But Why: A Podcast for Curious Kids

But Why Live: Trees

June 12, 2020

[Jane] This is “But Why: a Broadcast for Curious Kids.” I'm Jane Lindholm. For now, eight weeks this spring, we're bringing our podcast to the airwaves for live radio shows in collaboration with Vermont's Agency of Education. The idea is to offer you kids who are out of school a chance for your own call-in radio show. And if you live in Vermont and surrounding areas, you don't even need the internet at all. You can just call into the show.

Now, I know some of you are already out of school, but I hope you'll stick with us for the next few weeks because we have some really fantastic shows planned for you. And we know you're going to want to call in and get some answers to your questions, including today. We're going to be talking about trees. Now, I have to warn you, I think it's safe to say that there are hundreds of you who have sent us or are trying to send us now questions about trees. So, we probably won't be able to get to all of them unless our guests talk very fast. But I think you're going to find some very interesting information in this hour, even if we aren't able to answer your awesome question.

In fact, the idea that you might learn something new and cool about trees is part of why we've invited these specific guests here today. Alexia Constantinou and Katie McMahen both work at the Simard Lab at the University of British Columbia in Canada. The Simard lab is a diverse group of students who study how trees and soil are connected to the ecosystem. Alexia studies how forest harvesting affects wildlife, and Katie studies the way the food forest web recovers after mining. Alexia Constantinou and Katie McMahen, thank you for joining us today.

[Katie] Thank you for having us.

[Alexia] Yes. Thanks very much for having us on. I'm really looking forward to the show.

[Jane] Yeah, me too. And so, kids, if you have questions, we would love for you to call now, or you can send an e-mail to Questions@butwhykids.org. Let's dive right into the questions. And we're going to start with some basics here. And then I really want to get into, later on, a little bit more about tree communication, which is one of the things that the Simard Lab specializes in. But let's start with this question from Lucy.

[Lucy] I'm from Hartford, Connecticut, and I want to know how trees grow.

[Jane] We had another question from a four-year-old in Bristol who wanted to know the same thing. So, Katie and Alexia, which one of you wants to tackle just the basics of how trees grow?

[Katie] Katie here, I can take that first one. Just like humans, trees need food and water to grow. But they get this there, get this food and water in quite a different way than we do. Trees and plants are really incredible in that they can actually get their food from the sunlight. This process is called photosynthesis. And it's really amazing. The trees can take energy from the sunlight. And just using water and carbon dioxide, which is a molecule
floating around in the air, they can create energy. And, so, this energy is in the forms of sugars which contain carbon. And so, that's how they get their main energy. But then the water, of course, comes from the soil. So, they can take out the water from the soil using their roots. And they also get other nutrients and vitamins from the soil as well.

[Jane] Well, let's go a little bit deeper into that with a couple of other questions we have, because you were just talking, Katie, about some of the things that a tree needs like water and that it also needs oxygen and sunlight. So, here's a question from Sienna.

[Sienna] I'm eleven years old. I live in Davis, California. And my question is: do trees breathe? And if they do, where do they breathe from?

[Jane] All right. And before you get to that, here are two more questions.

[Linda] Hello. My name is Linda and I am seven years old. I live in Ashland, Oregon. My question is how do trees give us oxygen.

[Raymon] Hi. My name is Raymond and I'm seven years old and I'm from London. My question is, how do trees make oxygen?

[Jane] We also got a question from Rishi who lives in the United Kingdom with the same question. So, talk to us a little bit more about oxygen and the role of oxygen for trees in how they breathe and in how we breathe.

[Alexia] Sure. You can almost think of trees as breathing backwards from us. When we take a breath in, we're breathing in air and we're taking the oxygen out of it. That's what we need to breathe. Then when we exhale, out comes the carbon dioxide. Trees actually do this in reverse. I mentioned earlier that when they do photosynthesis, they're taking the carbon dioxide out of the air and using that to create their sugars, their energy. But then once that sugar's in the tree and it gets used up, then when [the tree] uses up that carbon, it actually produces oxygen. Then, that is released back out into the air for us to breathe as humans. I think one of the questions mentioned, where does that happen? The air actually goes into the trees through little pores in the leaves or the needles called stomata. That's where the air comes in when the leaves on the needles are doing photosynthesis.

[Jane] Do we call it breathing? I mean, would you say that trees breathe?

[Alexia] You know, that's an interesting question. People feel strongly about whether it's appropriate to apply human-centered words to trees. And I'm sure we'll get to this later today when we're talking about trees communicating—whether trees could talk or if only humans can talk.

And so I can't put this in the same category. You know, the air is going in and out of trees and they're using carbon from it and putting oxygen back into it. So, whether you want to call that breathing or use the scientific words of photosynthesis and respiration is, I guess, out for debate.

[Jane] All right. We have two questions about the out or outer parts of trees, so let's start with this one from Karen

[Karen] I'm five years old and I live in Lewistown and my question is, why do trees have bark?
[Hazel] My name is Hazel. I’m from Brooklyn and I’m four and a half. My question is, why do trees have different textures?

[Jane] Alexia, what do you think? Why do trees need bark? And why does all the bark look so different?

[Alexia] Well, those are two wonderful questions. Thank you for asking them. I’ll tackle the first one. Why do we need bark on trees? So, trees grow, they create new cells from this part called the cambium. And that’s where the new cells are being created every, every year as they grow. And we need bark to protect that area and to protect the trees from things around it that are going to try and attack it. So, we want trees that have thick bark. If they need to be protected from beetles that are trying to get in or animals that are trying to chew on them or fire that's going to burn them up. So, they need thick bark to protect themselves. And that bark can be thicker or thinner on different kinds of trees and the different things that are hazards for them in their environment. So that's why they have different textures. We have trees like Douglas Fir over here on the West Coast and they have really, really thick bark to protect them from fire and to make them more resistant to fire. And then we have thinner trees that don't grow quite the same way and they're able to have bark that's only tough to get through if you’re a particular kind of bug or something like that. So that would be my answer for that.

[Jane] Well, while we're talking about that, let's hear this question from Calvin.

[Calvin] I'm six years old, and I live in Vermont and my question is: how do you know what trees are what kind?

[Jane] So, Alexia, you were saying, you know, there’s different bark on different trees. And part of that is because the bark does different things. But bark is one way to help identify one kind of tree from another. What are other ways?

[Alexia] Well, that's a really good question, because we can definitely get confused when we're learning about what these different trees look like and how to identify them, because some look really similar and are of the same family and genus and some are wildly different and their mutual ancestors were much further back in time. So, the one way we can distinguish is, yes, from the bark. Another way we can distinguish is from what the leaves or the needles look like. So, we can separate coniferous like year-round green trees, evergreen trees, from trees that lose their leaves in the fall. So deciduous and coniferous trees are different from one another, generally by way of leaves and needles. So, when you think about a big maple or an oak, they have leaves that look like the palm of your hand. They're big and open where evergreen trees have little tiny needles. So that would be one way I would distinguish. And we have trees that have different shapes. So, the way the trunk goes into the branches goes further into smaller branches and further and their size. That also is different between different trees. And then we have... what else do we have? We have the shape of the leaves or the shape of the needles. So, an oak looks different from a maple in the shape that the leaf makes. And trees that are up in the mountains have different ways of spreading their needles so that they don’t get too much snow on them. So, we can look at those things to distinguish between different species.

[Jane] So it’s not just that you can tell one species of tree from another, but you can also kind of start to tell how the tree grows or what kind of environment it might be living in or what type of tree it is, because the way they grow is adapted to their environment.
Yeah. I mean, Katie, feel free to jump in here. I would say that trees, as they have become different species, specialize to the niche that they live in. So, we can say that an example I would give is there's two different types of hemlock tree. One is called Western Hemlock and one is called Mountain Hemlock. And they're very similar. But one difference is the needles on the Mountain Hemlock stand up a little bit more on the branch. And that prevents snow from accumulating on them. But Western hemlock doesn't live where there's really much snow at all, so it can be a lot flatter. The needles can be much flatter on the branch because that's not a problem that they encounter in their environment.

Jane We're talking today about trees with Alexia Constantinou and Katie McMahen, who both work at the Simard Lab at the University of British Columbia. And we've been talking about some general ways that we can start to learn about trees and how they grow and what kinds of leaves they have and bark and how we identify them. But we also want to talk about tree communication today, because it is so fascinating to understand how trees communicate with one another and why. So, let's go first to Ekka, who's calling in from Toronto, Ontario. Hi, Erica. Nice to talk with you.

Ekka Yeah, hi.

Jane Hi. Go right ahead.

Ekka My question is, what kind of consciousness do trees have?

Jane Whoa! What kind of consciousness do trees have? Katie?

Katie Thanks, Ekka, that's getting really deep for the first question. Yeah. I mentioned earlier that people sometimes struggle with how to apply words that we use to describe humans. You know, talking, thinking, consciousness. What does that mean for animals and trees? And this is a big question and I don't know that everybody agrees on the answer to this question. But what we can say is that just like humans, trees are constantly sensing the environment around them. You know, they're adapted to be in tune with what's going on in the weather. What's with the temperature? And they're also in tune to various threats in their environment. And they have ways of adapting to what's going on in their environment. So just like humans are conscious of things and their surroundings and we change what we do based on our observations or what we hear or see, trees are able to adjust based on the temperature or if they detect some kind of a bug or pathogen is nearby.

Jane Wow, that is so cool. All right. So, we've got a lot of tree communication questions for the two of you. Let's go to Aurora in Wethersfield, Vermont. Hi, Aurora. What's your question?

Aurora My question is, what do trees use their communication for?

Jane Good one. What do trees use their communication for?

Alexis Thanks for asking that Aurora. Yeah, go for it, Katie.

Katie Sure. Yeah. Thanks, Aurora. So, trees use communication for a whole host of different things. I can give you a few examples just to give you the diversity of why trees might want to communicate. The first example I can give you is there might be some kind
of pathogen coming to the area or a tree has been attacked by some kind of bug. And it's worrying for its health. It can send specialized signals to other trees so that those trees know, oh, this bug is in the area and they can get their defenses up as well. So, sharing those stress signals is one way.

Another way is that. It's maybe a different form of communication, but trees will send other types of signals or other types of chemicals. Sometimes the communication or the chemicals they send aren't always good. Some trees send what we call allelopathic chemicals. And those are actually harmful chemicals. And they'll send those to other trees to try and harm them so that they can grow better and the other trees start to grow more poorly.

[Jane] So, they sort of fight those trees there. It's like they're trying to do better than those other trees.

[Katie] Exactly. So a lot of the trees communication and sending signals as we talk about it in a good sense, but occasionally there are a few bad instances of it. On the other side, some trees, rather than sending bad chemicals, will actually send nutrients and food. We know that big tall trees-- mother trees, we sometimes call them. When you're walking in the forest and you see big old tall trees, those are mother trees. They have the best access to sunlight and resources. And we know that they will actually send some of their nutrients and food to some of the smaller seedlings that are growing on the forest floor and are small and struggling. So that would be sort of a positive way that trees are interacting.

[Jane] That's kind of amazing that these mother trees can send some of what could be their nutrients to these younger trees that might have more trouble growing. Do they only send these nutrients to trees of their own same species or do they send it sometimes to other species as well—whether they do that on purpose or not?

[Katie] Both, really. There's some evidence that trees will actually send more and more nutrients to seedlings that are their own babies, that they're related to, which is pretty incredible, but kind of makes sense if you think about wanting your family line to survive. You know, as parents, humans really want their kids to survive, and, so, it makes sense that trees want their babies to survive so that they can grow up and continue. But interestingly, other trees can still work together. So, there's a really cool example where there are birch trees and they have leaves. They are growing in the same forest with the coniferous tree that has needles. In the spring, when the birch trees, when their buds burst, the leaves all come out. They're really vibrant. They have extra energy. And, so, they send that to the coniferous tree that have needles. But in the fall, as the birch trees started to lose all their leaves, they weren't able to make as much energy. So, the conifer would send some of the energy back to the birch tree when it needed it.

[Jane] Wow. This is so fascinating. We're talking about trees today and we're talking about tree communication. And we have more questions about how trees communicate with one another and including even do they hear-- are trees able to hear. So, stay with us and keep your questions coming.

I'm Jane Lindholm, and this is “But Why: a Broadcast for Curious Kids.” We're talking about trees with Alexia Constantinou, who researches tree habitat and how animals and trees interact. And Katie McMahen, who researches ecological recovery with trees. They both do their research at the Simard Lab at the University of British Columbia Faculty of Forestry. And the Simard Lab also looks at how trees and soil are connected to the
ecosystem and how trees communicate with one another. Let's go to Piper, who's calling in from Wheelock, Vermont. Hi, Piper. Hi. What's your question?

[Piper] my question was, how did trees communicate with other trees?

[Jane] Yeah, so we've been talking a little bit about the fact that they do. But Alexia and Katie, could you talk a little bit more about how trees communicate with one another?

[Alexia] Yeah, I would love to give you one fun example of how they're doing that and why.

So trees, if we use the definition that people have for having consciousness, which was a question that Katie just addressed, no, trees don't have a brain and neurons in the same way that we do or that animals do. But they are kind of hubs of absorbing the different signals in the environment around them. That's what Katie was just describing. And, so, they can communicate with each other through what we call mycorrhizal connections. So, the roots of trees have these really fine hyphae and they connect to the hyphae of other trees. And these connections -- the hyphae and the mycelium and the connection between them-- is what we call a mycorrhizal connection. And between those connections, that's how they're able to send nutrients to one another or signals.

There's another example where they can release some gases like ethylene. And that example comes from when giraffe's go to eat trees. The tree doesn't really like that. So, they don't like that the giraffe is eating their leaves. And, so, the leaves become really bitter. The tree has detected that danger, that giraffe predator and …

[Jane] like eat it in a matter of minutes, in seconds, it can make the leaves bitter?

[Alexia] Yes, it can react quite quickly across just one tree and then all the trees around it for at least one hundred yards is also going to react that way. So, the trees have communicated using ethylene and they all become bitter so that the giraffes have to go farther away to eat their leaves.

[Jane] Do you know, we actually got a question about that from Clayton, who's seven, and lives in Sydney, Australia, and was wondering why some trees use things like poison to prevent animals like giraffes from eating their leaves?

[Alexia] Well, I think it's funny. We don't usually look at an animal like a giraffe or like a deer and think that they're predators. But to a tree, if something so big comes towards you and starts munching on your leaves, that is a predator. That is a danger to you and to your continued growth and your health. So, they can they release you have this bitter taste. The giraffe doesn't want to eat it anymore. And they're protecting all of the trees around them in their little hub by releasing that ethylene. So, they all become bitter and the giraffe doesn't want to stay there.

[Jane] All right. So here are a couple more questions in a row that we got from kids and one from Finley who's six and lives in Edmonton who wants to know why trees communicate. But let's listen to these other ones, too.

[Ayla] Hi, my name is Ayla and I'm 10 years old from Portland, Oregon. My question is, do trees actually communicate with each other?
Hi, my name is Avi. I'm six years old and I live in Essex Junction, Vermont. How trees know where each other are. When they come off from their tree, how do they know where to put their roots to connect to each other?

I hope that Ayla and Finley have started to see, yes, trees can communicate with one another and a little bit about why. But I'm curious about Avi's question, too, about when trees are growing, how do they know where to put down roots and if those roots are connected then to that communication?

And so, Alexia, talked about mycorrhizal network and I think it's a really good time to dive a bit more into about what those are and what they mean. So, when a tree root is growing down into the soil, it's growing and looking for water and nutrients, but it starts to form this really amazing symbiotic relationship--that's a relationship where both parties benefit--with fungus. So, when you see a mushroom growing, the mushroom is just this a very small part of the fungus, its body. Most of it is actually below ground in the form of a thin threads. Those threads will connect with tree roots, and the fungus will surround the little pieces of root or will grow into it. They form this relationship. The reason they do this is the tree itself gets lots of energy and carbon from the sun. It will trade that with the fungus for nutrients that the fungus can get from the soil. And, so, it's got this really good partnership where the fungus is benefiting by getting carbon. And the tree itself is benefiting by getting nutrients like nitrogen or phosphorus with help from the fungus. And, so, all these roots are connected by -- are interacting with fungus. But each fungal body can then grow out into the soil and meet other roots from other trees. As they grow out and meet more and more roots, it creates these huge below ground networks, which we sometimes like to call the wood wide web.

The wood wide—that's a good one.

Yeah, the wood wide wide web. Yep. There'll be many species of fungus doing this simultaneously, so you have these overlapping networks.

It's kind of amazing. You know, we humans like to think of ourselves as the center of the universe and things exist because we know they exist and we can see them. But there's this huge network, the Wood Wide Web, underneath the soil that, you know, until people like you were able to start doing research, we didn't even know anything about and we probably never thought that trees would communicate with one another.

Yes, it's challenging to visualize and it's challenging to study because you can't always it in the way you can see the aboveground part of a plant growing. So, a lot of our research now, we actually sequence the DNA in the soil to figure out which fungi are there and which fungi are doing to roots of different trees.

What's the DNA?.

So DNA is the code to life that's in every cell. And, so, we have it in every cell of our human bodies. And so do trees and it's always unique. So, when you can read the DNA sequence of the different cells, you can figure out, oh, you know, a human’s there, or a cat’s there or, in terms of the soil, you can figure out which types of fungi are there. By reading those different codes.
Jane: Katie, you were just talking about how trees use fungus and how fungus is a part of this communication network. But Penelope, who's 10 and lives in Roseville, California, wants to know, can trees communicate with other plants?

Katie: So any plants that form these mycorrhizae with compatible species can form a network. There are two main types of mycorrhizal fungi. If they form mycorrhizae with the same species, then there's no reason why they can't connect. And we see examples of this. I mentioned earlier how we had a birch tree and a coniferous tree connected and working together.

Jane: So, Alexia, Lexi, who's four and lives in Essex Junction, Vermont, wants to know, do trees hear when other trees fall in the forest?

Alexia: That's a really good question. Thank you for asking that, Lexi. This is something that I'm also just learning about, and my understanding so far is that they don't hear in the same way that we hear with our ears, but they can actually hear vibrations in the air, so they can... An example would be that the buzzing of a bee actually is a vibration that a plant can pick up on. So, that's more an evolutionary adaptation that's happened so that they can respond to organizing their flowers and pointing them or producing sweeter nectar in response to the bees and their vibrations. They hear vibrations, which also means that apparently trees can hear vibrations in music. I imagine that a tree hitting the ground and falling does create a vibration, but that's my best answer. Katie, do you have any more information on that?

Katie: I'm afraid I don't.

Jane: It's pretty cool to think about, though. Let's go to another question then from Talia, who's calling in from Princeton, New Jersey.

Hi, Talia. What's your question?

Talia: My question is, can trees get sick?

Jane: Can trees get sick? And before you answer Katie and Alexia, let's hear a similar question from Mira.

Mira: I'm four years old. My question is: do trees get sick like us humans? Who takes care of them.

Jane: Yes, Talia and Mira are both wondering about do trees get sick and Mira is wondering if they do, who takes care of them?

Alexia: I can start to answer that one and then maybe Katie will have more to add. Trees can get sick and there's, unfortunately, a number of different ways that trees can get sick. But I'll start by saying that when trees get sick, sometimes either it's the circle of life and the process of life that they either get better or unfortunately, they will die in the form that they're in, in the standing tree and become nutrients that the other trees use later. Either that will happen or someone like Katie or myself or another researcher will be there to study why that happened and what's going on. Or someone will take care of them by removing what's making them sick.
I'll start to get into why a tree might get sick. We have a few different hazards in a forest or in an environment where trees grow. One example would be too little water; a tree can get sick from drought. That would mean that they're not pulling up enough water through their roots to serve all of the functions that they need to stay alive. So, that tree will eventually get sick and can either withstand the drought with their evolutionary adaptations or they'll start to get really sick and they won't be doing so well until there's water again.

Another source of sickness could be when we have lots of beetles that bore into the bark of the tree or are eating the leaves or the needles of the tree. When too many beetles or insects come at a tree and they swarm and they're eating away all the pieces that make [the tree] able to make food for itself and release oxygen and make sugars, the tree eventually will either have to build up a tolerance and a mechanism for getting rid of those insects, or they will get sick from that and they'll stay sick.

Another factor is when there's an animal that's eaten too much of the tree. Especially when trees are little seedlings and they're just trying to grow and then all of a sudden, a big moose comes along and it just chomps off the top part. Well, maybe the tree, it's too sick and it can't survive without that part of it. It's lost a big chunk. So, those are some of the different reasons why trees might get sick. And we call one of these relationships, particularly the one with the one with insects. It's called an evolutionary arms race. So basically insects and trees are constantly locked in this battle of one gains a little bit of an edge and is able to get into the trees. The insects get this little edge in evolutionary time and they're able to get through the thicker bark or whatever it might be. Then the tree--the next move it makes over a long time is building up a thicker bark or a tolerance to that kind of boring in. And then the insects make another move and then the tree does. And they're constantly in this battle of protecting themselves and trying to get food.

[Jane] This is “But Why: a Broadcast for Curious Kids.” I'm Jane Lindholm. Today, we're exploring the fascinating world of trees with two researchers from the Simard Lab at the University of British Columbia, Katie McMahen and Alexia Constantinou. What questions do you have about trees and how trees fit into the rest of the landscape around you? Katie and Alexia, let's do a little bit of a lightning round here. And we'll start with Levi, who's calling in from Huntington, West Virginia. Hi, Levi. Go right ahead. What's your question? Hi, Levi. I hear you. Are you there?

[Levi] Yes.

[Jane] Go right ahead.

[Levi] My question is. If trees grow out of seeds, how did the first one grow? [indistinguishable] for a seed to grow?

[Jane] Oh, good question. We get this in a lot of different realms from the first human. If they're--you know, who is the first human, if there was no parent? So, Levi's wondering, how did the first tree grow? If there was no seed which came first, the seed or the tree. Katie and Alexia. Do you ever think about that?

[Katie] You can get yourself in a little bit of a pickle trying to figure it out, but the way we think about it as scientists is it's through the process of evolution. Trees didn't just appear in the form that they are. All trees and plants came from one single common ancestor. That would be a very small kind of plant-like organism. It evolved over time into all these fascinating, different types of trees...
[Jane] Well, did we lose you for a second there? Katie, I think we've lost Katie. Alexia, are you still there?

[Alexia] I am still here.

[Jane] I'm so glad. You take it from Katie.

[Alexia] Okay. As Katie was saying, we look at seeds in the growth of different things and the evolution of different plants through just that, through evolution. Katie just mentioned that trees did not just appear. There wasn't just a huge tree like you see in a national park, just sitting alone somewhere suddenly and then created seeds. These little seeds would have evolved from different plants that I believe-- don't quote me on this --originally came from algae or from different bacteria that then grew and then became something else and evolved into what we know now is as little seeds that became trees.

[Jane] All right. So let's talk a little bit more here about trees and the many different types of trees. Let's go to Charlotte, who's calling in from Dartmouth, Nova Scotia. Hi, Charlotte.

[Charlotte] Hi. Hi.

[Jane] Hi. What's your question?

[Charlotte] My question is, why are there so many different types of trees?

[Jane] Oh, good one, Charlotte. And before you answer that, Alexia, while we're getting Katie back on the line, let's go to Thomas, who's calling in from Calais, Vermont. Thomas, you have a question about lots of trees, too, right?

[Thomas] Yes

[Jane] Yes. All right. What's your question?

[Thomas] My question is, how many different kinds of trees are there?

[Jane] Oh, good one. OK. So lots of different kinds of trees. Why are there so many and how many different kinds of trees are there, Alexia?

[Alexia] That is such a wonderful question. Thank you both for asking. There are 60,000 different kinds of trees and…

[Jane] Whoa! 60,000.

[Alexia] 60,000. I know. Maybe I should pause for dramatic. There are 60,000 different kinds of trees. In Vermont, where you are, there's more than 75 different kinds of trees. They've all evolved. All 60 thousand came originally from one common ancestor. We break them down all -- the 60,000 -- into different groups based on the kind of leaves or needles or fruits or whatever they might have. But, yeah, that's a lot of trees.

[Jane] Why do we need so many kinds of trees?
Alexia: Well, they've all evolved to fit different places and needs and environmental conditions. We need different trees to support all these different kinds of ecosystems that we have on Earth. In an ecosystem or ecology sense, we need all these different trees because we have all these different kinds of animals and different amounts of water or lack of water and other communities of plants around these trees. And for humans, we need trees because, well, we have lots of wood in our homes and we have furniture and we need these trees that produce lots of oxygen. So, they serve so many different services, both for just humans and the societies we live in. And for ecosystems more broadly.

Jane: All right. Let's go to Avery, who's calling in from Frederick, Maryland.

Hi, Avery. How what's your question?

Avery: Why are branches?

Jane: So Avery is asking about branches. Avery, are you still there? All right. So, Avery told our call screener that the question was, what are branches for? Like, what's the point of branches? And Katie, I think we have you back, so I'm going to throw that one at you. What's the point of branches?

Katie: Sure. Well, one kind of interesting thing about branches is, if you think about a tree going straight up without any branches, it wouldn't have very many leaves on it or wouldn't have very many details on it. So, as it grows out and creates these branches. Every branch will have so many needles and leaves that it will have way more, way more than it would if it just grew straight up without branches.

And so the purpose of having all those leaves is that it can do photosynthesis, which it needs to do to get energy. That's one of the reasons. Interestingly, as trees grow taller and taller, it gets harder and harder for trees to get water all the way from the soil and the roots all the way to the top of the tree. And, so, they think the main reason that trees stop growing taller is because it can no longer get water to the very top. And so when it reaches that point, it makes more sense to the trees just start to grow branches and grow wide then to grow up.

Jane: All right. Let's tackle another one here from Ben in Wallingford, Vermont. Hey, Ben.

Ben: Hi. My question is, how old can trees get?

Jane: Ooh, how old can trees get? Ben, I'm going to pair your question with one that we got from Kaisan.

Kaisan: I am eight years old. I live in Seattle, Washington. My question is, why do trees live longer than humans?

Jane: So, Katie, do you know why trees live so long and how long they live?

Katie: Well, interestingly, trees never really die of old age. That just doesn't happen for them.

So those are both really good questions. Trees die for the reasons that Alexia talked about earlier. If there's drought and they can't get enough water, if they can't get enough nutrients or maybe if they get attacked by beetles or some kind of insect. But as long as
they can fend off the insects and keep getting food and water, they're just going to keep growing and keep growing continuously, and this can be a very, very long time. The oldest tree that we know about is, I believe, in California. And it's a bristlecone pine tree. And they think that it's over forty-eight thousand years old. So that's really old.


[Anna] Hi.

[Jane] What's your question?

[Anna] How many roots do trees have?

[Alexia] How many roots do trees have?

[Alexia] That's a really great question. Thank you for asking. Actually, I'm not sure of the number of roots that a tree might have, but I do know that trees grow underneath the earth and they actually can be even bigger than the top of the tree. They can extend wider than the crown of the tree is as big aboveground. And that includes all the thick, coarse roots that we see and that are like really big coming out of the base of the tree and all the really thin ones that we've talked about earlier, the little strands. So, I know that it's really big, and I imagine that means that there's thousands. Do you know how many, Katie?

[Katie] You know, I don't know the exact number, but the number will, of course, change depending on how old the tree is or the type of tree.

[Jane] All right. Here's a question from Caroline.

[Caroline] I'm four years old, and I live in Carabassett Valley, Maine. My question is, is it OK to cut down trees?

[Jane] Alexia, you work on forest harvesting. So what about Caroline's question? Is it OK to cut down trees?

[Alexia] That's a really important question and actually a very controversial one, Caroline. So that's a big thinker. We know that, as people, we do use trees to make homes, like we mentioned earlier, and to have furniture and to build stuff and stuff that our societies need now. And so generally, my answer would be it is OK to cut down trees, but not all of them and not some kinds. We need to live in this balance of taking what we need while replacing and replanting trees after we've done that and making sure that the ecosystems and the forests are still able to sustain themselves. We can have areas where we harvest the trees, we replanted and then we come back and harvest it again later. And this is a process that has been around for a very long time and sometimes even forest harvesting and when we cut down trees can mimic how a fire or beetles would attack a stand of trees. So, it is OK within moderation, just like anything else.

[Jane] All right. Here's a question that we got from Keeley. Keeley is nine and lives in New York City.
[Keeley] My question is why on mountains do the trees go upwards and not sideways?

[Jane] I like that question. So, if you're thinking about a mountain, yeah, why don't the trees grow out sideways? Why did they go? Why and how do they grow straight up? Have I stumped you, Alexia and Katie? Would you want to take it,

[Katie] Alexa? I think this is your area.

[Alexia] My initial answer is--it is a little bit of a stumper--my initial answer is, first, that the tree needs to grow towards the sun. So even if they come a little bit out sideways in their growth, they are eventually going to go upwards towards the sun to get as much sunlight as possible. One of the driving forces of how any plant grows is it wants to get as much sunlight as possible. Whatever angle it needs to be on to make that happen is what it will do, just by way of evolution. Also, roots are going to be tethered into as much soil as they can possibly find on the side of a mountain. So those two things put together, it will eventually grow as upwards as possible. That's why that's my best answer at the moment.

[Jane] Yeah. And, you know, I think about some of our smaller plants. You know, if you have a plant that's in the window, you can see that plants start to lean toward the sunlight. So, it sounds like the trees are kind of doing the same thing, trying to reach up and up and get the most sunlight.

[Alexia] Yeah, it's just like when we think about flowers that open up in the morning to get the sunlight and then they close again at night. Everything is really just trying to get as much of Mr. Sun as possible.

[Jane] All right. Here's a question that we got from Reed,

[Reed] I'm five years old, from Missouri. My question is, shy are trees, boys and girls?

[Jane] Yeah. Do trees—do all trees have sex, male or female? Or is that only true for some tree species? Let's talk a little bit about tree reproduction. Alexia, do you want to start?

[Alexia] Sure. We do have trees that are separate boys and girls. But we also have trees that have both sexes on one. So trees, for reproduction, there are some that release their spores. All this stuff that we see in the spring-- pollen, which it's allergy season right now, so there's a lot of it around, all the little yellow stuff that you see that accumulates on top of water or on the top of your car or something like that. All that yellow pollen from male trees is trying to find female trees where they have cones that are receptive to that pollen. What I would add to that is that trees are trying to have these two pieces meet and then the seed will come together, and the seed within it has all of the instructions from the male and the female parts for how to grow. And then they get released later. That's where I'll leave that for now.

[Jane] You know, we're almost out of time. And I'm just curious because we've answered a ton of really cool and interesting questions. But Katie, is there anything that you think we should all know about trees that maybe, you know, maybe we just don't know about yet, that you've been studying and you think, oh, everybody who is listening today should know this?
[Katie] Ooh, that's a very, very tough question to answer, because there's so much interesting about trees. Let's see. You know, I think the most interesting thing that I study in my research is how can we plan when we're growing trees? If we grow young seedlings near big mother trees, can we plan to do that? And then the mother trees will help our seedlings grow up better. And so, I'm really interested in studying that, because if we save these mother trees and protect them, that means that all the other trees growing around them in the future will grow better.

[Jane] Yeah. So that's interesting thinking about what Alexia was talking about, that, you know, you have to think about moderation when it comes to cutting down trees. So, Katie, in some ways you're suggesting maybe don't cut down the mother trees.

[Katie] Yeah. That's something we certainly talk about in our research team is how can we how can we plan our logging, or even in the city can we plan to protect these big old trees? Because they have so much memory of the ecosystem and they are of so much to value for future seedlings and for the connectivity that they have below ground.

[Jane] I think we'll leave it there for today because it's a really interesting way to think about it and think about the roles that humans can play as we try to, you know, live our own lives, but also have to be conscious about all the other living things around us and how they may be communicating and interacting and what's a way that we can all live together. I really appreciate both of you being on the show with us today. Katie McMahen is a PhD candidate researching the way forest food webs recover after mining. Katie, thank you so much.

[Katie] Thank you. It's been really fun.

[Jane] And Alexia Constantinou is a master's student studying how forest harvesting affects wildlife. Alexia, thank you. It's great to talk with you, too.

[Alexia] Thank you so much for having us.

[Jane] Both Alexia and Katie work at the Simard Lab at the University of British Columbia Faculty of Forestry. And the Simard Lab is a diverse group of students studying how trees and soil are connected to the ecosystem. I want to thank all of you listening for sending us such amazing tree questions. Thank you. Make sure you come back next Friday. We're going do another live show and we're going to answer questions from young people about racism with the authors of the book “The ABC is of Diversity”. Send your questions about race and racism and protests ahead of time to questions@butwhykids.org and join us live Friday at 1:00 p.m. Then on the 26th, a musical celebration.

I'm Jane Lindholm. We'll be back next week. Until then, stay curious.