empty sunscreen bottle, which is a great sound because it means we used it all up.

MOLLY BLOOM: So you were really close. It was a puff of air. It was just a puff of air coming out of a sunscreen bottle.

SUBJECT: Ba, ba, ba, ba, ba, ba, ba, ba, ba, *Brains On.*

MOLLY BLOOM: So like Bennett, a lot of our listeners have sunscreen on the brain and I mean not literally on your brain. Your skull keeps that important piece of hardware from burning. I mean you've asked us about sunscreen a lot.

BENNETT LANG: Hi, my name is Bennett Lang, and I'm a redhead from Excelsior, Minnesota. And I wear a lot of sunscreen in the summer. So my question is, how does sunscreen protect you from the sun?

PETE: My name is Pete from Bozeman, Montana. How does sunscreen protect your skin?

HANNAH: My name is Hannah. I'm from Los Altos, California. My question is, how does sunscreen work?

MOLLY BLOOM: I'm guessing these questions came from the fact that whenever you want to go outside and some of us want to go outside all the time, you have to cover yourself in cream, or lotion, or spray.

SUNDAY: To find out how the stuff protects us, we're going to zoom in (BEEP) on our skin (BEEP) to the very cells themselves. (BEEP)

MOLLY BLOOM: Our skin is made up of layers. Take a look at any skin on your body. That's the top layer, and it's called the epidermis. This layer of skin makes melanin, the pigment that gives color to your skin, and it also makes new skin cells.

SUNDAY: Under that layer is the dermis, and there's a lot going on in there.

MOLLY BLOOM: That's where your nerve endings are. Those help you feel things.

SUNDAY: Like a pinprick or the soft fur of a cat.

MOLLY BLOOM: Also in the dermis, the glands that make sweat and oil, the follicles that grow hair, and all the blood vessels that feed your skin.

SUNDAY: And under all that is a layer of fat.

MOLLY BLOOM: There is so much going on with skin. We needed another expert to help break it down.

DR. INGRID POLCARI: My name is Dr. Ingrid Polcari. I'm a pediatric dermatologist.

MOLLY BLOOM: Remember those UV rays?

SUNDAY: UV radiation is part of the electromagnetic spectrum.

MOLLY BLOOM: Visible light, the light we can see, is also part of this spectrum. Ultraviolet radiation, UV radiation, has more energy than visible light. And there's a whole spectrum of this radiation from low energy radio waves on one end to the higher energy gamma rays on the other end.

SUNDAY: Here's a little ditty from our friends the Dinah birds to help you remember.

THE DINAH BIRDS: (SINGING) Radio microwave, infrared visible, ultraviolet, X-ray gamma. Yet here we go. Space between waves gets shorter and shorter. Electromagnetic spectrum, that's the order. Radio microwave infrared, visible, ultraviolet, X-ray gamma. Radio microwave, infrared visible, ultraviolet, X-ray gamma. It's the electromagnetic spectrum. The electromagnetic spectrum. These are the facts we checked out, the electromagnetic spectrum.

SUNDAY: So how does this ultraviolet radiation from the sun damage your skin?

DR. INGRID POLCARI: We keep DNA in our skin cells, and that DNA is really important to keep those skin cells healthy. And when that UV radiation comes in, it actually damages the DNA.

MOLLY BLOOM: DNA is a kind of molecule that carries all the genetic information for our cells. It's like the instruction manual for all the cells in our bodies.

DR. INGRID POLCARI: There are ways that the DNA can repair itself. But sometimes we stretch that to the limit. There's only so much damage that can undergo repair, which is why we need to be careful. We need to be careful about not getting sunburns and not getting sun tans because at some point, those DNA damages are going to turn into harmful changes and maybe even create a skin cancer.

MOLLY BLOOM: Let's zoom in even further to get an answer to this question from Sam.

SAM: How come your skin turns red when you have a sunburn?

DR. INGRID POLCARI: The redness is really just like an SOS call saying, hey, I'm under attack.

MOLLY BLOOM: When you get a sunburn and even a tan, that's your body's way of trying to protect the DNA inside the skin cells.

SUNDAY: There are two types of UV rays penetrating your skin, UVA and UVB.

MOLLY BLOOM: UVB is the one that does most of the damage in your epidermis. zoom in on your skin. (BEEP) Now zoom in on your skin cells. (BEEP) Now zoom in on a molecule in the cell. (BEEP) And now zoom in on an electron in that molecule. (BEEP)

When the UVB goes into your skin, it's actually being absorbed by electrons in your skin that excites these electrons. And when they get excited, they make the molecules they are part of behave differently than they should, that could mean changing their shapes or making them stick together in weird ways.

SUNDAY: When this damage occurs, your body springs into action to help clean it up.

MOLLY BLOOM: Cells send out cytokines. Those are chemicals that send messages.

SUBJECT: Clean up needed at the epidermis.

MOLLY BLOOM: More blood is sent to your skin.

SUBJECT: Here we come.

MOLLY BLOOM: This makes your skin red and inflamed.

SUBJECT: What a mess. Those darn UV rays have done it again. Let's get to work.

MOLLY BLOOM: Proteins in the cell will try to repair the damage DNA.

SUBJECT: Ha, here's the problem. We'll get you in working order in no time.

MOLLY BLOOM: But if the repair job isn't perfect, the blood cells will remove the cells that couldn't be fixed.

SUBJECT: Let's get you guys out of here.

MOLLY BLOOM: And the pain receptors in your skin get activated by other chemical signals.

SUBJECT: Ouch, let's not do this again. This hurts.

MOLLY BLOOM: The UV rays also send your pigment making cells into action. These melanocytes produce pigment to try to protect your cells. This is what causes a tan. When our skin gets a sun tan, it's actually a sign that our skin has been damaged. They are signal to us that we've had too much UV rays on our skin. Then after a bit, the leftover dead skin cells will flake or peel off. So how do we keep from getting burned in the first place?

SUNDAY: One way is to wear sunblock. There are a couple of different kinds.

MOLLY BLOOM: One kind is a physical blocker.

DR. INGRID POLCARI: These are things like zinc oxide or titanium dioxide. And these types of sunscreens basically sit on the surface of your skin and mostly reflect or scatter those UV rays that are coming at your skin.

MOLLY BLOOM: Like a wall blocking those sun's rays from hitting your skin in the first place.

DR. INGRID POLCARI: The other type is chemical sunscreens. And these are substances that are absorbed into the skin.

MOLLY BLOOM: Remember when the electrons in your skin absorbed the UV radiation causing damage? The chemical kind of sunscreens absorb the UV rays before they can get to the electrons in your skin. The damaging UV energy gets absorbed by these chemicals and turned into a very small amount of heat so small that you can't feel it.

DR. INGRID POLCARI: So first thing I'll say is that most people don't use as much sunscreen as they should. The recommended amount of sunscreen for the average adult sized person is a full ounce of sunscreen for exposed skin on a body in a swimsuit. Most sunscreen packages come in 3 ounce bottles. So if you think about it, that is three applications of sunscreen. That's a lot of sunscreen. If you're not using as much as they recommend, then that SPF number that you've been reading in the bottle is no longer valid.

So SPF stands for Sun Protection Factor. And it tells you how much more protection you are getting from the sun as compared to if you had no sunscreen on at all. And what they do is they look to see time to sunburn with a certain amount of sun on the skin versus time to sunburn with the product on. And if, for example, it takes 30 times longer to sunburn with that sunscreen on, that's where you get your SPF of 30.

MOLLY BLOOM: The Earth's ozone layer, which is way up in the stratosphere, also helps shield the Earth from ultraviolet rays.

SUNDAY: It's kind of like the Earth's sunscreen.

MOLLY BLOOM: But the ozone layer is thinner than it used to be, which makes protecting your skin even more important.

SUNDAY: Another way to protect your skin is to not expose it to the sun at all.

MOLLY BLOOM: You can do this by staying in the shade or covering up your skin with hats and clothes.

SUNDAY: There are also times of the day when the UV radiation is more intense than others.

DR. INGRID POLCARI: We know that the UV rays are the strongest usually in most places between 10:00 in the morning and 4 o'clock in the afternoon. One rule I like to talk about is the shadow rule. So if you don't have your smartphone in your hand, and you can't look at the UV index, you could use the shadow rule to decide whether or not it's safe to be outside.

So if the sun is right above you, your shadow is typically pretty short. You can't really see much of a shadow. And that should be signal to you that the sun is pretty strong, and you probably shouldn't be outside unless you're protecting your skin. If your shadow is very long, that usually means that the sun is coming up or about to set. It's earlier in the day or later in the day, and those UV rays are much less strong. So if the shadow is longer than you are, that's usually a signal that it's pretty safe to play outside.

MOLLY BLOOM: And here's another question we asked Ingrid to help us answer.

ESME: My name is Esme from Colleyville, Texas. My question is, how do freckles and moles get on your skin?

MOLLY BLOOM: Freckles are basically build up of the pigment in our skin. And Ingrid says they come from sun exposure.

DR. INGRID POLCARI: We could look at freckles as a reminder that we have to be extra special careful in the sun. So if you have freckles, that's your body telling you that you're extra delicate in the sun, and you need to do a little bit better job than your friends who don't have freckles at preventing sunburn.

SUNDAY: And redheads are more likely to get freckles because their skin produces pigment differently than people with other hair colors.

MOLLY BLOOM: Those of us who get tan produce eumelanin, which is a brown black pigment. Redheads produce a totally different type of pigment called pheomelanin, which is a yellow red color.

SUNDAY: And moles are different.

MOLLY BLOOM: They are not buildup of pigment but rather a cluster of the cells that make pigment.

DR. INGRID POLCARI: Moles are actually growths on the skin. And guess what? They're made of melanocytes. So those same cells that make that pigment that would give us a suntan, for example, but it's like a little cluster of melanocytes in one little growth. There are a few things that contribute to mole development. Sometimes you just inherit the tendency to have lots of moles from a parent or a family member. But we also know that kids who get more sun, especially in early childhood, will have more moles.

SUNDAY: So no matter your skin color or your hair, it's important to protect your skin from the sun.

MOLLY BLOOM: It's not visible light or heat that causes sunburns but rather ultraviolet radiation from the sun, energy you can't even see.

SUNDAY: These high energy rays can damage the cells and DNA in your skin.

MOLLY BLOOM: But wearing sunscreen can protect your skin from these damaging rays.

SUNDAY: You can also cover up your skin with hats or clothes or stay in the shade when the sun's rays are the strongest.

MOLLY BLOOM: That's it for this episode of *Brains On.*

SUNDAY: *Brains On* is produced by Marc Sanchez, Sanden Totten, and Molly Bloom.

MOLLY BLOOM: And *Brains On* is made possible in part by a grant from the National Science Foundation.

SUNDAY: And before we go, it's time for our moment of um--

[HUMMING]

NYLA KAREN: Hi, my name is Nela Karen, and I'm from Wyandotte, Michigan, and my question is, what is the farthest a human can see?

MOLLY BLOOM: What is the farthest a human can see?

SUE KRISTED: Well, on a dark night, it's possible that one could see a flickering candle up to 30 miles away. Of course, that doesn't happen on Earth because Earth is curved, so the distance to the horizon is only about three miles. But if we did have a flat Earth on a dark night, then we could see 30 miles potentially. My name is Sue Kristed, and I'm an assistant professor at the University of Minnesota, and I have studied vision.

Our eyes are best tuned to seeing differences, so the difference between the flame and the dark night. So we wouldn't be able to see that candle flame during the day. For example, at noon when the sun is out, we wouldn't be able to distinguish that tiny, little flame in sunlight. You wouldn't see that it's a green candle that has a flame on it. You wouldn't necessarily be able to make out exactly what that object was so far away. You would just be able to distinguish the point of light like how we see the stars

MOLLY BLOOM: Reading the *Brains* Honor roll makes me feel like I can see all the way around the world. Speaking of which, here's the most recent group to be added to this esteemed list-- Willow and Freya from Melbourne, Australia, Ellie and Izzy from Maplewood, New Jersey, Isaac from Yucaipa, California, Kelvin and Samuel from Charlton, New York, Atia from Toronto, Kyle from Mount Juliet, Tennessee, Olivia from Wilton, Connecticut, Collette and Rosalie from Los Angeles, Young Hoon from Sunnyvale, California, Lucia and Joaquin from Los Angeles, James from Houston, Archer and Fritz from Minneapolis.

Delaney from Toronto, Taru from Pleasanton, California, Mirae from Palo Alto, California, Roosevelt and Jenny from Charlotte, Penelope from Durham, North Carolina, Ava from Minneapolis, Finn from Kansas City, Eoin from Puyallup, Washington, Etta from Vancouver, Beatrix from Minneapolis, Richard from Houston, Chloe from Toronto, Rain from Eden Prairie, Minnesota.

Ethan from Durham, North Carolina, Alexander from Los Angeles, Simon from Oakland, California, Ivy and Tam from London, Vina from San Luis Obispo, California, Freya from New Zealand, Nathan from Rio Rancho, New Mexico, Edison from Shoreline, Washington, Holly from Durham California, Aaron, Bennett, and Stella from Madison, Wisconsin, Laurel from Knoxville, Eli from New York, August from San Francisco, Ayla and Lawson from Steamboat Springs, Colorado, Sage from Tulsa, Atreyu from Orlando, Henry from Roeland Park, Kansas, and Victoria from Tesla, Yukon.

SUBJECT: Brains on.

MOLLY BLOOM: We had engineering help this week from Michael Crawford, Cameron Wylie, and Corey Chappell.

SUNDAY: And production help from Emily Bright, Katy Clarkson, and Ryan Katz.

MOLLY BLOOM: Many thanks to Liz Cardinal, Laundy, John Lambert, Crystal Barber, Paul Tosto, Meg Martin, Christine Hutchins, and you and Care.

SUNDAY: If you're a fan of brain on, consider leaving a review in Apple Podcasts.

MOLLY BLOOM: It really helps other kids and parents find out about the show.

SUNDAY: And you can keep up with us on Instagram and Twitter.

MOLLY BLOOM: We're @brains_on.

SUNDAY: And we're on Facebook, too.

MOLLY BLOOM: We'll be back soon with more answers to your questions.

SUNDAY: Thanks for listening.