Getting Curious with Jonathan Van Ness & Professor Beronda Montgomery

JVN [00:00:00] Welcome to Getting Curious. I'm Jonathan Van Ness and every week I sit down for a 40 minute conversation with a brilliant expert to learn all about something that makes me curious. On today's episode, I'm joined by Michigan State University Professor Beronda Montgomery, where I ask her: Are Plants Literal Geniuses? Welcome to Getting Curious, this is Jonathan Van Ness. I'm so excited for this episode because I have been wanting to learn about trees for so long. Without any further ado, welcome to the show, Professor Beronda Montgomery, who is a molecular and biology *and* microbiology and molecular genetics at Michigan State University. Professor, the resumé! And welcome.

PROF. BERONDA MONTGOMERY [00:00:44] Thank you so very much. I think my mom is most excited about the resume, but thanks a lot.

JVN [00:00:49] I mean, I can see why! You have like a literal "and," and you are a professor of so many different things in your title that is, really I have to say coming in handy to serve our ulterior motive and question of the episode. Now, I have two, like, a two-pronged question into this. I was minding my own business in February of 2020, I was in New Zealand on a comedy tour and, I know it's weird, it's like, it was, like, six weeks before everything shut down. So it was still like the last, last time I've ever been on a plane, but anyway, so these trees in New Zealand, like, the second I landed and looked at the trees, I was like, "These trees are like really interesting and different than any tree I've ever seen, like, around home." The roots were like, kind of, like, skinny and tall, but, like, outside the ground. And they were, like, these interesting, like, wedgie sort of shapes that I never seen before. And I just could not get enough of the trees. Then meanwhile, like, two months later, the world shut down, coronavirus shut down North America and the United States, and then my now husband taught me how to garden and we got really into gardening. So between those two things, I was like, I have been a nightmare millennial just running around the world not realizing that nature was so cool and then I realized I had all these questions. So thank you so much for being here.

PROF. BERONDA MONTGOMERY [00:02:08] Well I'm really excited about being here. Congratulations on the husband part and how cool that he's teaching you about gardening. That's a keeper for sure.

JVN [00:02:18] Ugh, thank you. And you have a new book which is called 'Lessons from Plants,' which is published by Harvard University Press. Not too shabby; I'm obsessed! Again, title. But yes, I mean, you're the perfect person to talk to about this. So, I think my first question is, why are New Zealand trees so different than American trees?

PROF. BERONDA MONTGOMERY [00:02:39] Yeah. So it's really, it's one of the cool parts about plants is that because they are in different environments, they have different behaviors and different adaptations. And unlike humans that also adapt to their local environments, we can *see* the adaptations that plants make. So you saw these roots that are sometimes called brace roots because they're helping brace the plant because of the kind of either stability or lack of stability of the ground that they're growing on.

JVN [00:03:04] Ah! Ok, yes, let's zoom out, because it's important to zoom out because it's such a, like, a specific question I just asked. What is literally a plant?

PROF. BERONDA MONTGOMERY [00:03:13] So plants, they're super cool beings, first of all, but more technically, they are multicellular organisms that are capable of making their own food. So from very simple compounds: water, carbon dioxide and sunlight, they can convert that into sugars. And in the process they produce oxygen. So they are by nature organisms that are, it's called oxygenic photosynthesis. So, using light to make sugar, and in the process, producing oxygen.

JVN [00:03:41] Ok, I'm obsessed with that story. It kind of reminds me of that part in er, 'Billy Madison' when he's like "chlorophyll, more, like, chlorophyll," and it's, like, rude! Not true! But doesn't chlorophyll have something to do with that whole process?

PROF. BERONDA MONTGOMERY [00:03:56] Absolutely. So that's the kind of characteristic nature of plants that we see them as green and the green is, is the chlorophyll. So chlorophyll is the compound that uses sunlight to make sugars, but it's the green chlorophyll that's typical of plants.

JVN [00:04:11] What is the syrup? What is the syrup that comes out of maple trees?

PROF. BERONDA MONTGOMERY [00:04:15] Oh, so this is, this is a compound. It's a liquid that flows from one part of the plant to the other. So it's where, the leaves of the plants are what are responsible for producing sugars through photosynthesis, but then other parts of the plants need access to that sugar for energy. And so plants have the, it's cal-, a sap or phloem where the sugars get loaded into this at the leaves and then it gets transported through the plant so that it can go all the way to the roots so that they have sugar and all compounds between. And then humans and other organisms come along and realize that that sap with sugar is there. And then we can tap into the plant and get it to flow out and use it for other purposes.

JVN [00:04:53] So if we were gonna, like, compare that to our own systems, is it, like, this sugar like it's photosynthesizing the leaf and then it goes, like, back into the branches and it's almost like the veins or something?

PROF. BERONDA MONTGOMERY [00:05:04] Absolutely. Absolutely. So it's, it's the transport system for the sugar throughout the plant so that all parts of the plant that need access to it can get access to it.

JVN [00:05:14] So if we tap into trees and drink their sap or use their sap or whatever in maple trees, it doesn't kill the tree.

PROF. BERONDA MONTGOMERY [00:05:20] No, it doesn't. Trees, you know, plants are really adaptable. And, and basically, as part of that, sugar is being drawn off, they recognize that they need to make more and so they can just adjust and upregulate their ability to make sugar. We could draw it off so fast that they can't make that adjustment. But typically people who do it kind of have a sense of how to do it without killing or damaging the plant beyond.

JVN [00:05:42] Oh my God ok, I'm obsessed with that. Ok so now I can go back to my normal line of questioning 'cause, I, I'm so sorry-

PROF. BERONDA MONTGOMERY [00:05:40] Follow the excitement!

JVN [00:05:50] Yes, I have to go with it. So what are, like, the different categories of plants?

PROF. BERONDA MONTGOMERY [00:05:56] Yeah, so there are many different kinds of plants. So there are herbaceous plants that basically just produce leaves. You know, we think about the basil and things that we use in our kitchens. There's seed producing plants, there are woody plants and bushes like trees, and there, one of my favorite category of plants, are annual wildflowers. So these are usually very small plants that pop up in a season when they have the opportunity. They come up very bright and flowery and then they, you know, life goes on. But it's just a kind of one season, put it all out there and move on.

JVN [00:06:28] Oh my gosh, I actually, come to think of it, I didn't just become obsessed with plants in my 31st year, I actually went through a wildflower-obsessed phase when I was like seven, and my mom and I would drive around and I would, like we'd pull over and we saw cool wildflowers and I'd make little bouquets, I was obsessed. I love that you love those too! What's the difference between annuals and perennials?

PROF. BERONDA MONTGOMERY [00:06:48] So annual plants are plants that basically have their entire lifecycle from seed to flowering in their life is over in one year. Perennials come back year after year. And so that's the main difference.

JVN [00:07:02] So then like after a year, though, because, so, will they, but, they'll make seeds and then, like, will it kind of come back the next year, even if you don't plant it 'cause the seeds might sprinkle themselves right there?

PROF. BERONDA MONTGOMERY [00:07:12] Exactly. So sometimes you'll see the offspring of the same annual plant come back, but that's a different plant. Whereas the perennial, it's the same individual that's making flowers each year.

JVN [00:07:24] Yes, that makes sense! Ok, ok, now, ok, so what are some things that, like, we think are plants but maybe, like, don't actually qualify as a plant?

PROF. BERONDA MONTGOMERY [00:07:34] I think the most common ones would be some of the things that are aquatic. And so a lot of, you know, people who do diving and things like that, they will see aquatic plants, like some things that are actually sea marine sponges, and they think that they're aquatic plants, but those are actually animals. Sea marine sponges are animals, classified biologically as animals.

JVN [00:07:58] Interest! Ok wait so then, what about, um, ferns?

PROF. BERONDA MONTGOMERY [00:08:03] Yes. So ferns are, this is the interesting thing, it depends on where you were in kind of biological history. Very early in biological history, there were only two classes. There were animals and plants. And so at that time, there were lots of things like cyanobacteria that are actually photosynthetic bacteria or ferns or other fungi that were considered plants just because they were non-animal. But as we've become, um, you know, have more knowledge about those cyanobacteria, green algae are non-plants that they still carry out photosynthesis.

JVN [00:08:36] Oh my God, wait! So, will you say that one more time? What you're really saying this for someone who doesn't understand science words is, is that as we've gotten like later, like, as we, like, develop more biological understanding, like, are you saying, like, that the E3Live that you would take shots of the, like, at the health food bar, like, that little, like, chlorophyll-like, shots, like, that's not really a plant?

PROF. BERONDA MONTGOMERY [00:09:00] A lot of times, no, a lot of times those may come from cyanobacteria, which are actually bacteria. But, and I think it's just that, you

know, as we became to know more, we started out classing, classifying anything that's not an animal as a plant. And then we recognize that there *are* distinctions within that. Some of those things were actually bacteria, some of them. I think also we get very much, we have a bias towards thinking of seed plants as plants as opposed to other things that are plants that don't produce seeds. And so it's just that as we've learned more, what gets classified biologically as a plant has divided that sum.

JVN [00:09:35] What's a thing that doesn't produce seeds?

PROF. BERONDA MONTGOMERY [00:09:38] Um, so actually, ferns don't technically produce seeds. They produce spores, which is distinctive from a seed, and in, they're other plants that actually reproduce vegetatively. And so they sometimes can produce seeds, but most of the time they actually, and vegetative remains, if you've ever had a house plant where you break off a piece of it and you get it in another container and produce an entire new plant, plants can reproduce in that way. And that's vegetative reproduction. That's just producing from the tissue that you have there, but not going through the actual seed process and germination.

JVN [00:10:13] I think we've done that with grass at our house, like, different grasses. Oh, my God, that's amazing, I love that story. Ok, so wait, so then what's, what's, what's funghi? Is it fungi or funghi?

PROF. BERONDA MONTGOMERY [00:10:26] So some people say fungi, some people say funghi. It just, you know, there are different combinations. But that's a distinct class of, of, um, the most common one that people are aware of are mushrooms. So mushrooms are a type of fungi and these are largely non-photosynthetic tissues that, um, they feed off of other tissues. So sometimes they feed off of decomposing leaves or other organic compounds that you find. And so they're distinct because they don't produce their own energy through the process of photosynthesis.

JVN [00:10:57] Oh, yeah because like they have to live off someone else. So they are not a plant.

PROF. BERONDA MONTGOMERY [00:11:01] Yes, yes. Yes.

JVN [00:11:03] Fierce. Ok, so what are some of the ways that plants like, because I think sometimes, it's like that movie, 'Notting Hill,' with Julia Roberts, with that one lady at the dinner table is like, "Oh, I'm a fruitarian, I don't eat fruit or vegetables, 'cause they like," but like, that show's always stuck with me. What are some of the ways that plants do actively react to their environment?

PROF. BERONDA MONTGOMERY [00:11:22] So in so many ways. And I think that's what's fascinating about them to me, that's got me fascinated with them for so many years. So plants, one of the reasons they react to so many different things in the environment is that they spend their entire life in the same place, right. And so it's not like humans where if you don't like where you live anymore, you can move or, I'm a Southern belle, I'm sure you couldn't tell just from you know this short interaction, but I grew up in Arkansas and every summer when it was hot and humid, you wanna leave, right. Now I'm in Michigan and we have people who leave in the winter. Plants can't do that. And so they have to really be aware of what's going on around them and use that information to match their behavior. So they can respond to light, they can measure how many hours of light they get per day, and they use that as a cue for whether it's summer versus winter. They can measure temperature to know if it's summer or winter. They can measure the amount of nutrients that are in the soil and use that to adapt their behavior. They can measure humidity.

JVN [00:12:20] They can measure humidity?!

PROF. BERONDA MONTGOMERY [00:12:21] Oh, yes. Yes, they can measure humidity.

JVN [00:12:23] How?

PROF. BERONDA MONTGOMERY [00:12:23] So basically plants, on the leaves they have these little structures that are called stone stomata. And that doesn't matter so much as that these, it looks like two beans and a hole in the middle, and this is where carbon dioxide gets into the plant or oxygen gets out. And those are very good humidity sensors because if it's too humid, they can either open or close those in response to the humidity and so they can measure humidity and then adapt accordingly, yes.

JVN [00:12:51] So that little tubey things with the hole in the middle, will you only be able to see that like under a microscope, right?

PROF. BERONDA MONTGOMERY [00:12:56] Absolutely. Yes, under a microscope, yeah.

JVN [00:12:58] And the whole leaves are covered with that?

PROF. BERONDA MONTGOMERY [00:13:00] Yeah, so the leaves have those mostly on the bottom surface for most plants, but they are all over the leaves, yeah.

JVN [00:13:07] I cannot handle, I could cry, that’s amazing; I’m obsessed. Ok, so wait, now this is just, like, other age-, well, I guess it's not age-old, but it feels age-old to me. So, like,

ever since I started gardening and being aware of plants, like, in my backyard, since I've had a backyard I've been gardening, which is all of, like, it was from, like, August until, like, December of last year. Well, actually, was, like, August to February of this year, actually. So, ah, so basically once the temperatures got cold, I started asking, I don't wanna be one of those people who's like, "My husband, my husband," but it's true, like, it's, like, that's who was there.

PROF. BERONDA MONTGOMERY [00:13:42] Celebrate it!

JVN [00:13:42] I can also just say, I can just say Mark. So anyway, so I would ask Mark, I was like, "Are these dead? Like, everything looks dead!" And he's like, "No, it's just winter, like they're just sleeping." I was like, "No, these look dead." They look deader than a doornail, I'm freaking out. Like are my lantanas going to make it because I'm obsessed with these, like, plants in Texas called lantana; so pretty. And they have all these, like, different shapes and all these different colors. And, like, some of them are ombre, and I just, like, love them so much. So I was, like, "Are my lantana going to f-ing die?" And he was like, "They're not dead, they're literally just sleeping." And I was like, "Well, what about these hydrangea?" "They're just sleeping." "What about this," I mean every day I'm upset. So they, so that's what he's saying, they knew it was winter.

PROF. BERONDA MONTGOMERY [00:14:24] So what I would say to you is listen to Mark. He understands these plants. And so, yes, absolutely. One of the biggest kind of examples of that, that we're all aware of, is fall colors, right. And so the fall colors are actually that the plants have sensed that it's win-, fall and that winter is coming. So they are preparing for winter to do exactly what your husband said: to go into a rest period. And so one of the reasons that, I love fall just because the colors are beautiful, but what the plants are actually doing are preparing for winter when they don't have as much ability to make their own sugars because it's so cold. And so they drop all the leaves so that they won't have to support those and then they can just rest through winter and be prepared to come back in spring. So he's absolutely right. It's a, it's a period of anticipation and then rest.

JVN [00:15:12] Ah! Ok, leads me right to my next question. So how do you feel, like, ok, so the thing that I got really obsessed with last summer was growing watermelons. So at this house that we rented, we were minding our own business, I was, like, I didn't expect to love them so much. I just got two little starters at the garden shop and then before I knew it, they were growing, they were flowering, these flowers 'cause, like, I guess I didn't realize that, like, the stuff that sometimes turns into the fruit, like, was a flower originally. I must have, like, been going through it, when you go through, like, basic plant class in school, 'cause, like, I just didn't remember. So then it was going really good. I had a watermelon like this big, like, almost the size of my face. I was Insta-storying it very frequently last year.

Then when we, like, moved into our, like, forever house, I, like, moved it and it didn't have as much sun and then, like, it just slowly started, like, rotting and then it just, like, I picked it up this, like, one morning and it had this huge, like, black hole and like my watermelon, like, it did not make it. And then I realized, "Oh, my God, this is too much shade here. I've been watering the shit out of it," 'cause it was, like, August, but it didn't get enough sun, so I was like, "I got to, like, transplant these things. I need to, like, move-." I didn't move them out of the, like, pot, I just moved them into different spots that had a lot more sun exposure. And then Mark was like, "We got to cut all these dead leaves off." And I was like, "No! That's like, that's like the last bit of leaves that I can see of, like, what it's, like what's going to happen if we cut." And he was like "No, like, it's got to concentrate." I was like, "This plant doesn't know how to concentrate." And he was like, "No, it really does. Like we have to like cut the," and so that is true! We pruned the things off. Tell me more.

PROF. BERONDA MONTGOMERY [00:16:47] Yeah, it's absolutely true. And so that's one of the things that fascinates me about plants, is that they are able to make new tissues throughout their lifecycle. And so you know once you start to see browning leaves like you did, that's the plant going through some kind of stress generally. And, as soon as you remove those, the plant can then concentrate all of the energy that it has left on new tissues or healthy tissues. And so it is important once you start to see that kind of death of tissues to remove that so that the plants can. The concentration, in my mind, is really the plant making decisions, molecular decisions about where to spend its energy, because it has, there's a certain amount of energy that the plant has and it's trying to support dead tissues or dying tissues as well as new tissues. You're diverting energy into two places and so you really do want to give the plant a chance to use its energy for all of the kind of healthy growing and new production of tissues, so.

JVN [00:17:42] Ok so like, whether it's like, like if you have, like, different types of food that you're growing, like, you got some lettuce, you got some, you know, like, I was saying watermelon, you've got some peppers, like, I also became very obsessed with jalapenos and, like, red chilies because those had such pretty flowers. Ah, and also I never knew about okra, but, like, these flowers are so stunning!

PROF. BERONDA MONTGOMERY [00:18:02] They really, they are, yeah.

JVN [00:18:04] Oh my, and I've always, like, been a queen who's, like, really good at making chili. And then, like then when I add, started adding that, it kind of took it to this whole other level. So, regardless, that's, like, for a different podcast. But so if, if I mess up something because it did, I didn't get my watermelon, I didn't get jalapenos, and I didn't get artichokes, and I didn't get, what else didn't I get to adulthood, 'cause I just kind of

blew past those planting guides and I was like, "Ok, well, if I missed the window, I'm just going to do it anyway." So I was like, "Maybe it'll work." But it didn't work in a lot of cases. But are there different plants that will respond differently to, like, you know, cutting stuff off or, like, pruning things like, like or do other ones, like, are some hardier than others as far as, like, actually getting to adulthood?

PROF. BERONDA MONTGOMERY [00:18:48] Yeah, so part of it is plants are different in how long it takes them to get to adulthood. And that's why the planting guides are good, right, because some of them need a little bit longer just based upon their evolutionary or ecological history, how much time it takes for them to get to. Some of them need to go through periods of, so some plants you need to plant them early in spring because they actually need exposure to a few cold nights to get their healthiest life and others don't. And so it really, each plant kind of has its difference in that. Sometimes it also matters who you're planting together. Some plants love to, really grow well together. Some of them need the same thing, and if you grow them together, they're in competition as opposed to being able to live kind of complementarity in the space.

JVN [00:19:35] How do we find that out? Just, like, Google it? Get a book, like-

PROF. BERONDA MONTGOMERY [00:19:38] Yeah there, there are some good garden guides, but you know, generally the, a lot of the garden guides will tell you if you have plants that have, like, really big leaves, you don't want to plant that to plants that don't because they are competing for sun, like, you can actually produce a shaded part of your garden just by who you plant next to each other. And so plants that need full sun and are growing, 'cause something that makes these big leaves start to think they're in the shade. And in that case, they don't have a healthy life. And so Google is great, plant garden guides are great, but really figuring out which plants grow well together and how to, where, how and where to plant them in your garden is really important.

JVN [00:20:17] So what about, like, you know how we see fossils of like animals?

PROF. BERONDA MONTGOMERY [00:20:22] Yes.

JVN [00:20:23] Is there, like, fossils of, like, plants?

PROF. BERONDA MONTGOMERY [00:20:26] There are, yes! Yeah, so there are two kinds of things that happen. So a lot of times you get fossil impressions of plant leaves because the leaves don't always persevere. But there are some beautiful impressions of the shape and, you know, of leaves, the size of leaves. A lot of what we get in plant fossils are seeds,

cones, you know the hardier parts. There's a lot of beautiful plant fossils of woody plants. So you might have seen some petrified wood or something like that?

JVN [00:20:54] Yes!

PROF. BERONDA MONTGOMERY [00:20:55] Those are plant fossils. And so there are, usually of the hardier parts of the plant, and then we can see impressions of other things that are like herbaceous, like the leaves, yes.

JVN [00:21:04] Do we ever see, like, when, like, berries or, like, apples or, like, when, like, was there ever, like, fossils of, like, food where we see like, when certain foods, like, 'cause you said like, that, some, like, based on their evolutionary history, like, do you ever see, do we ever *see* evidence of, like, evolutionary history of, like, food and, like, trees and stuff?

PROF. BERONDA MONTGOMERY [00:21:23] Yes, there's two things that happen. Sometimes you do get fossils of some kinds of the fruits and seeds, but also, I, to, and this is based not on my science knowledge, but based on my reading, there's also been some evidence of finding those in some of the, like, Egyptian tombs and other places. They found some evidence of what kind of plants and foods and other things that they ate, and that's really fascinating to me just on a personal level, doing reading to, to be able to kind of trace back history based on some of the things that are found. And usually things that are found there, those were some of the important plants and fruits, right, because they actually got entombed in some of those ways.

JVN [00:22:01] Ok, so I, I'm going to ask you a very brief question and then we're going to go on to the real question. Do you ever watch british baking on Netflix?

PROF. BERONDA MONTGOMERY [00:22:08] Oh, yes.

JVN [00:22:10] Yes, ok me too; I'm obsessed. So do you, do you remember the season, I think it's, like, season one on american Netflix where Nancy wins.

PROF. BERONDA MONTGOMERY [00:22:16] Yes!

JVN [00:22:17] Nancy-, so I am, like, the president of the Nancy Birtwhistle fan club. I am obsessed with her so much. I follow the shit out of her on Instagram. Like, I love her so much.

PROF. BERONDA MONTGOMERY [00:22:25] Oh she's on Instagram?!

JVN [00:22:27] Yeah, she has a great Instagram. If you're into like, she's really, like, plant stuff, like, clean, like, like clean or like green cleaning stuff like not too chemically, etc. But she does this thing where she mixes like egg shells with, like, salt to, like, sprinkle around plants that slugs try to eat. So, like, isn't that an example of like, oh actually that's an example of a human doing something for a plant because of an animal threat. Do any plants, like, do anything themselves to, like, tell an animal to go fuck off or, like, another thing?

PROF. BERONDA MONTGOMERY [00:23:02] Oh my goodness, is so exciting. Plants have a really complicated language so, and if, I, you, you can get me too excited about this. I'll tell you two quick things they do, so plants-

JVN [00:23:12] Don't get quick! I have time!

PROF. BERONDA MONTGOMERY [00:23:15] I get too excited about this 'cause I found out something super cool about this. But I'll tell you, so the first thing that I know about this is that plants, when they are, for example, attacked by insects, produce a gaseous compound, right, that, it serves two purposes. That compound goes out and the plants next to it can sense that compound and know that there's some danger in place. And then they can start a defense system so that if insects attack them, there's not that much damage.

Plants also, one of my colleagues actually in Michigan State studies this, plants also produce compounds so that, for example, like tomatoes, if hornworms are eating on the tomatoes, plants produce a chemical that those hornworms ingest and it actually disrupts their ability to absorb nutrients from the plant. And so they're not healthy, they don't have healthy lives and they can't really reproduce. So plants have this really defense, whole defense system. But one of the things that you got me so excited about, that I read about last year, is that plants actually can also do something where, for example, if they're being attacked like by wasps, a parasitoid wasp or something, some plants can produce a compound that doesn't affect the wasp, but a predator of the wasp senses this compound.

So the plants call in someone else and they say, "Please come and eat this wasp, this wasp is bothering me." And so then the predator that eats the wasp can sense that the plant's been attacked by this wasp and come in and take care of it. And I just thought that was super cool because plants are, I consider, gangster. They're like, "Come and take care of this for me because I need to live and I can't do it, but you can. So, here's the signal that what you like to eat is available; come have a picnic."

JVN [00:24:51] It's so genius! But wait, what was the very first thing that you said?

PROF. BERONDA MONTGOMERY [00:24:54] Yeah, so when plants are attacked by insects, they make a gas that is a kind of airborne. It also can go through the plant, but it can go through the, into the environment, and so basically it signals to other plants in the environment that are potentially damaging insects here and you should prepare, um, defenses.

JVN [00:25:12] So what are their defenses like? What can they do to minimize damage?

PROF. BERONDA MONTGOMERY [00:25:15] Yeah, so one of the things that they do, if you've ever seen a leaf in your house that might have had just, not the entire leaf is brown, but there's a little patch where the leaf is brown, plants will just kill part of the leaf because a lot of the ways these insects work, in many ways, is to, you know how we were talking earlier about the sap that maple trees make, a lot of the way these insects work is that they insert this little stylus right into the phloem and take that sugar. And so if plants can actually kill off a particular cell, those cells die, the insect can't get any sugar from that but the rest of the leaf can still. So they will actually kill part of themselves, to, to keep the insects from having access to the sugars, or, as I was saying, they can make these compounds that actually make the insects sick so that they can't thrive and then the insects themselves probably die.

JVN [00:26:02] So, like, where is the plant's brain that, like, tells it to kill that part of itself?

PROF. BERONDA MONTGOMERY [00:26:08] Yeah, so generally, the plant doesn't have, like, a centralized brain in the way we think about it. Plants, each cell, or cells working together, communicate with each other and start a particular behavior. And it's usually all chemical. It's, you know, they make these chemical signals that coordinate behavior.

JVN [00:26:27] So, wow! So how do we, how do they learn to do that with each other? How do they evolve like that?

PROF. BERONDA MONTGOMERY [00:26:36] Yeah, so the thing that, plants basically, like many different organisms, have some kind of natural variation in the population. And so the way I like to think about is if you're looking at humans, we have natural variation in our height, right. Some of us are short, some of us are tall. Plants have natural variation in their ability, for example, to respond to insects. And yet if you're in an environment that you're constantly being attacked by insects, the ones that have the higher ability to respond to them are the ones that survive, produce seeds, and over time, it's your ability to respond to what's present all the time that determines who survives, makes more offspring. And over time, that ability then is what's carried forward. And that's, I mean I'm not an

evolutionary biologist, and I'm sure my evolutionary biologist friends, when they listen to this, are going to laugh at the way I, I've explained that. But that's really what evolution is. There's natural variation, there's some selection in terms of what's needed to survive, and over time, those who survive are the ones who have offspring and pass on their genes, which is the ability to respond to, you know, whatever is present.

JVN [00:27:42] So that's completely fine, they can do whatever they want because the thing with this podcast is, is some, you know how they say that newspapers are written for, like, an eighth grade on average reading level or whatever. I really span from, like, first grade to, like, *maybe* bachelor of college. I don't know if I'm, like, delusional and, like, my brain, but, like, I feel like we really cover a lot of questions. So I, I think I might have, like, a fourth grade one, though, accidentally. What about Venus flytraps? Because they just came to my mind, are those plants?

PROF. BERONDA MONTGOMERY [00:28:12] They, so, Venus flytraps are plants. And I think that it, you know they're plants from the definition we started with: they have the ability to conduct photosynthesis and make sugars for themselves. What causes some people to question whether they're plants is because, that, they do have this ability to trap insects, right, to dissolve those insects and to use the nutrients. But what, what they're doing there is that those plants are using the insects as a source for nutrients such as, like, nitrogen or, or something like that. And so they still have the ability to conduct photosynthesis, but in addition to making your own sugars, you need access to nutrients or, that's why you give plants fertilizers. They need iron and nitrogen and phosphates and other nutrients to support the building of their body in addition to using the sugars. So, Venus flytraps, some plants are able to get nut-, nitrogen from the soil or to make their own nitrogen in collaboration with bacteria, which is another cool thing plants do. But some plants, like Venus flytraps, have adapted to trap insects and just use their bodies as the source for the nutrients they need instead of getting access to, like, Miracle-Gro or something like that.

JVN [00:29:22] Ah! It's like how nature does Miracle-Gro. Ok, wait, I have another question. So what about, last year I was growing tomatoes, I have these like white little things, these, like, little fucking white-

PROF. BERONDA MONTGOMERY [00:29:34] Oh yes!

JVN [00:29:35] -Creepy crawlies and they were spreading and then doing, and so then I just started pruning them crazy one day once I realized and believed that Mark was right, that, like, it's ok for us to cut things off of the plants so that it really can concentrate, 'cause

sometimes you just get sad to lose a little flowers though, you know ‘cause it’s so pretty. Now once I accepted it, I get it. So, yeah, but what were those little-

PROF. BERONDA MONTGOMERY [00:29:53] So basically tomatoes are really cool to me because, so those are, they're basically small insects that you can't really see. And, if they were able to persist, they would continue to grow and reproduce. I don't know if you've noticed when you touch tomato leaves, sometimes they feel a little sticky, and they feel a little hairy. So tomatoes make these little hairs, um, they're technically called trichomes, and other hairs that are on the leaf, and they're sticky; that's part of their defense. And so a lot of times you see them covered with those white flies because the tomato has actually trapped them a little bit in the hairs. And that's perfect because once they're trapped, if you cut off that leaf, it keeps them from spreading around. But, yeah, those are little insects that are trying to get access to the sugars of the plant to support their own kind of lifecycle.

JVN [00:30:39] So then, I’m taking a hard left into woody plants. So in my hometown, there's, like, a lot of, like, oaks. And then before I was born though, I remember they like, my mom talks about this like it was, or no it was elms, it was, like, the great Dutch elm disease of like 1985, and, like, all these oaks in Quincy died, so, like, what are tree, like, what are some of the threats that trees face, like, outside of deforestation?

PROF. BERONDA MONTGOMERY [00:31:02] Yeah, so we do see a lot of that, right. In terms of I think a few years ago there was some trees in California that were wiped out by a disease that was spreading through. So often, any kind, a lot of times those disease, they can be fungal in nature. So we talked about fungi before; there are fungi or bacteria sometimes that infects trees, the trees, generally when it wipes out the trees, like your mom was talking about with the Dutch elm, it's because the plants don't have the ability to defend. So we were talking about how plants *can* defend. Oftentimes, plants are capable of defending things that they've seen before, right.

And so they have this ability to recognize it the same way we take a vaccine so that our body recognizes something and shuts it down. Plants usually, if they've had exposure to something, they've evolved the ability to recognize it and shut it down. Sometimes something comes through like Dutch elm disease that affects a tree that doesn't have the ability to actually respond to that through defense, and so then it wipes through an entire population. And those can be sometimes fungi, sometimes bacteria. We also find that trees sometimes get affected by introduction of other species. So, again I was saying I grew up in Arkansas, and when I was young, that, there was some endogenous plant coming through the south, kudzu, right.

JVN [00:32:23] What's endogenous mean?

PROF. BERONDA MONTGOMERY [00:32:25] I'm sorry, it wasn't endogenous, it was a, um, a foreign plant. Natural plants are kind of ones that are there all the time are the local ones that are there. This is, I'm trying to think of what they call these, um-

JVN [00:32:37] Like a foreign invader plant or something?

PROF. BERONDA MONTGOMERY [00:32:39] Right, right.

JVN [00:32:40] Or is that like the Donald Trump way to say it?! I bet there's a better, like, cool like science way to say that. Invasive species?

PROF. BERONDA MONTGOMERY [00:32:48] Invasive species! See, you're helping me; you do have your bachelor's knowledge of this! So there are these invasive species that come in, and kudzu was one that was sweeping the south at the time. And sometimes that can actually grow on trees. Some of these plants, if they're viney, can grow on trees, block trees from having access to what they need, and that can actually cause some of these species to die as well. So, as you said, there's kind of the human interventions. There's natural things like forest fires. But then there can be attacks on plants by kind of compounds, organisms, bacteria, fungi, or invasive species that they've not been exposed to before.

JVN [00:33:23] Is there any examples of like, in your knowledge of like, like the Dutch elm disease, for instance, of, like, the 80s, and then, like, as, like, if someone came in and, like, either replanted those trees or like, how long would it take for that tree to be like, "I've seen you before, I'm shutting it down." And how long does that take evolutionarily? Could it takes like 50 years? Or would it take like 500 years?

PROF. BERONDA MONTGOMERY [00:33:43] It can take a long time for plants that are as big as trees because it's you know how long it takes for plants to um evolve the ability to adapt to these things is based upon their life cycle, right. And so we know some trees grow for 100s and 100s of years. And so sometimes in trees there is very long before we see the ability to respond to something like that. In terms of generationally, right, and that's the thing about plants, plants have a lot of ability as individuals within their lifetime to respond to things. But that's just kind of a plasticity of response. It's not a change in the genome in terms of your, those genes being inherited by offspring and then passed on. But so it can take a really long time for trees.

JVN [00:34:25] So, like, it's not something that, like, we're going to be able to see, like, a tree, like, learn to deal with Dutch elm disease, like in our lifetime; it takes a minute?

PROF. BERONDA MONTGOMERY [00:34:33] Yeah, it takes a while. I mean, sometimes over the course of your lifetime, you can start to see some of that. So I think about, like, places like Chernobyl where there's a massive you know destruction of an environment, and then over time, within 30 or 40 years, you can start to see new plants that are coming up there. And so, like over the course of our lifetime that plant may only have two or, life cycles, right, in terms of the length of time. But yeah, for something as big a, a tree, it takes more than one lifetime to see kind of change, a, shifts in the populations of trees.

JVN [00:35:06] So trees would have the longest life cycles and then like maybe, like, what else has really long life cycles that we wouldn't think about, like, a bush?

PROF. BERONDA MONTGOMERY [00:35:16] Sometimes bushes do. It depends on how you, how you think about it, right. So we talked earlier about things that are produced by seeds and things that produce clonally. If you ask biologists, you can have a clone of something that's been reproducing for 100 of years because it started from the original plant. And so they would think of that as something that's long-lived because it's just re-, it's not kind of going through a complete die off and reemergence. But trees are generally the longest living plants that we kind of think about.

JVN [00:35:47] Ah! Ok, so, so far in our interview, like, what are like, like, what are you most interested in in like plants and, like, what's your favorite kind of plant and when did you know that you wanted to be a plant literal scientist?

PROF. BERONDA MONTGOMERY [00:36:02] Yeah, so one of my favorite plants is a mimosa. I don't know if you know what a mimosa is.

JVN [00:36:06] At brunch I do.

PROF. BERONDA MONTGOMERY [00:36:08] Ah yeah, don't we all. Well, I shouldn't say I should speak for other people; don't we both. So a mimosa, a mimosa is this plant that almost looks like a fern to most people. But if you touch its leaf, it slowly starts to close up. So a lot of people have been exposed to this because teachers will bring this into the classroom. And if you touch the tip of the mimosa leaf, it just starts to close up on itself, right, because it's very sensitive to touch. And in some ways, that's, we were talking about a protection response from insects, in a lot of ways that it's thought that that's a protection response, because if you're landed on by an insect but you close, it doesn't have access to

chew on the tissues as much. So I just love that because it's so, it's a sensitive plant and I like sensitive plants.

But it's interesting; I didn't decide to become a plant scientist early. I actually, at five years old, decided to be a lawyer because there was this car that was driving recklessly through the neighborhood and I wanted to sue him and my parents refused to give me a lawyer. So at that point I decided I was going to law school to do pro bono work for all the future five year olds who needed lawyers, right. So I actually stuck with that. Even in middle school, it became pretty clear that I was really good at math and science but I had said I would be a lawyer for so long that I slowly started to evolve to think I would be a biological patent lawyer. And these are lawyers who write patents about medicines or whatever. And then, ultimately when I was looking to go to law school, it just didn't seem as exciting as I wanted it to be.

And I decided to work in a lab just to see what it would be, like, to do the experiments that I would be writing patents about. And I fell in love with experimentation, first, then took several classes. And when I took a class on plant physiology and realized how cool plants were, I slowly evolved. My mother, however, finds this really funny because my mother has the best green thumb of anyone I know. Like, I grew up in a house with hundreds of plants, the yard was this, you know, just the star of the neighborhood and she said, "I tried to introduce you to plants then and you weren't interested." And I said, "Not at all." But now it's kind of come full circle, so, yeah.

JVN [00:38:10] Oh, my God, that's so cute!

PROF. BERONDA MONTGOMERY [00:38:13] Yeah, thank you.

JVN [00:38:18] Ok, so this other time I was in Japan and I was walking and I saw, I was in this forest and I saw all these trees, which is the most pretty thing I've ever seen in my life; it actually made me, like, cry like a baby 'case it was just, it was incredible. But none of the tree tops touched each other and it made, like, this gorgeous, like, design. And then I put it on my Insta stories and people were like, "That's crown shyness, that's crown shyness!"

PROF. BERONDA MONTGOMERY [00:38:43] Yes!

JVN [00:38:44] Will you tell us what crown shyness is?

PROF. BERONDA MONTGOMERY [00:38:45] Yeah, so that *is* crown shyness and it's really cool. You can also see it if you're flying, right, if you're flying over a forest, you'll often see these kind of gaps where the trees don't touch each other. So it's so fun that you bring this

up because I did talk about that as well. So one, for a long time, it was thought that it was just accidental, that, like, trees got close to each other and they would brush and then they would, the branches would break, and that's why they weren't close. But as scientists were studying this, they actually realized that if you had plants that were related so that, like, they're kin, they actually do that more frequently than plants that are not related. And so what they started to realize is that it may be a way of making space for each other in the environment so that as we get close to each other, we're not competing. And we, there's just the kind of you grow close to each other but not touch where you would actually damage each other. So it seems that it's actually a response where plants are sensing that they're next to each other and growing as close as they can, but not absolutely, um, touching each other and causing the harm to each other.

JVN [00:39:49] That is so interesting! So do we ever see crown shyness in, like, plants that aren't kin?

PROF. BERONDA MONTGOMERY [00:39:55] Yeah, so you can see it in plants that aren't kin as well, yes, yeah.

JVN [00:39:59] Ah ok, so how can we see plant behavior as a model for human behavior?

PROF. BERONDA MONTGOMERY [00:40:06] So I'll start by saying I think we need to more broadly look at organisms other than ourselves in general for inspiration about how to live on the planet, right. I think sometimes we can just become so focused on ourselves that we don't recognize the, all the other organisms that have been on this planet for a long time, they're doing quite well, which means they understand something about how to exist on the planet. And so I think generally we should learn more from other organisms. I think plants are particularly fascinating because we depend upon them absolutely for our existence. If plants went away we would not exist because we breathe the oxygen and yet we don't spend a lot of time understanding about them. And I believe in, one of my life principles is reciprocity. It's how do you live together with other organisms and recognize how you're giving to each other? And because my life is absolutely dependent on plants, I think it's important to understand more about them and then to ask, "What can I learn not just about them, but what can I learn from them about being."

JVN [00:41:06] So I feel like that's this really, I remember learning about that in grade school and I feel like it's this nebulous idea that I'm so happy that you brought that up. It's like, we would not exist because plants create oxygen. So we spent a lot of time talking about, like, how plants create sugar for themselves, but how do plants interact with, like, the air that we breathe and really interact with, like, the oxygen, carbon, like, all that thing

in the world in general? Like, it's, it's really not some, like, esoteric idea that's like, you know, that doesn't affect you, like, it literally keeps us all alive, right.

PROF. BERONDA MONTGOMERY [00:41:39] Absolutely. It absolutely keeps us alive. And I think, you know I try to think of it full circle. So, I think it was late in 2018, I was traveling with my sister and son and they wanted to visit a former plantation in South Carolina and I really didn't want to go--that's a long story--but, we travelled together and I do something they want to do, we do something they, you know. But when I got there, I saw this 600-year-old tree, which was completely fascinating. And I started to think about the fact that certainly we depend upon its oxygen, but the carbon dioxide that we breathe also becomes a part of the tree, and it uses the carbon dioxide to make sugar, the sugar then gets put into wood. And so I started to think about the fact that this tree actually held the captured breath, right, of our formerly enslaved ancestors. And when you think about that, every breath that you take is potentially contributing to the life of a plant, as you're depending upon that plant. And so, you know, even the way that we live, whether we have pollutants in the soil or whatever, plants can adapt to that it, it ada-, it does impact their life.

And I think a lot of people like you who have started to garden start to have a greater appreciation for what it takes to go into a plant being successful. And so I ask then, how do you use that knowledge that you now have to think about how your life is affecting all of the plants around you, which are critical to everything that we do, right, not just the sugars, the fruits we eat, the vegetables, the wood we use to build our houses. Plants really are central to everything that's a part of our life. And I think as a, as a true form of reciprocity, understanding how that happens and then asking what we can learn from it is really important. Also, my particular bent about learning from plants is also rooted in a lot that I've learned from indigenous people. So one of the first books I read about plants' life in this kind of capacity was from Robin Wall Kimmerer, who wrote 'Braiding Sweetgrass.' And I was really inspired by the ways in which indigenous people and other people around the world think about coexisting with plants and learning from them.

JVN [00:43:40] Thank you so much for sharing that with us. Um, ok so, how can we be more conscientious and, like, better stewards of our community and, like, take better care of plants like in the world and in our home, like, all over the place.

PROF. BERONDA MONTGOMERY [00:43:53] Yes. So I think, you know, I would start with the thing that's inspired me about humans with plants and then I will answer your question. But I've been really inspired by the way that humans, if they have a plant in their home, in their garden, they expect that the plants should grow, right. And if there's anything going wrong with the plant, like you saw these little white things on your tomato or you saw the

browning leaves, they really start to ask questions about what can I do to help support this plant, be healthier and happy. And that's the, that's the, most humans' response. So humans really to me already have this awe-inspiring relationship with plants, I just think we don't stop and intentionally reflect on you know what we can learn from more intentional observation and deep reflection on those particular processes.

I think when you really dig into it, most humans, as I said, expect that plants can grow. And if there's a problem with the plant, they don't stop and think, "Well, let me teach this plant how to be a better plant." They, they really say, "How can *I* figure out what this plant needs?" And so I think just taking some time, as you did when you were a child, to stop and wander over the annual wildflowers, you know, when, if you live in an area where the trees do lose their leaves in the fall, stopping and asking what that means. But also in spring, taking a walk, every, every spring I take the same walk the first few weeks of spring just to watch the plants come back, right, to watch the leaves emerge. And so I think just taking some time to not just say, well, "I have these plants in my house because I want it to be beautiful," but to reflect on: "How is that, what are you doing, how are you interacting with them," and what that means about who they are as organisms and who you are.

JVN [00:45:31] Ah, ok yes, so, this year, because I, like, cannot wait for spring and I can't wait to plant again and, like, try my next batch, and I moved to Texas and it's so beautiful. And like I, like, I'm like, I live in the woods, and like I walk in the woods, so I was like, very eagerly awaiting buds for the first time so like, I know what you're talking about. I never have been so excited to see buds on the tree. Then, of course, there was a massive, huge freeze of all freezes. Like, like I mean, just like just-, my, like, my lettuces and people went through way worse than I did so you know but, but my heart, after it was done breaking for all, like, the human suffering, my lettuces were just like literally decomposed under their blanket, like I know they're gone. There's like all these other things that, like, oooooh, I don't know, like, I don't know if I'm going to have to like dig it out, but this is, oh my God, and if you don't have good news for me, I don't wanna put pressure on you because you can't change nature and it's not your fault. But I do have a question that just came back to me that I do need to ask.

PROF. BERONDA MONTGOMERY [00:46:37] Yes.

JVN [00:46:38] I was gonna like rip this Band-Aid off but, I'm just going to, like, ugh, ok, so, in January, I, I--I literally hear my voice, like, shaking about it 'cause, like, I don't want them to be gone--but I bought this, like, baby lemon tree and this baby orange tree and they're like in pots there oh, my God, your reaction already looks really upset, fuck, but they weren't, but, there's a few things I would just like to add, ok, so just hear me out, ok? Hear me out, hear me out doc! Ok, they were in pots, kind of close to the house, they were too

heavy to get into the house because it like could've shattered and there was like steps and stuff so like, they were in pots with soil, not in the cold ass ground, but they did, they didn't snap, but like, they went from being upright to like ehh but I did cover them in like this, these blankets, like for trees. And when I first took them out, once it got warm again, it was, like still completely, like, bent over. But since they have gone upright again, but all the leaves are clearly dead, the leaves are definitely dead. But if citrus trees' leaves die like can they still grow up to be like adult trees?

PROF. BERONDA MONTGOMERY [00:47:52] Yes they can. And so I'm glad I let you get through the whole story because I was feeling sorry for you and sad. But the fact that they were bent and came back up means that they're still alive. That's a response, right, where they can, they, they were able to detect. And the beautiful thing about plants--we haven't talked about this--the *leaves* are needed for photosynthesis, but plants have, they have a specialized part called a meristem, and that's almost like where stem cells are. So you've probably heard of stem cells in human biology, and everything needed to recover is in that little stem cell. And so as long as they're still alive, they may have a year that they look pretty, you know, like the Charlie Brown Christmas tree, but some leaves will come back and they *can* grow, they can still continue to grow. So they should be ok; that, that's a good sign that they were able to recover. And so those meristems should produce new leaves once it gets to the right, yes. You have to, you have to post a picture on Instagram or something because I'm worried about these trees-.

JVN [00:48:50] Oh I will, I have to follow you, I gotta follow you, I gotta follow you in, and yeah, I will, I also, I'll DM you all the time-

PROF. BERONDA MONTGOMERY [00:48:54] Yeah, because I really need to know now. I'm invested in these trees.

JVN [00:48:56] No I will! I'll tell you everything, I will. Now, ok wait, so I also, we have these like two big bushes that these fucking deer, at first I loved the deer, I was obsessed with the deer. I used to love deer, I used to think it was so fun till I started really planting stuff; now I'm devastated. So I did, like, build, like, a mini fence that looks like, definitely looks like someone's first time building a fence 'cause like the, like I, I mean, it was like I just was like, "Get away from my things!" But they really, like, tore into, like, I mean there's like four surviving leaves on two different bushes. Are those going to die?

PROF. BERONDA MONTGOMERY [00:49:30] No they, they, yeah-

JVN [00:49:31] But that happened before the freeze, that happened like three weeks before the freeze they got eaten bare, then this massive freeze. And, like, two weeks

before the freeze, these, like, lantana, ‘cause I was like, you know, I was telling you I was obsessed with lantana, do you know what those are?

PROF. BERONDA MONTGOMERY [00:49:45] I don't! I don't know if I do. I have to look that up.

JVN [00:49:47] They’re these, like, big bushy, like, Texas kind of like shrubby bushes. And some are pink, some are yellow, some are red, some are ombre, some are orange, some-

PROF. BERONDA MONTGOMERY [00:49:56] Yeah when you said ombre, I’m like, I have to look this up. I don't know if I do, yeah.

JVN [00:49:59] So, but I prune the shit out of them because I read that you could and then some of them just, like, they started looking really straggly, and once Mark, like, once I was like assured that, like, oh my God, like, actually cutting them so they can focus is actually kind of amazing ‘cause it makes them, like, thicker and, like, you know, bushier at the base and stuff. So then I just went ham with these tree shrubs; it actually looked like I had like a divine secrets of the ya-ya, like sisterhood, like, yeah, I mean like my arms are all cut up because like, like the, the gardener’s gloves didn’t go up high enough, and I was just, like, ahh, and I just, cutting these bushes up. But then there's a huge freeze. So are they gonna die because I did it right before the huge freeze?

PROF. BERONDA MONTGOMERY [00:50:33] No, they should be ok. And even the ones that the deers have eaten, you should, they should come back. What's really neat about that, so you were talking about how when you prune them, they become bushier. Biologists think that that's actually, like, a response so that when in nature deer are, like, it's similar to pruning, the plants can grow bushier and the next time the deer comes back, it's harder for it to get access to it. So it's thought that building up the bushiness is a defense mechanism to make it harder for animals to get access to all of the tissues. So they actually should survive. But I'm, I’m serious, I literally have to follow you on Instagram because now I'm going to be worried about all of your plants and they have to be happy and healthy.

JVN [00:51:11] We need new friends!

PROF. BERONDA MONTGOMERY [00:51:12] Yes!

JVN [00:51:14] But I'm really excited ‘cause when my watermelon died last year, like, people were really invested in it on my Insta stories ‘cause I talked about it a lot. And then this one lady made me feel so much better because she was like, “Just so you know, it

literally took me three whole seasons to get my watermelon to adulthood." So she was like, it does take like, and then that made me, I just felt like, yeah, I have such a visceral attachments to my plants now, like, in the same way that I do like my cats, like, my soul, like, bleeds for my plants when they don't now make it or when something happens. And, like, my artichokes, like, no, like my artichokes, like, they like, no, like dead, like, dead as doornails.

PROF. BERONDA MONTGOMERY [00:51:54] See, I've never grown those, I've never tried those.

JVN [00:51:57] They're so cool looking. I think, I think they do kind of prefer like, like, zone eight, zone seven moments, like, at least from what I read on Google. But, who knows what that's like, who knows. So ok wait, so um, oh! Is it true that trees' roots go as deep and as wide as, like, the top of them outside of the ground do?

PROF. BERONDA MONTGOMERY [00:52:20] At least, yeah, for a lot of trees they do. The other thing that's really fascinating to me is how, so we talked earlier about fungi, probably 80 to 90 percent of trees actually have fungi associated with their root because it expands their ability to take up water and also the fungi make phosphate or other compounds that the plant can use. But what's really cool is that one fungi may connect two trees, so the two trees may actually be communicating on the ground where their roots are connected through that kind of fungi and other, it's really cool things going on underground.

JVN [00:52:52] What about cactuses? How do they do stuff that's different than like all the, what, are they woody fruit or seed or whatever; what kind of plant are they?

PROF. BERONDA MONTGOMERY [00:53:02] Yeah so, you know, cacti are, do have a woody structure under them. I don't know if, some of them have a very dense woody structure and many of them are flowering. So you know you have probably got cactus flowers at some point in, at a restaurant. What's really the most cool thing about cacti from my limited, you know, exploration of them--I went through a period of being fascinated with them, just kind of not as a biologist, but as a, as a human interested in plants--is that they're adapted to store water, right. That's why they, their tissues are so thick, that's why they're different. Their root systems are actually quite different from other plants in some regard. But they are adapted to, when water is available, to take up as much of it as possible and then to be able to store it because they may have periods where external water is nowhere around for long periods of time.

JVN [00:53:49] Ok, so then you'd mentioned before that when you were, like, falling in love with, like, microbiology and, like, molecular biology and you, like, were doing all the

experiments in the patent place, like what, ‘cause I feel like it took me this entire time just to get like a basic understanding of, like, just, welcome, so what do you do, like, ‘cause I mean like I know you’re a professor, but like, what experiments do you do? Like, what, like, cool things can you tell us now that we all kind of know some things?

PROF. BERONDA MONTGOMERY [00:54:16] Yeah, so what are our, our primary interest is how light cues are used by plants to tell them what time of year it is, whether they should be flowering, what kinds of behaviors they should do. So we actually study, there are proteins and plants that when light, certain light is available, these plants start an entire communication cascade. So I think about it as the telephone game you know where we used to have information and then share it. But plants do it with much more trust and fidelity because the information has to get carried. And so we study how that gets started in response to light cues and what that means in terms of plants knowing whether it's summer or spring or fall and what they should be doing, whether they should be in spring making flowers and summer, making fruits, or if the light cues are telling them that it's wintertime and they should be preparing for rest over winter. So we, that's part of what we study in my own group.

JVN [00:55:06] ‘Cause you're at Michigan State University, which is, like, an incredible school, and now, comma, that's giving me major, not Michigan State, but what you're studying, global warming vibes because doesn't, like, global warming have, like, a negative impact, obviously, on plants, I guess, right?

PROF. BERONDA MONTGOMERY [00:55:20] Yes, yeah. So climate change and global warming is really a threat to plants because it often is changing their environment faster than they can adapt to it. So we talked about how change happens slow enough, the plants that have that variability can persist and make offspring. Climate change and global warming are happening so fast that sometimes plants go, they almost go to extinction before they're able to adapt to the changes. And that's one of the big problems. Plants also are sometimes working overtime because the carbon dioxide levels are changing. And that means that how they respond, their behaviors also have to adapt to that because they're so dependent on carbon dioxide. So it is a huge problem in terms of thinking about whether we are driving plants into extinction or if plants are changing in ways that are going to have kind of reverberating effects back on us in terms of their, our, our dependence upon them as well.

JVN [00:56:13] So because there was just this, like, gigantic freeze in all, in Texas and all these like trees like cracked in half and all these branches fell off and all the cute little fat buds were starting to come up on all the trees, like, I could see all these cute little baby circles I never really, well I kind of noticed it my subconscious before, but I never was, like,

excited for them to like unfurl. So are they gonna, like, freeze off and come back or like what happens when the plants get confused because of the weather?

PROF. BERONDA MONTGOMERY [00:56:38] Yeah, some of them, we actually, I've seen, we've seen this several times when this happens. Sometimes they get confused and they reset, right. They reset to winter. And so then spring will be delayed and often they won't have a kind of a full season. And so if you ever look at the tree rings, that's why you know sometimes they thin and sometimes they're thick because their season is shorter and they don't have as much time to make the kind of ring in the tree. What we saw here was interesting; I think it was last, a couple of years ago we had a similar issue here and the trees started to go, the leaves started to be red again, and so my neighbor thought they were going into fall preemptively. So sometimes they're confused. It's almost like, you know, jet lag in a way where things have been reset and they're trying to respond, but they're off season. And so it really does affect, kind of that particular season. They usually persist, even some of the trees that crack. We have some trees on campus that were hit by lightning and it's just half of a tree now, right, but it still makes leaves on that one half, and so these plants are really kind of adaptable and many of them will survive. Some of them may not, but a lot of them will be able to survive even if they have an off season.

JVN [00:57:43] So, if trees ever get, like, a disease, is there ever any like human intervention that you can, like can you give a tree, like, medicine or a plant like medicine, that's, like, not cutting it off? Or cutting the sick part off?

PROF. BERONDA MONTGOMERY [00:57:55] Yeah, a lot of, you know, there are a lot of biologists who kind of study that, whether a lot of times it starts with looking at what trees would normally do when they were sick and use it, trying to come up with compounds that mimic that. Sometimes what they do is often, is if they see trees getting sick and they know there's another plant, let's say it's a different plant that would be able to respond to Dutch elm disease, to try to use compounds that that organism would use to see if you can induce a response. And so there are lots of different ways to try to use kind of biological interventions to help plants respond to disease, other than pesticides and those kinds of things you know, yeah.

JVN [00:58:31] So then back to what you said, so what is um, what are like some of the interesting things that you guys have like found lately? So it's, like, the, this sometimes, like, connects the trees and the plants and they talk to each other and make, like, fungus connections under the ground.

PROF. BERONDA MONTGOMERY [00:58:44] Yeah, so we don't study fungus connections, but we do, we do study, um, part of what we study is related to the crown shyness that we

were talking about. So the, the proteins that we study that perceive light are involved in kin plant setting up crown spacing. So you know, they, some of those protons, proteins are involved in those kinds of things. And also a lot of what we study has some implications for agriculture in that the light cues are directly linked to when and where plants flower and produce fruit or how long they make green and healthy leaves. So some of the things we study have had implications for lettuce, um, agriculture because, you know, you want the plants to keep making green and healthy leaves or for other types of fruit and vegetable-bearing plants.

JVN [00:59:27] Ah! Ok, so now what if we like, what would you just be, like, as a literal professor of molecular biology and microbiology and molecular genetics, um, what would you just be remiss if you didn't share with us after this interview like that I should have asked or like that you really want people to know?

PROF. BERONDA MONTGOMERY [00:59:45] You know, I think the, the one thing that I always try to impress on people is that a lot of times we enter into our curiosity about things, plants or trees, trying to make them relevant based on how similar they are to humans. And I think these organisms are fascinating in and for themselves. And I, you know, I love the name of your podcast,' Getting Curious.' I wish we would just be more *curious* about why organisms are the way they are, not because they have any implications on our life directly, but because they're cool and worthy of kind of admiration in and of themselves.

JVN [01:00:19] Ah! Yes! You know what I think about that, I mean, I wish that too, I think, I was thinking about this a lot, and I think that it's like, "comparison is the thief of all joy."

PROF. BERONDA MONTGOMERY [01:00:28] Yes, yes. Yes.

JVN [01:00:31] And then at the same time, it's like as humans, we just have this need to like, it's like a knee jerk reaction. And I struggle with it, too, to, like, want to compare things to myself, I want to try to, like, categorize something. And so I think that's, like, a frustrating, weird thing, and I, and well not a weird thing, but like a human thing, and I think it's important to, like, notice that when it's in action. And I just think you couldn't have hit the nail on the head any harder. And I am so grateful that I've had this moment in my life to, you know, think that, or even just notice how amazing plants in nature are. But, it does make me think about like how when I was doing hair full-time, like, prior to the success of, like, 'Queer Eye' and other things, like, that I've been able to do, it's like when I was struggling so hard with addiction and just like other things, it's like, I didn't have noticed, a, a chance just to stop and smell the roses, so to speak. And I think that, I think one thing that I've taken or just noticed is, it's like this nature and, like, the wonder of

nature is always there for us to notice even if you don't think that you know it's there for you, it *is* there for you and it's so fascinating.

PROF. BERONDA MONTGOMERY [01:01:35] Absolutely! Absolutely!

JVN [01:01:38] So, um, ah Dr. Beronda Montgomery, thank you so much for coming on and for talking to us. I thank you so much, and I had so much fun! You've been listening to Getting Curious with me, Jonathan Van Ness. My guest this week was Michigan State University Professor Beronda Montgomery.

You'll find links to her work in the episode description of whatever you're listening to the show on.

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