Getting Curious with Jonathan Van Ness & Sarah Aarons

JVN [00:00:00] Welcome to Getting Curious. I'm Jonathan Van Ness and every week I sit down for a gorgeous conversation with a brilliant expert to learn all about something that makes me curious. In this episode, I know that all of our episodes are, like, really good, but this one is, like, so freaking interesting. I literally cannot stand it, cause we're talking about something that I think is, like, so interesting and I need to know more about. On today's episode, we are joined by Sarah Aarons, where I ask her: how important is dust? Welcome to Getting Curious. This is Jonathan Van Ness and we have got an episode for you. So let me tell you how it all started: I was minding my own business a few months ago and I scratched my arm in, like, the golden hour and I saw, like, this dust fly off. Which reminded me of this, like, clip from this TV show that I used to watch when I was little that was hosted by Summer Saunders and they would do these random facts. And she said that, like, 99% of dust was human skin cells. And then I was, like, "What the hell is dust?" And then we discovered Dr. Sarah Aarons, who is an Assistant Professor of Earth Sciences at UC San Diego's Scripps Institution of Oceanography. She studies mineral dust that is transported to polar regions and preserved in the ice core record. How are you? How're you doing? You doing good?

SARAH AARONS [00:01:16] I'm great. I'm here in San Diego. It stopped raining recently and the sun came out. So everything's good.

JVN [00:01:21] Yay! Those atmospheric rivers have just been all up in California's face lately.

SARAH AARONS [00:01:28] Yeah, definitely. We were lucky – we didn't have any landslides down here, but a little bit north of us was hit pretty hard. There's actually a very interesting link between atmospheric rivers and dust.

JVN [00:01:38] What the fuck! I just wasn't ready for the hard hitting facts coming so fast at the beginning of our episode. What is the link between atmospheric rivers and dust?

SARAH AARONS [00:01:46] People started noticing that when you had dust transport from Asian deserts across the Pacific Ocean, that you had atmospheric rivers that would hit the West Coast of the United States. And so they came up with this hypothesis basically that dust in the atmosphere is acting as a nucleus for water vapor to kind of absorb onto the dust particle. And so you get basically precipitation from dust transport. And it was verified by people basically collecting water during these atmospheric river events and measuring Asian dust in that water. So it's kind of a really cool way that the dust cycle or dust in the atmosphere is linked to water generation and deposition.

JVN [00:02:32] Oh, my God, I was not even ready. That is so interesting. Which then, aggressive other second question, are dust and dirt the same or different?

SARAH AARONS [00:02:45] Dust is basically defined as really fine particles of solid material. So it can be rock or it can be plastic. It can be, like, soot from wildfires or fossil fuel combustion, any sort of solid material. If you're able to grind it up fine enough to be lifted into the atmosphere by wind that is defined as dust. And so when I say I work on mineral dust, it's basically, I'm studying fine grained particles of rock that get blown up into the atmosphere. So dirt is kind of defined as sitting on the ground, right. So it's, like, you know, dirt is kind of similar to soil and that it also can be really fine grained, but it's grounded. And once it gets lifted up and transported, that's usually when it's called dust.

JVN [00:03:34] Obsessed. If we were to take a dust sample, like, from my living room—I do have five cats, three dogs. The chickens don't come inside. There's, like, me, my husband—and we put the dust under the microscope, what would be on that slide and, like, how would that dust have formed?

SARAH AARONS [00:03:50] Yeah. So because you're collecting it inside your house, a lot of it's going to be your dead skin. [LAUGHS] You're gonna have a lot of hair, pieces of hair that's broken down. A lot of clothing material.

JVN [00:04:02] No, not my ends, they're too healthy. No, my, my dust doesn't have any because I don't have split ends, actually. Not in our dust traps. There's no hair because our ends are, like, do you see how solid those are?

SARAH AARONS [00:04:12] Yeah, those look pretty–, those look really good.

JVN [00:04:14] No, thank you. I'm so sorry. I'm not being a nightmare.

SARAH AARONS [00:04:16] Maybe it's your cat hair. Your cat and dog hair.

JVN [00:04:18] Yeah, yeah you're right, it's a cat, yeah, it's them. Cuz they don't use JVN Hair because we don't do animal testing.

SARAH AARONS [00:04:22] Yeah, yeah, yeah. So it's probably a little bit of cat and dog hair. There's probably a little bit of bacteria, maybe, like, little tiny bits of bacteria. Maybe a little bit of, like, fungus spores.

JVN [00:04:35] Ooh, mycology.

SARAH AARONS [00:04:38] Yeah, maybe a little bit of pollen, depending on the time of year and whether you have your windows open. Yeah, that's pretty much what I would expect inside your house.

JVN [00:04:47] So it's, like, just another situation of duality. Like, yes, we're disgusting, but also we're gorgeous and it's not our fault that we can't control that we shed, like, bajillions of

skin cells, and that is in fact dust. And that's, that's fine. But I am obsessed with all the different kinds of dust. I guess I never understood, like, so there's mineral dust. What other dusts are there?

SARAH AARONS [00:05:10] I bought up plastic. Plastic is a really big topic right now. There's, like, a bunch of stuff going around about microplastics in the ocean. Recently, like, a few years ago, there was a paper that was published about microplastic deposition in national parks. And there was a researcher who put up these dust traps in national parks in Utah, and she basically figured out how much microplastics are being deposited in really, really remote environments on an annual scale. So she went out there and sampled every few months or so and was able to tell, like, "Okay, we have this many tons of plastic, tiny little particles of plastic that you can't really see with your naked eye, falling in places where we shouldn't have them at all.

JVN [00:05:55] Where do they come from?

SARAH AARONS [00:05:57] Yeah, a lot of it is coming from when you throw your clothes into the dryer. So, like, a lot of our clothes are made of synthetic material like plastics. And when you put them in the dryer, it's, like, tumbling around. And you have to have some sort of, like, friction or agitation to, like, break up, you know, your material. And your dryer basically vents into the outdoors. And that's how it gets into the outdoors. I mean, not to say, like, you know, pollution, too, right? If people throw their plastic bottles out in the road or whatever, it will break down and it'll eventually form microplastics, too. So it's basically just humans that are leading to, like, higher rates of microplastics in the atmosphere.

JVN [00:06:39] Would landfills contribute to that, too? Like if just, like, the plastics in the landfills, like, break down over time and, like, wind and just, like, really little teeny tiny bits just get kind of, like, chipped away, almost?

SARAH AARONS [00:06:49] Yeah, exactly. So wind and water are, like, two really good ways to break down things in the natural environment. And, you know, a landfill is anything but a natural environment. But, like, if you have plastic that's exposed and there's wind and rain that's hitting it, it'll break it down and then it'll be transported by the wind. Dust particles are usually—the ones that are transported in the atmosphere—smaller than 30 microns. And, like, for reference, like, a human hair is about 70 microns in diameter. Most of the dust we're seeing is, like, less than five microns in diameter.

JVN [00:07:22] Diameter, which is the whole way across.

SARAH AARONS [00:07:24] Yeah. And, like, the stuff that we collect in Antarctica in the ice is around one micron. So it's much, much smaller.

JVN [00:07:33] We just got home from London and we were staying in, like, our friend's apartment, like, would their dust in, like, urban London be different than, like—because, like, we live in Texas—so would it just be, like, less like environmental, like, pollens, and it would just be, like, more, like, tons of different people's skin cells cause you're, like, on the subway and, like, just around other people?

SARAH AARONS [00:07:51] It depends on, like, how much, I guess, exposure you have. So if you're going out on a subway and interacting with a lot of people, then you're probably picking up some material from them, too. If you live, like, in a really wooded area with a lot of forests around there, you probably have a lot more pollen. If someone lives in, like, urban London, like, in the middle of the city, there's probably more industrial dust. So things like soot.

JVN [00:08:16] Ooh! What would that be? Like, what are, like, those soot-y, like, like, industrial dusts? Like, is that just, like, broken down stuff?

SARAH AARONS [00:08:25] So people call it black carbon, black or brown carbon, and it's really small particles, even smaller than mineral dust, smaller than, like, a micron in diameter, which makes them worse for humans to breathe in because they can get further into your lungs. But it's basically just, like, you know, fossil fuel combustion. When you drive a car, when you look at the exhaust, you can see those particles sometimes, basically, like, the smoke that's coming out of an exhaust, that's what black carbon is.

JVN [00:08:54] And black carbon's, like, a type of dust?

SARAH AARONS [00:08:57] It's an aerosol. So you know, scientists like to refer to any sort of particles that are in the atmosphere as aerosols. So not just dust, but also things like black carbon, sulfate, things that are byproducts of fossil fuel combustion. And those things that are in the atmosphere, they interact with incoming solar radiation – so they can basically block incoming solar radiation or reflect outgoing long wave radiation. And that can have an influence or an impact on Earth's climate. So it can either warm or cool Earth's climate.

JVN [00:09:36] So the amount of, like, these, like, black carbons coming out of, like, factories—would even, like, the methane from, like, livestock farming—like, would that be, like, one of the things that we're talking about there?

SARAH AARONS [00:09:47] Methane and CO2, they're greenhouse gasses. But aerosols, they kind of act in, like, a similar way. So they're in the atmosphere, they have an effect on radiation. And radiation is, like, the amount of sunlight that we're receiving on Earth's surface, at a given time period. And whatever's in the atmosphere matters a lot because the sunlight has to travel through that in order to reach Earth and, like, the composition of it will influence, like, how much light is received at Earth's surface, but then also, like, how much heat is trapped on Earth's surface. If that makes sense?

JVN [00:10:25] It does and I, like, tracked that entire time. So, yay! As a scientist who studies dust, do you remember, like, a few months ago when people were showing that, like, like, slow motion camera of people, like, flushing their shitty toilet with, like, the thing open. And it was saying, like, "Essentially this is why you have to cover your toothbrush because, like, the shit particles really do, like, fling all over the place in your bathroom?" So, like, as someone who studies, like, dust and particles as a scientist, like, did you see that?

SARAH AARONS [00:10:52] I have always been very skeptical of keeping my toothbrush out next to my toilet for that reason.

JVN [00:10:59] [WAILS] Oh no, it was right, you guys! NO! You heard it here probably third or whatever. But it's so… So it is true. So shit dust. And when you fart, you're basically, like, farting fart shit dust? Like, shit dust.

SARAH AARONS [00:11:12] I mean, I think, like, if you're wearing clothes, you know, like, the clothes kind of act as a filter.

JVN [00:11:17] But didn't you see that thermal thing on TikTok that was, like, it had a thermal camera and it was catching people at the subway farting? And you could totally see, like, this, like, little plume come through their jeans! I'm just really surprised that, like, that is really, like, there really is dust shit. And I saw the look on your face, so, like, you heard it here first, guys! Like, that whole toilet flushing with the thing open and your toothbrush out there, like, don't do it.

SARAH AARONS [00:11:37] Yeah it's, like, with the water too, right? So, like, you flush the toilet and it's, like, stirring really vigorously and, like, there's probably a little bit of water vapor that gets out, too. So I, I keep my toothbrush in my cabinet, shut. I make sure it's shut every time I use it, so, yeah.

JVN [00:11:55] Wow. Okay, So then here's my second wellness/beauty dust-related question before we go back into science land. Okay, so quick question, like, do you know what dry exfoliating is, like, with those dry brushes when you, like, brush your skin with it, you know, like, like, the dry exfoliation? [SARAH AFFIRMS] Do you think that if I did that and, like, exfoliated with like a, you know, like a, like, a physical, like, schluffing exfoliant, like, do you think as a scientist, like, if I was to be really good at exfoliating for, like, like, you know, totally and completely clean a room. So it's, like, starting with no dust, then do one week where you're really exfoliating and then one week where you just don't do it at all. Do you think that it would create less dust, like, if you were really exfoliating, or do you think it's, like, all a bunch of fucking hog's wash, as my grandma would say?

SARAH AARONS [00:12:39] Well, have you seen that movie Gattaca?

JVN [00:12:41] No.

SARAH AARONS [00:12:42] No? Okay. It's with Ethan Hawke and Uma Thurman—and you should see it, it's a good movie—but basically it takes place in the future. And Ethan Hawke's character, he's impersonating somebody else, and he's trying to make sure that none of his DNA gets, like, left behind at the workplace. And so he does that every morning. He scrubs himself, like, raw, basically to try to reduce the amount of dry skin that's going to come off of him and, like, get onto his keyboard so that he won't be detected. So, yeah, to answer your question, I think, like, if you do exfoliate at ton, it'll reduce the amount of dry skin dust that you have in your house. For sure.

JVN [00:13:22] So exfoliating is not a fucking sham and you are already here from, like, a dust literal scientist. Okay, so I'm obsessed. I, like, thank you for doing that detour with me. I needed it for my queer soul. Thank you. That was really life affirming. And I loved every moment of it. So if you've ever seen one of my standup comedy shows, you'll know that, like, I do this thing that's, like, that's a [SCREECH] hard right? Like, which is when I go off track and I just, like, so, so far, that's all we've done so far. So I swear to God, I'm going back into my questions that I have prepared. So now, you study, like, how dust travels. So, like, how—how and how far—does dust travel? Like, it can go through the air from China all the way to North America? Like, how is it traveling?

SARAH AARONS [00:14:06] Yeah. So you have to have enough dust to be, like, available, right? It has to be sitting there. It has to be ready to go somewhere. And then you have to have energy to transport it. And that energy is wind. And so when the wind gusts are high enough, it lifts that dust up into the atmosphere and it sometimes goes up into the stratosphere and is transported, like, thousands of miles. It can be transported, like, across the Pacific Ocean. Dust from the Sahara Desert gets transported across the Atlantic Ocean. And people can measure it in Florida or the Caribbean or even the Amazon. So the dust that we're measuring in Antarctica comes from, like, South America and Australia.

JVN [00:14:56] Wow!

SARAH AARONS [00:14:57] So, like, we're getting stuff that's coming from, like, thousands and thousands of miles away.

JVN [00:15:00] When I was living in New Orleans filming Queer Eye on our last season, I was observing these, like, gigantic swarms of dragonflies, like, over this, like, football field. And then one of our previous Getting Curious guests who I think does regret giving me her cell phone number because every time I see an interesting insect, I Facetime her. But she was saying that those very dragonflies, they literally, like, ride the atmospheric, like, jet streams, a super far-ass way. So it's just so striking to me for how big the globe is, that still how, like, interconnected it can still be, like, in these measurable sort of ways. So, like, would volcanoes or, like, tornadoes or hurricanes ever, like—I was thinking, like, Mount St. Helens or like, really

big, like, volcanic eruptions through history—like, does that ever cause, like, more of a like, you know, transportation of dust, like, to far flung places?

SARAH AARONS [00:15:54] Yeah, definitely. That's a really great way to get it into the upper atmosphere and transported through, like, jet streams and trade winds to other locations. So, there was an eruption in—I don't know how many years ago this was—but a volcanic eruption in Iceland. And there were all those airplanes that had been grounded.

JVN [00:16:12] Oh yeah!

SARAH AARONS [00:16:13] Yeah, and so, like, this is stuff that once it gets into the atmosphere and kind of gets in the, the predominant wind patterns, it gets, like, circulated around the globe. If it's big enough, it can also really disrupt Earth's climate. These mega eruptions can be detected, like, from, like, thousands to millions of years ago.

JVN [00:16:33] Oh, like, so we can still detect dust from, like, eruptions that happened, like, millions of years ago?

SARAH AARONS [00:16:41] Yeah. For millions of years ago, people look at, like, soil profiles, for example. If you, like, dig a soil pit or you're looking at the rock record, you can often find thin layers of volcanic ash that can be dated and you can figure out, like, which volcano it came from. In ice cores, if we have a volcanic ash layer, you basically look at, like, the composition of the dust or the ash and you can figure out which volcano it came from. And then, you know, "Okay, like, this was the eruption that happened in 1773. So we know the age of this ice." So it's kind of used as, like, an independent way to date the ice.

JVN [00:17:24] Fuck, that's interesting. I'm so tempted to jump ship for my next question to just go there. But I just, well, because I think one thing I've learned already that I really didn't understand is that like the amount of dust, no matter what it comes from, whether it's, like, from an eruption, pollution, whatever it is, it affects the atmosphere which affects like, you know, temperature and, like, climate, global warming, like, there is, there is a reason for us to be curious about, like, how much dust there is in the atmosphere. So, like, do we know how much dust there is the atmosphere? Is there a way that, like scientists used to measure, like, the transparency of the atmosphere, like, how much dust is in it?

SARAH AARONS [00:18:03] Yeah, that's a really good question. I feel like you already know the answer to it! I was saying that dust absorbs or reflects light. It depends on the size and the composition of the dust. But we have satellites, right, that are just floating around in space and they have sensors on them. And they can basically, like, detect areas of absorption or reflection in the atmosphere.

JVN [00:18:25] Oh!

SARAH AARONS [00:18:26] And so they can derive how much dust is in the atmosphere during a particular time period. The current estimates of how much dust is in the atmosphere on average is about 20 teragrams, at any given time. And a teragram is equal to a trillion grams. So it's, like, a huge amount of dust in the atmosphere at any given time.

JVN [00:18:50] Because there's probably still dust from, like, Cleopatra or something, like, all the humans, like through time! Like, they're like little—because once dust is formed, can it ever break down, like, all the way? Like, will my skin cell dust be on this Earth for, like, 500,000 years? So really, I will live on? Or no.

SARAH AARONS [00:19:11] So there's a lifetime for how long dust can be in the atmosphere. You have to have enough energy to keep it in the atmosphere so the wind will transport it. But eventually, like, that wind will die off or weaken and then the dust will settle out of the atmosphere. So you can have the dust fall on land or in the ocean or on glaciers and ice sheets. And so those are, like, our sinks. We call them "sinks." It's, like, where things go and when they're deposited in those sinks, they kind of get preserved and saved for us to look at, to look at, like, "Okay, what was the dust looking like a thousand years ago or a million years ago?" So it's a cycle. So you have your sources of dust, which are, like, deserts. We also have a lot of dust coming from where glaciers are retreating. That's a new source of dust. And then you have your sinks. So your sinks are where the dust is deposited, and that can be the ocean, land, and ice.

JVN [00:20:18] So you study mineral dust. So what's particular—if we, if we don't know already—what's particular about mineral dust as compared to other ones? Like, does mineral dust just, like, exclusively come from, like, rocks and minerals?

SARAH AARONS [00:20:32] I mean, when I'm measuring dust in a sample, there's a lot of other stuff in there, but I don't care about that stuff so much. I mostly just care about the mineral dust. And that's all coming from the breakdown of rocks. So as rocks are weathered or basically broken down from rock into fine grained sediment, that's what I'm interested in looking at. And, and I care about it because of the ecological significance of it. So I'm thinking about, like, you know, "If this dust was deposited on land in the mountains or in the surface ocean, what would it do to life in that area? Does it have critical nutrients that would help organisms in those areas thrive?" So that's, like, kind of the underlying questions that we're after a bit.

JVN [00:21:20] So, like, what kind of mineral dusts, like, will you find? Is there, like, quartz mineral dust and, like, like, flint mineral dust or like limestone? Like, is it like every type of rock imaginable mineral dust?

SARAH AARONS [00:21:31] Yeah. So a lot of it is like clay minerals, so it's super fine grained. So it's not, like, a primary mineral. A primary mineral would be something like quartz or, like, zircon. Sometimes we find that stuff, but mostly it's clay minerals. In some of our samples,

we've found pieces of diatoms, you know, they live in the surface ocean and, like, they get also lifted up into the air and transported and deposited. And so, like, we find living things in our samples.

JVN [00:22:02] But those, like, marine creatures, those diatoms, but they're so lightweight that they can get swept, like, off the ocean and then you find them, like, their little dead sea creature body because they got lifted out of the water? So they're, like, little dried up things?

SARAH AARONS [00:22:12] Yeah. So we find their little dead bodies in our ice, you know, from, like, 100,000 years ago. We're, like, "Oh, okay. Well, it must have been open ocean conditions during this time period because we found these diatom, you know, shells in our sample."

JVN [00:22:28] Wow! So, and then I think we know, like, where it's found: like, often mineral dust is found and, like, the sinks, right? Like that's where it's deposited, like, which is, like, your land, surface ocean, glaciers. What was the other ones you said?

SARAH AARONS [00:22:43] I have, like, a schematic I can show you.

JVN [00:22:45] I fucking love schematics. We're big fans of schematics around here.

SARAH AARONS [00:22:48] Okay, cool. So this is a schematic that I use a lot. So on the left hand side, we have our source, which is our desert, and you have to have enough wind to lift this up into the atmosphere. And so you're transporting this dust in the atmosphere, and then you have a lot of scattering of solar radiation or absorption. So, like, sometimes those dust particles can, like, basically absorb that heat from the sun. You have dust that's deposited in the surface ocean, so it's delivering nutrients to the surface ocean. But a lot of that dust basically sinks through the water and is preserved in the marine sediment record. So people go out and they drill these cores in the ocean and they get these records of dust that are, like, millions of years long. I talked a little bit already about, like, dust and atmospheric rivers and, like, cloud formation. So it's basically, like, it's easier for water to condense around something that's already there. So if you have a dust particle in the atmosphere, that water will condense more easily around it. And you can have, like, atmospheric river generation. You have dust deposited on land. And we can, we can monitor this, like, with modern dust collectors. I just, like, set things up out in the forest and, like, go and collect them every once in a while. And then you have dust that makes its way to the polar regions and it's deposited on ice sheets and glaciers. And we can look at, like, ice cores. Or we could also look at, like, sediment cores, too. That's, like, the source. And then these are all the sinks that exist for dust.

JVN [00:24:26] That is so cool. What does, like, an ice core or, like, the lake core tell us about what was going on, like, millions of years ago or even hundreds of years ago?

SARAH AARONS [00:24:35] Yeah. So that's a really good question. When we're thinking about dust, there's, like, a lot of things that can influence, like, how much dust is in the atmosphere at any time. And one of them is, like, how much dust there is. So, like, the availability of it. And that really depends on whether or not it's dry. So if it's dry and you don't have a lot of, like, rain you're going to have more dust that's available. It's going to be dustier conditions. So if you, like, are looking deeper in time and you measure a time period where it's dustier, then you can say, like, "Okay, this time period was probably drier than this time period because there's more dust in our record." If you're trying to figure out where that dust came from, you can use isotopes to fingerprint where it came from. So that's, like, what I do a lot of, is, like, fingerprinting where the dust came from, which continent it came from, and if you know which continent it came from, then you can say, like, "Alright, the wind was blowing in this direction during this time period." And if it changes over a different climate period, then you can say something about the way that predominant wind directions are shifting as a result of a changing climate. Does that makes sense?

JVN [00:25:51] Ah! Yes, because like right now, like in our latitude, like in North America, like the weather usually goes, like, from west to east, but maybe, like, 100 million years ago, it was going, like, east to west, like maybe was the reverse or just, like, different, like, jet flow. So you can figure out if things are going a super different way a long time ago or the same way a long time ago.

SARAH AARONS [00:26:11] Yeah, exactly. There is, like, a really cool paper that was published a few years ago where these scientists were looking at two marine sediment cores in the Pacific Ocean. So the westerly winds are, like, predominant wind pattern in North America. So you have, like, wind that's blowing from the west towards the east. And, like, if it's warmer, people think that there's this poleward migration of that wind pattern. And this study confirmed it through dust. So they're, like, "We see a shift in the amount of dust that's coming from this region to the more northern marine sediment core." And so they were able to show, for the first time, that during warm periods you actually have shifts in the positions of these predominant wind patterns.

JVN [00:26:58] How cool.

SARAH AARONS [00:26:59] Yeah, I thought it was really cool. I thought it was a really great study.

JVN [00:27:03] So we talked we touched about on this a little bit, but I want to go deeper. So we learned from Dr. Marsha Allen, she was teaching us, like, how she determines the age of water from, like, the groundwater samples that she works with. How do you, like, determine the age of dust?

SARAH AARONS [00:27:18] It is hard. So, I mean, the stuff that we are measuring in ice cores, we usually know the age of the ice that we're looking at. And so it's, like, if you have a

paleoclimate record that's dated well, then you know, “Okay, like, well, this dust fell at this depth, right, it’s in this depth in this ice core record. So we know the age of it from there.” We don't actually know how old the dust is. We only know how long ago it was deposited in that sink. Does that make sense?

JVN [00:27:51] Ah! Yeah. It's, like, you don't know when it originated from, but you can reasonably say, like, "Okay, it was deposited like 3 million years ago or, you know, 30,000 years ago" or whatever you're measuring.

SARAH AARONS [00:28:01] Yeah, exactly. So it's really hard to figure out, like, the age of material. You can date rocks, you can figure out how old rocks are, but when it's in the dust form, it becomes trickier and trickier.

JVN [00:28:13] So what's the deal with this paleo dust? Is it, like, a fad diet where you can eat all the butter and meat you want but you can't eat carbs or something, like, yeah, what's this paleo dust?

SARAH AARONS [00:28:23] Yeah, so paleo dust basically just means, like, “past dust.” So dust preserved in the paleoclimate record.

JVN [00:28:32] Ahhh.

SARAH AARONS [00:28:33] So when I'm talking about sediment cores or ice cores or lake sediment cores, if we're looking at dust in those records, that's paleo dust because it is not modern dust, it's, it was dropped in that sink and it has been preserved there since it was dropped.

JVN [00:28:51] When you're studying an ice core, like, how long is that sample of ice? Is it, like, 50 feet long? Can it be, like, a foot long. Is that from, like, a mile down in the glacier? Like, where are these cores coming from?

SARAH AARONS [00:29:03] Yeah, so Most of the work that I've done in Antarctica, the ice has come from the Taylor glacier, which is about a 40-minute helicopter ride from McMurdo.

JVN [00:29:15] So your ass went to fucking Antarctica?

SARAH AARONS [00:29:21] Yes.

JVN [00:29:22] Did you read that article in The Atlantic about that guy, who went to Antarctica? It literally took me, like, an hour and 15 minutes to read, and it was, like, a really good article—but they were measuring, they'd, like, drop the sensors, like, under the ice to see how fast the glaciers were melting. But just the story of them, like, dealing with the Antarctic, like, was so harrowing and, like, I was just, like, you couldn't like, pay me—there's

not enough money in the world. Even if I was gonna save humanity, like, I just could not do it. And then I think the first time that you said that, it was, like, going over my head and then in my head I was, like, "Did I interview someone about that?" And then I was, like, "No, it was that fucking article!" Because my, Mark was, like, my husband was, like, Why do you read? And I was like, "Shh. Don't talk to me. I have to, like, finish this." But you did that! Like, you went on a ship from—did you go from Argentina or did you go from a different place?

SARAH AARONS [00:30:05] We actually, like, fly to Christchurch, New Zealand.

JVN [00:30:08] Oooh!

SARAH AARONS [00:30:10] Mhm. And then you take an Air Force plane from New Zealand to McMurdo. So depending on, like, the plane it can be a C-17, which was, like, 5 hours or something like that. Or it can be 8 hours.

JVN [00:30:24] How many times have you been to Antarctica?

SARAH AARONS [00:30:26] I've been twice.

JVN [00:30:27] Wow!

SARAH AARONS [00:30:29] Yeah. So I would have gone this year, but I just had a baby five months ago, so I couldn't leave him behind.

JVN [00:30:35] Ah! Congratulations on baby. But Antarctica—not that that baby isn't fierce—but holy shit—so, I'm sorry. I'm a nightmare, but it's fine. It's, like, I'm having too much fun in this interview, and you're just, like, fascinating. So does that mean, like, have you been to, like, every continent then, since you've been to Antarctica?

SARAH AARONS [00:30:50] Yeah.

JVN [00:30:51] Damn! I don't know if we've ever had someone on Getting Curious who's been to every single one!

SARAH AARONS [00:30:56] You know, going to Antarctica is like the closest I think you can come to going to another planet, but still staying on Earth. It's just this amazing place and I loved going there and I'm really excited to go back.

JVN [00:31:09] So but you didn't take a ship. You flew to Christchurch and then you're like, you land on like an ice sheet or something?

SARAH AARONS [00:31:15] Yeah. So you land on the ice shelf. It takes a really long time to slow down because there's not as much friction, you know? So you're just, like, you land and

you're just, like, [MIMICS A PLANE LANDING] and you're just, like, gliding for like it feels like miles before you eventually slow down.

JVN [00:31:29] How long would you say it is? Like, how long are you gliding? Like, like, 5 minutes. 2 minutes.

SARAH AARONS [00:31:34] It felt like maybe 2 minutes or something like that, yeah.

JVN [00:31:37] Cause usually it's, like, 30. It's like, not very long.

SARAH AARONS [00:31:39] No, no. And then you, like, they open the door and you walk out and it's just everything is so bright because it's just, like, white, you know, white ice. And then the sky is, like, you know, reflecting off of it and it's just, like, super bright. And then you get on this bus and you get transported to the station, which is, like, a few miles away. And sometimes there's, like, penguins just sitting on the ice that you can see, like, you know, it's just really surreal. It's just, like, a really cool experience.

JVN [00:32:10] Did you stay in the station thing?

SARAH AARONS [00:32:12] We did for about a week when you're getting ready to go out into the field. So the National Science Foundation runs, like, McMurdo Station and they want to make sure that everything's super safe. So you do this kind of snow safety training thing.

JVN [00:32:27] Like how to avoid the crevasses or whatever?

SARAH AARONS [00:32:29] Yeah. And, like, how to build shelters in the field.

JVN [00:32:32] Did you have to do that? There wasn't just, like, a pop up tent?

SARAH AARONS [00:32:35] Well there's these things called Scott tents, it's this, like, really, like, pointy yellow tent that you have to, like, put up. And they're really hard to put up when it's super windy out. But you put those up and usually people use those for shelter. But in case like there's a huge wind storm that would, like, blow your tent away if it wasn't anchored well, then you have to figure out, like, how you're going to survive in that situation. So we actually, like, built a little snow shelter and I didn't spend the night in it. I spent the night in the Scott tent. But it's, like, good to know how to survive.

JVN [00:33:10] So many nights did you have to sleep in the field?

SARAH AARONS [00:33:13] So there was, like, a practice one at McMurdo. And then we took a helicopter to Taylor Glacier, and I spent about, like, three weeks on Taylor Glacier camping.

JVN [00:33:22] Fuck me! Both times? Or like.

SARAH AARONS [00:33:26] So the first time it was about three weeks and then the second time was about a week. It's just, it's cool because you basically, like, set your tent up on the ice. And the first night I remember, like, hearing these huge boom noises, like, these cracks, and I was like, super scared. I was like, "What is that? I don't know what that is. And the next morning my advisor told me she's, like, "Oh yeah, that was the glacier, like, the glacier, like cracks and moves, like, all the time." And I just had never heard it before because I think it was the first time I'd ever been on a glacier before. I'm going to share my screen really quick, too, so I can show you a picture. You know, it's a really physical thing that we're doing. It's, like, we're drilling for these huge cylinders of ice and they're really heavy. Like the one that we're holding in this picture below here is, like, it's over 100lbs.

JVN [00:34:13] That's probably, like, six feet long and, like, one foot wide, maybe?

SARAH AARONS [00:34:18] Yeah this one that we're holding, is, like, over a meter long and so it's, like, over three feet long, and it's, like, I don't know, it's I think it's 22 inches in diameter.

JVN [00:34294] Yeah, it's, it's really big. So this is, like, physically exerting. And look at those mountains in Antarctica.

SARAH AARONS [00:34:35] Yeah. So it's, like, you know, a lot of people think of Antarctica and they're, like, "Oh, it's just like a frozen wasteland." But, like, where we were, it's surrounded by mountains and really pretty.

JVN [00:34:49] I just, it took me a minute to grasp that, like, you went to literal Antarctica. And I would say that my only note for you as a person is this: why is it not your first thing that you lead with in a party that you've been to every continent? If I've been to every continent, like, it would be, like, I might get it tattooed somewhere. Like, it's above averagely extremely cool. Like, just it's, like, fucking super duper cool. Okay, so now we're going back. Did you ever find paleo dust in those ice samples?

SARAH AARONS [00:35:21] Yeah. So the first time we drilled for ice, there was, like, 30,000 year old ice to present day. And then the second time it was like 145,000 year old ice to about 120,000 years ago. So that covered a time period. It was the last warm period compared to today. And yeah, we, we found dust in there and we, we looked at its chemical composition and, like, the isotopes of those, of those dust particles and we figured out like where it came from.

JVN [00:35:52] Was the warm period, like, do we know if it was, like, warmer than now? Like not to say that global warming isn't happening, but like, could we maybe be okay or are we, like, super fucked? What do we think?

SARAH AARONS [00:36:201 It's called the last interglacial period. It was, like, the last warm period before today. And right now, you know, people's estimates are that it was warmer than currently. But the orbital conditions were different. And so when I say orbital conditions, I'm talking about, like, the tilt of the Earth's axis, the shape of the rotation of the earth around the sun, and, like, how wobbly Earth's orbit is. So, like, those three things are the primary controls on Earth's climate, and, and they change on predictable time scales. So, like, every 100,000 years or so, we're supposed to be alternating between a warm and a cold period based on those three different things. But because, you know, humans have shown up and started pumping a bunch of fossil fuels into the atmosphere, we're starting to change the radiative budget, the balance of Earth's radiation. And, like, you know, how much heat we're actually absorbing into the ocean. And the rate that we're doing it as humans is unprecedented. So our ability to predict how Earth's climate will adjust to that is, like, we've never had to deal with this before because it's never happened before in Earth's history.

JVN [00:37:15] So is that the most primary way that industrialization is, like, leaving its mark on nature? Is that, like, humans are pumping more carbon, it's carbon, right? You literally just said that, right? Carbon dioxide.

SARAH AARONS [00:37:26] Yeah. Carbon dioxide. Yeah. Carbon dioxide in the atmosphere. But there's also more black carbon. So, like, people can measure black carbon in paleoclimate records, in the ice core record. And you can see the start of industrialization happening because you have an increase in the amount of black carbon that you find in ice. And, you know, Black carbon, not just in the atmosphere does it have effects, but also, like, if you deposit it on snow and ice surfaces, it lowers the albedo, which is, like, the reflectivity of it. So it's, like, dark. And, you know, if you wear, like, white on a summer day, you know, like, you say, pretty cool, but you wear, like, a black shirt in the summer, you're, like, sweating through it. It's the same thing with black carbon. So if you have black carbon deposited on a snow or ice surface, it will absorb heat faster and it will melt faster.

JVN [00:38:16] Are there, like, particular places in the world that are hit harder by that increased black carbon and just increased carbon dioxide, like, I hear you saying, like, wherever it's cold or like, icy or white. So, like, mountaintops, like the poles, like, colder areas. [SARAH AFFIRMS] But is it, like, kind of everywhere? Like, no one can really escape it if the entire atmosphere is changing.

SARAH AARONS [00:38:37] Yeah. So our atmosphere is, like, fairly well-mixed. So if we're pumping in CO2, like, you know, in North America, like we're going to see that in the rest of the atmosphere. And black carbon, too, the impacts that it has changes depending on what latitude you're at. So like here in Southern California, we're not going to feel as much change in terms of climate as polar regions are going to experience. There's this term Arctic amplification, which is basically that with climate change, the climate will change more dramatically and more rapidly at higher latitudes. So places like Alaska, like where I'm from.

So, you know, you're going to have warmer conditions and the climate will change more quickly.

JVN [00:39:24] You're Alaskan?!

SARAH AARONS [00:39:26] Mhhm.

JVN [00:39:27] Congratulations on your ranked choice voting system, though, that like, delivered you from having to have fucking Sarah Palin be your representative. Like, go Alaska.

SARAH AARONS [00:39:35] Yeah. I know. I was really happy with it. We're really happy about Mary Peltola being elected.

JVN [00:39:39] I love her!

SARAH AARONS [00:39:41] Yeah. So she's, like, the first Alaska Native woman, so we're just super excited. You know a lot about, like, Alaska politics. I'm surprised.

JVN [00:39:49] Well, I know a lot about American politics. So, like, Alaska is like, you know, okay, they're doing the damn thing. Okay, wait. So I think we have talked about, like, that dust and climate change do have a relationship, and there's a way to, like, measure, you know, when things are warmer, like, the dust, like, record goes up farther north, then, like, what it did in like, colder eras. Like, there's a way for us, or there's a way for scientists to track this. But my question is here can dust be a part of any, like, climate solutions?

SARAH AARONS [00:40:16] Yeah. So there was, like, this hypothesis. It's called the, the iron fertilization hypothesis. So marine phytoplankton, they need iron in order to thrive. And the iron fertilization hypothesis was that dust, which is the primary form of iron that's delivered to the surface ocean far away from land, could serve as, like, this fertilization potential for phytoplankton. And there's actually been people who have, like, dumped tons of iron or tons of dust into the ocean to see how phytoplankton respond to it. And, you know, phytoplankton, they're primary producers. So they photosynthesize. So they, like, draw down carbon dioxide as they're thriving. And so, you can change the greenhouse gas composition if you have a lot of phytoplankton productivity. So there's this idea that, you know, if you're generating more dust and it's being transported to the surface ocean, you can actually fertilize the surface ocean and change the amount of carbon that's in the atmosphere. Since then, there's been a lot of research that has shown that this is, like, more nuanced than that. Like, the type of iron that's in the dust really matters, so, like, the oxidation state of the iron, whether it's, like, reduced iron or oxidized iron matters.

JVN [00:41:37] Because they dumped the whole bunch of dust in there and then nothing really, or, like, the phytoplankton were, like, "Ew, we're dying," and then they were, like, "Oh."

SARAH AARONS [00:41:43] I mean, it did work. Right. So there was a phytoplankton bloom. And, like, I don't know if you saw this in the news recently, but there were a bunch of wildfires in Australia [JVN AFFIRMS] and, like, yeah, and there was, like, all this, like, soot that was basically, like, transported to the ocean and then deposited and then you had a huge phytoplankton bloom there, too.

JVN [00:42:03] Does that mean that that part of the ocean just turns, like, super green, or do you have to, like, measure it?

SARAH AARONS [00:42:08] Yeah, you can see it. You can see in satellite imagery, like, it looks really, really green. The form that the iron is in, and its composition, matters a lot and also the size of the particles, too. So it's like if you have smaller particles from wildfires, you have a higher surface area, so they're able to dissolve more easily. Since that iron fertilization hypothesis, there's been, like, a huge offshoot of, like, studies that have focused on, like, "Okay, what time period are we looking at? Was there a change in dust flux or the amount of dust to the ocean during this time period? Does the type of iron that's delivered to the ocean matter? How is this iron accessed by phytoplankton?" Just, like, a ton of questions have arisen from that research.

JVN [00:42:51] What would the benefit of that be? That, like, because the phytoplankton can like, suck carbon out of the atmosphere or something? So it could potentially, like, lower the temperatures of the ocean or something if there was more phytoplankton?

SARAH AARONS [00:43:02] The idea is that, like the phytoplankton would draw down carbon dioxide from the atmosphere and then, like, they die and, like, some of that carbon is exported to the deep ocean as they sink through the water column. So it's, like, a removal of carbon from the atmosphere and put into a sink, which is at the bottom of the ocean.

JVN [00:43:24] I hope that doesn't have any negative effects. Like, hopefully that's fine. Right? It's probably fine. Right?

SARAH AARONS [00:43:29] Yeah. I mean, eventually, like, that, you know, that sink will be recycled and it'll turn into a volcano and, like, the volcano spit out carbon dioxide. So everything is like a cycle. Like, we can never truly get rid of carbon on Earth unless we, you know, put it on a rocket ship. Right. So everything is connected and it goes through a cycle.

JVN [00:43:52] Honey, I'm obsessed. It's a circle of life, as my husband would say. So you're minding your own business one day as, like, a young person in Alaska. And then you were like, "I'm obsessed with dust." Like, what was your moment? How did you become obsessed with, like, mineral dust?

SARAH AARONS [00:44:08] Yeah, it was kind of a really roundabout way. I was in college, and I was pre-med, actually, and then I, like, totally bombed my first chemistry exam, and I was,

like, "Okay, I need to switch majors." So I was a history major for a really long time, and I didn't know what I would do with that. And my dad actually suggested to me that I take an Earth Science class. And I was always, like, "I love science, I love looking at, like, figures and stuff like that for some reason. And then I loved being outside." So that's how I got interested in Earth Science. And then when I took those classes, I took paleoclimate and then I also took geochemistry. And when I applied to grad school, I just said I wanted to work on those two aspects of Earth Science. And it was actually my advisor, Sarah Aciego, who had this project in Antarctica looking at dust in the Taylor Glacier and asked me if I wanted to go. And I was like, "Yes, absolutely." You know, like polar regions are really important to me because I'm from Alaska and I care a lot about, you know, climate and how that's changing the polar regions. And the idea of going to Antarctica was irresistible to me. I never knew, like, going into it that I was going to be so into dust. But like once that door was opened up and you see, like, how much influence dust has on Earth's climate, both like in modern day and then also in the past. It's just, yeah, you can create like a whole career out of it.

JVN [00:45:36] I didn't even know about these connections. I have another Antarctica question. I'm sorry that but so like, divergent into like, what's it like to go to Antarctica, but could you drink coffee there? Like, is there a coffee machine or. And there's no fucking coffee Like how to have a warm drink?

SARAH AARONS [00:45:49] No, there's coffee like at McMurdo. There's even like a coffee bar there, but like in the field we bring our own coffee, we make, make our coffee.

JVN [00:45:58] Do thermoses even work in Antarctica? Like, will it still keep it hot for, like, 5 hours.

SARAH AARONS [00:46:03] Yeah, it'll keep it hot for 5 hours. And, like, there's this thing that they make in, like, New Zealand and Australia. It's like, it's basically sweetened condensed milk in, like, a gel form. But they put it into this, like, toothpaste container and so you, like, squeeze it into your coffee and like, yeah, it's, like, pretty gross when you think about it. But it was actually really, really good because you have to eat like a ton of calories to stay warm in the field. So you're just, like, squeezing sweetened condensed milk goop in your coffee every day.

JVN [00:46:34] Too bad there's not a Taco Bell in Antarctica, because I could have totally, like, suck up at Taco Bell and I'm, like, just get my calories. Then, like, "I'll take four Mexican pizzas, three double decker tacos, add chicken and sour cream. Thank you." Delish!

SARAH AARONS [00:46:46] Yeah, don't have to worry about it.

JVN [00:46:47] Oh, my God. Is there ever times where, in your work, like, you come across, like, a climate change denier or somebody who, like—are you ever able to, like, school,

someone on something like using, like, a small scale material that is just like dust? Have you ever been like "Actually, as an Earth Scientist, X, Y, Z."

SARAH AARONS [00:47:06] People say the rock record or the ice records, they don't lie. So there are things that we can measure and they go back through time. They're historical and we can say, like, "Alright, we know it was cold during this time period, we know it was hot during this time period. for that climate related question, I think that it's, like, smoking gun is, is that the carbon dioxide part of it. So talking about, like, how that varies naturally, like, in the ice core record versus, like, what the carbon dioxide level is right now. So we have, like, really good constraints on that from the ice core record. And when we're, like, way above what's what we're expected to be, it's, like, there's no doubt in my mind that like this is because of humans.

JVN [00:47:55] Because the Republicans are, like, "It's been getting warmer and colder on Earth for millions of years." And then you're like, "Actually, here's the ice and see how, like, you can see the presence of carbon and it's, like, in this range. But then ever since our industrial revolution it's been, like, this completely other range that we've never, ever seen before." So you're saying, like, there is clear evidence that we've never had this much output of carbon dioxide in the atmosphere.

SARAH AARONS [00:48:21] Yeah. Like people, things that always had similar levels of carbon dioxide in the atmosphere, like, millions of years ago. But the rate that we've increased the carbon dioxide has, like, been unprecedented. In the end, you know, people are, like, "Oh, well, how do we know that that carbon dioxide came from humans?" And the answer is isotopes. So, like, you can measure the carbon isotope composition of the carbon dioxide in the atmosphere, and it's very similar to what fossil fuels are. So it's like now we know we have a fingerprint, we know exactly where that carbon came from. Um And that's why I love isotopes. I think they're just, like, this super cool detective tool that you can use to say, like, "We know that it came from this place because the isotope composition matches." And, like, in Alaska, you know, people are like, "Oh, I thought it was supposed to be, you know, getting warmer in Alaska, but like, we've got the most snow we've ever gotten this year." And it's, like, "Well, when you're making snow, you have to evaporate that water from the, from the ocean. And so it needs to be pretty warm. So like, if you have a really snowy season, like, a snowy winter season, that actually means it's warmer, right?"

JVN [00:49:32] Oh yeah, because I think it's, like, past a certain temperature, like, it doesn't, like, because I remember that growing up in the Midwest, like, if it gets too cold, then it doesn't even snow, even if there is like cloudy skies because it can actually just be like too cold to snow.

SARAH AARONS [00:49:44] Yeah. And like people in Alaska, I think a lot of them know that climate change is real and happening. I mean, there's been, like, unprecedented rates of forest

fire there in the summer. And, like, you know, that's related to how dry it is in the summer and then also the temperature.

JVN [00:50:01] So what questions are you still working through as a mineral dust particle scientist?

SARAH AARONS [00:50:06] So I actually have a student who is in Antarctica right now, Austin Carter. He just had a TikTok video go viral. Actually. He stuck a GoPro down a borehole in Antarctica like 100 meters deep. It's really cool. I can send it to you if you're interested.

JVN [00:50:22] Yes!

SARAH AARONS [00:50:23] Yeah. So we're basically working on, like, these questions related to, like, weather dust fertilization in the distant ocean can actually impact global carbon cycles in a way that would, like, significantly influence Earth's climate. We're also thinking about, like, the modern day climate and, like, we're thinking about glacial retreat. And as glaciers retreat, you have this exposure of a lot of fine grained sediment that is fresh and unweathered and has a lot of iron in it and a lot of bioavailable iron. And we're interested in, like, trying to figure out, like, "Okay, so is this going to be good for, you know, phytoplankton productivity? Is this going to be, like, a fertilization impact? If it's deposited in the surface ocean, like, what happens to that dust? Is the iron in that does available for phytoplankton to use? Are there microbes in the ocean that are making it easier for that iron to be dissolved?" So more like finer scale questions about the chemical composition of the dust and like what happens after it gets into the ocean.

JVN [00:51:29] Which is kind of telling because you know what I'm saying, like, "*if* it gets into the ocean," like, because it's the glaciers are going back so fast, like, it's like when that stuff gets into the ocean.

SARAH AARONS [00:51:38] Yeah. It's like when it gets into the ocean, like, what happens next? And like, you know, the Antarctic stuff is, like, we are looking further back in time when we know that Earth's climate changed really dramatically. And, like, people think that dust had a big influence on Earth's climate. But we want to look a little bit deeper. We want to look at, like, "Okay, is there actually a lot of iron that's available for phytoplankton to use in this, in this dust?"

JVN [00:52:06] Are people doing that, like, in the North Pole, too? Like, are people doing, like, ice cores in the North Pole or is it, like, more of, like, an Antarctica thing?

SARAH AARONS [00:52:14] The longest ice core records are in Antarctica. Like, the 2 million year old records are in Antarctica. People do ice core research in Greenland. But those records don't go past the last interglacial period just because it's warmer in Greenland. And then you

also have higher precipitation rates. So, like, the ice flows out faster so you don't preserve ice as long there.

JVN [00:52:38] And they don't want to disturb Santa, like, because it is busy, like, throughout the year. So you have to, like, give him his space.

SARAH AARONS [00:52:44] Yeah, they want to give Santa a wide berth.

JVN [00:52:45] Mrs. Claus doesn't like that if you're like all up in our backyard, like doing fucking scientific research. Now if someone wants to go to a dust trap in their backyard or figure out more about dust, like, and the dust that they interact with. Like, are we just like ordering a dust trap and, like, setting it up in our house or, like, in our backyard or something?

SARAH AARONS [00:53:01] Yeah, So you can do a backyard one pretty easily. You can basically buy a bundt cake pan. So like a Teflon-coated bundt cake pan and you can fill it with marbles and you can put it on, like, a post in your backyard. And what happens is, like, the dust will fall on the marbles and it'll kind of, like, sift through the marbles and be trapped at the bottom and the marbles prevent the dust from being lifted back out of the pan. So you can leave it out there for, like, a month or three months or however long, and they can go out there and get your bundt cake pan, fill it with water, and then drain it into like a cup or something, and then you can let the water evaporate and you'll be left behind with the dust. So yeah, you can do it yourself in your backyard.

JVN [00:53:51] So it doesn’t matter if it rains, because, like, you're going to get it wet at the end anyway.

SARAH AARONS [00:53:55] If it does rain, you want to make sure the pan doesn't overflow, because then you might lose some dust. But yeah, I mean, it's fine if it does.

JVN [00:54:03] So what do you hope listeners take away from your work and just more generally moving forward? Because to me, it's how important it is. I learned how I didn't even know and know! And now I know more!

SARAH AARONS [00:54:12] Yeah, good, I'm glad you think that. I mean, I think before I started doing this research and some people like I've talked to, they're like, "Why dust? Why would you be interested in studying that?" And I think as I've gotten more into it, I've realized how large of a role dust plays on Earth's climate. Not just through, like, the fertilization potential of the ocean, but also the fertilization potential on land, and then also, like, dust in the atmosphere. So we talked about atmospheric rivers and, like, delivering huge amounts of water to Southern California. That's largely because of dust transport from Asia. And then I also talked about dust in the atmosphere, you know, scattering incoming solar radiation or making it warmer on Earth's surface. Thinking about, like, the role of something so tiny on

Earth's climate is something that I just want listeners to take away in that like everything's connected. So it's a cycle.

JVN [00:55:08] Ah! Oh, my God. I had so much fun today I cannot even stand it. Sarah Aarons, thank you so much for coming on Getting Curious. We are so grateful for you and your time and for your research and for sharing it so kindly with us. We love you to pieces. Thank you for coming on. Getting Curious! Dr. Sarah Aarons. Yeah.

SARAH AARONS [00:55:25] Thank you.

JVN [00:55:28] You've been listening to Getting Curious with me, Jonathan Van Ness, our guest this week was Sarah Aarons. You can find links to her work in the episode description of whatever you're listening to the show on. Our theme music is Freak by Quiñ. Thank you so much to her for letting us use it. If you enjoyed our show, introduce a friend, honey, and please show them how to subscribe. You can follow us on Instagram and Twitter @CuriousWithJVN for more. Our editor is Andrew Carson, Getting Curious is produced by me, Erica Getto and Zahra Crim.