

Brains On (APM) | Brains On! Trees: From seed to shining seed 1QDE6E3F4HVVXAYS9AHJFJEK80

SCI SERVENS GANSEL: You're listening to *Brainson* where we're serious about being curious.

[MUSIC PLAYING]

MOLLY BLOOM: Sci, what is your favorite tree?

SCI SERVENS Um, I don't know, maybe oak.

GANSEL:

MOLLY BLOOM: Oaks are very cool. I think my favorite is probably a magnolia or maybe a birch. I like the white bark. And I love trees. And it's clear our listeners love trees, too. Of all of the questions listeners have sent into *Brains On*, questions about trees are the most common.

RHODA: How long does it take for a tree to grow?

JULIUS: How do trees give off oxygen?

HENRY MILLER: How do leaves grow on trees?

CADEN: How do trees grow?

SCI SERVENS We're going to tackle those questions right now. Keep listening.

GANSEL:

[MUSIC PLAYING]

MOLLY BLOOM: You're listening to *Brains On* from MPR News in Southern California Public Radio. I'm your host Molly Bloom. And here with me today is 9-year-old Sci Servens Gansel from Minneapolis. Hi, Sci.

SCI SERVENS Hi.

GANSEL:

MOLLY BLOOM: We have a lot of questions to answer today, so we should get started. Are you ready?

SCI SERVENS Oh, yeah. Here's our first question.

GANSEL:

CADEN: My name is Caden. And my question is, how do trees grow?

HENRY MILLER: Hello, my name is Henry Miller. My question is, how did leaves grow on trees?

SCI SERVENS To find out the answer, Molly and I went to the University of Minnesota Landscape Arboretum to talk with somebody who studies trees.

MOLLY BLOOM: Horticulturist Mary Meyer told us we're only seeing part of the growth process.

MARY MEYER: There are basically three ways that it grows. Out in the very tiny tips of the branches, it's elongating out there with new growth every year. And if you look closely, you can see at the tip of the branch what's new for every year.

And the second way it grows is around the stem where the special tissue we call cambium gets bigger and bigger and bigger and makes rings. And we know that you cut a tree down, you can count the rings. Or you take a core out of a tree, and you can count the rings. So it gets wider and wider.

And the third way is the roots. The roots get longer and longer and longer and bigger around both down there. And we can't see that, but that's happening at the same time.

SCI SERVENS That's a lot of growing. But all that growth starts with a single seed.

GANSEL:

MOLLY BLOOM: Inside the seed is an embryo.

SCI SERVENS That eventually grows into a tree.

GANSEL:

MOLLY BLOOM: And the endosperm.

SCI SERVENS That's built an energy so the embryo can grow even before it has leaves or roots.

GANSEL:

MOLLY BLOOM: The embryo takes that energy from the endosperm and grows a chute and a root.

SCI SERVENS The root soaks up water.

GANSEL:

MOLLY BLOOM: And the chute grows leaves that eventually absorb light.

SCI SERVENS And the tree starts to grow.

GANSEL:

MOLLY BLOOM: Roots are super important to trees. But since we can't see them, we sometimes forget about them.

MARY MEYER: The majority of their roots are in the top three feet of soil, so three feet of soil, but they are way, way out from here. So mostly roots are growing lengthwise.

SCI SERVENS And roots are important because they provide the tree with water?

GANSEL:

MOLLY BLOOM: How in the world does the water get from the soil, the moisture, into that root and all the way up to the top of the trees? And that's a long way. And so is these very, very narrow columns of water that have this pressure behind them. And it's like a big long tube. And then we know that the evaporation goes out of the leaves, and that actually pulls up the water from the roots. So it's this big tension and columns of water, hundreds and thousands of them going up to support the tree.

MARY MEYER: Kind of like sucking water up through a straw and the root is covered with tiny root hairs to help them absorb the water. So you'll have the actual root itself, and then coming out sideways will be hundreds and hundreds of these tiny root hairs so that there are many, many, many cells where the water can come in that way. And then it gets in those bigger vascular tubes that are like straws.

That's cool, but that's not as cool as the photosynthesis. The photosynthesis is the coolest thing to take the energy of light and make that into sugar. So that's the most fascinating thing about plants. That's why I got into studying plants. I thought how come planes do that?

MOLLY BLOOM: Good question, Mary. Photosynthesis is really cool. It's how plants make all the energy they need to grow.

SCI SERVENS And it actually provides the answer to a question we get all the time.

GANSEL:

JULIUS: Hi, Molly. My name is Julius, and I'm seven years old. My question is, how do trees give off oxygen for us to breathe?

BECKETT: My name is Beckett. My question is, how do trees make air for us?

JILL: Hi, my name is Jill. Today my question is, how do trees make oxygen for us to breathe?

MOLLY BLOOM: And what better way to find the answer than by going to the source?

[APPLAUSE]

CATHY: Welcome back to *Cooking With Cathy*. For this next segment, we have a very special guest. She's here to show us how to prepare her very favorite meal. Willow.

WILLOW: Hi, Cathy. Thank you for having me. What a treat.

CATHY: The treat is ours, Willow, and a tree treat at that. It's not every day you have a tree in the studio. Now, I'm hoping you have a delicious cupcake recipe up your sleeve because I am ready to eat.

WILLOW: Not a cupcake, Cathy, but something equally delicious in my mind, glucose.

CATHY: Glucose? OK.

WILLOW: Well, you see, as a tree, I'm able to make my own food using some of the things that are all around, light, water, and-- hey, exhale over here--

[EXHALING SOFTLY]

--carbon dioxide, like the kind you just breathed out now, one of the key ingredients on my list. Do you want to see the rest of my recipe?

CATHY: OK, then.

WILLOW: So you need six parts water, (SLOSH) six parts CO₂, that short for Carbon Dioxide. Cathy, will you do the honor again.

[EXHALING]

Plus a dash of sunlight. Cathy, would you mind opening the curtains to let the sun in?

CATHY: Sure, here you go.

[CURTAIN SLOSHING]

WILLOW: Now, you can't do this with just your normal kitchen tools. You'll need some special equipment. For our pot, we'll use this chloroplast.

[SURPRISE]

CATHY: Oh, where can I pick up some chloroplast?

WILLOW: It's part of plant cells. Sorry to break it to you, Cathy, but chloroplast isn't sold in stores, but I'm full of it.

CATHY: Do tell.

WILLOW: This chloroplast is full of chlorophyll. That's a green pigment.

CATHY: Like green food dye?

WILLOW: Not quite. Chlorophyll lets me absorb the light I need for my glucose recipe. And light is basically energy, so it gives chlorophyll a boost of energy as well. This causes a chemical reaction that helps break apart the H₂O water molecules. Now, as you know, H₂O is shorthand for a combination of hydrogen and oxygen. When the H₂O breaks apart, it leaves hydrogen and oxygen molecules.

CATHY: Oh, I just love oxygen.

WILLOW: Well, I don't need the oxygen, so I put that out in the atmosphere for you to enjoy.

CATHY: Well, I'm coming for your trunk. You deserve a big hug for all that oxygen. Thanks.

[APPLAUSE]

WILLOW: You're welcome. Where was I?

CATHY: Well, I think that you just broke apart the water molecules into hydrogen and oxygen.

WILLOW: Right. And since you get the oxygen, that leaves us with this delicious hydrogen and the carbon dioxide that you so kindly provided when you exhaled. The energy from light reactions helps us combine the hydrogen and carbon dioxide into--

CATHY: Cupcakes.

WILLOW: Well, it is sweet like cake but not quite. We come out with C₆H₁₂O₆ or glucose, sugar.

CATHY: Yum, that is incredible. Big round of applause for Willow, the tree, and her glucose treats.

[APPLAUSE]

When we come back from commercial, it's time for what's that smell, our regular segment when we smell my leftovers and decide if I should eat them or throw them out. Stay tuned.

[APPLAUSE, MUSIC PLAYING]

MOLLY BLOOM: Before we tackle any more of these questions, we have an important task ahead of us. It's time for the mystery sound.

[ADVENTUROUS MUSIC PLAYING]

SUBJECT: Mystery sound.

MOLLY BLOOM: Here it is.

[MYSTERY SOUND PLAYING]

So that was a short one. So we heard two clips of the same thing. Do you have any guesses?

SCI SERVENS A leaf blower or a leaf sucker or something.

GANSEL:

MOLLY BLOOM: OK, so you think leaves are involved.

SCI SERVENS Yeah, probably.

GANSEL:

MOLLY BLOOM: OK, we're going to come back to that later in the show with the answer.

SCI SERVENS Or maybe the lead or maybe a tree in a storm.

GANSEL:

MOLLY BLOOM: Oh, that's also a good guess. We'll find out the answer in just a little bit.

SUBJECT: *Brains On.*

MOLLY BLOOM: Do you have a mystery sound you want to share with us, a question you want to hear answered on a future episode?

SCI SERVENS Or maybe you just want to say hi?

GANSEL:

MOLLY BLOOM: Email us. We're at @brainson@m-- as in Minnesota-- pr.org. And, hey, if you're interested in getting an email from us, we can promise that we send really good ones. They include updates from the show, links to cool science videos, and ideas for experiments you can try at home. Sound fun? Well, then just sign up for our newsletter.

SCI SERVENS Find it on our website at brainson.org.

GANSEL:

MOLLY BLOOM: While you're there, you can also listen to past episodes and see some cool photos and videos.

SCI SERVENS And, of course, we're on Instagram and Twitter @brains_on.

GANSEL:

MOLLY BLOOM: And really nothing makes us happier than hearing from you, your amazing questions.

SCI SERVENS Mind melting mystery sound.

GANSEL:

MOLLY BLOOM: And fun photos are the sunshine, water, and carbon dioxide to this show.

SCI SERVENS So here is the most recent group of *Brains* Honor Rollies.

GANSEL:

MOLLY BLOOM: The kids who keep this show going.

[MUSIC PLAYING]

Indiana from Seattle, Henry from Denver, Eva and Joshy from New Zealand, Isla, Laurel, Owen, and Elliot from Fayetteville, North Carolina, Audrey from Jonestown, Pennsylvania, Katherine from Damascus, Maryland, James and Clara from Malibu, California.

Polly from Los Angeles, Kyle and Xavier from Berkeley, California, Madeline and Jackson from Pendleton, Indiana, Sophie Rose from Orlando, Elias and Vivian from Amherst, Massachusetts, Andrew from Latrobe, Pennsylvania, Beckett from Atlanta, Laith from Washington D.C., Mackenzie from Saint Paul, Frank from Minneapolis, Cade from the Woodlands, Texas.

Keen from Madison, Wisconsin, Sam from Los Angeles, Claire from Fort Worth, Sierra and Tenzin from Alameda, California, Leon from Jacksonville, Florida, Josh and B from Ypsilanti, Michigan, Parker and Isla from Rio Rancho, New Mexico, and Annika from Ridgefield Washington.

SUBJECT: *Brains On.*

MOLLY BLOOM: You're listening to *Brains On* from MPR News in Southern California Public Radio. I'm Molly Bloom.

SCI SERVENS And I'm Sci Servens Gansel.

GANSEL:

MOLLY BLOOM: We're answering your many tree questions today.

SCI SERVENS Next up, evergreens.

GANSEL:

MOLLY BLOOM: Amelia wrote in with the question, why do evergreens stay green all year? The needles of evergreens--

SCI SERVENS Also known as pine trees are coniferous trees--

GANSEL:

MOLLY BLOOM: --they stay green all year.

SCI SERVENS Sort of.

GANSEL:

MOLLY BLOOM: I spoke with Kyle Gill, a forest researcher from the University of Minnesota, and he said evergreens do lose their needles.

KYLE GILL: They just don't lose them for the winter. So with a broad leaf tree or deciduous tree, they lose their leaves that we see every fall. And then they put them on again the next year. With evergreens, they actually retain those needles for two to three years usually, but then they end up losing them. Sometimes at this time of year, you see the red needles that are closer towards the stem. And those are usually the needles that they're then losing for the year.

They use them a little bit during the winter. They're ready to be photosynthetic reactive, but for the most part they're in a reduced activity state. A lot of that has to do with their roots being locked up in the frozen ground.

Right now is the time to see new needles growing. If you look at a lot of the evergreens around the cities, you see the lighter green that are coming out from the ends of the stems, and those are this next wave of needles. So they'll put new needles on every year. They'll put them on in basically a cohort or a group like they're doing now in this new growth. And they tend to lose them all at the same time for those cohorts.

MOLLY BLOOM: Pine trees do lose their needles, but the cycle is just much longer than trees that lose their leaves every fall.

SCI SERVENS And it doesn't lose all of its needles at once. So that's why it always seems to be green.

GANSEL:

MOLLY BLOOM: It's kind of like your hair. All of your individual hairs have a cycle of growing and falling out.

SCI SERVENS That's why some might come out when you brush your hair.

GANSEL:

MOLLY BLOOM: But they don't all fall out at the same time.

SCI SERVENS But what's happening when tree leaves and needles change color? I asked Mary Meyer from the Arboretum to

GANSEL: explain.

MARY MEYER: What we think is that most of that color is already in there. And there's just less of it than the green chlorophyll. And so in the fall, when the chlorophyll starts to die and degrade, all of a sudden we see the yellow and the orange and the purple colors that were there all the time. So those other pigments actually can photosynthesize also but not as well as chlorophyll does. So the colors of the fall, it varies by species and kind of tree. But they're there, and we just see them then in the fall.

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

MOLLY BLOOM: Ready you go back to the mystery sound?

SCI SERVENS Yep.

GANSEL:

MOLLY BLOOM: Let's hear it again.

[MYSTERY SOUND PLAYING]

Any other guesses?

SCI SERVENS No.

GANSEL:

MOLLY BLOOM: You're going to stick with your blowing through the leaves.

SCI SERVENS Mhm.

GANSEL:

MOLLY BLOOM: Here with the answer is producer Sanden Totten. Hi, Sanden.

SANDEN Hey, Molly. That is the sound of trees burning in a wild forest fire in my home state of California. We'll talk more
TOTTEN: about fires in just a minute.

MOLLY BLOOM: Are you surprised by that, Sci, fire?

SCI SERVENS Why?

GANSEL:

MOLLY BLOOM: Did it sound like fire to you now that you heard it?

SCI SERVENS I don't really-- yeah. But it doesn't really make sense.

GANSEL:

MOLLY BLOOM: Oh, we're going to tell you.

SANDEN It'll make sense in a minute. Just hang on.
TOTTEN:

SCI SERVENS You're on a tree episode.

GANSEL:

MOLLY BLOOM: We're going to talk more about fires in just a minute. But first, Sanden is going to answer the final question that we're going to tackle today from Rhoda in Atlanta.

RHODA: How long does it take for a tree to grow?

SANDEN Trees can grow up for a really long time depending on the type. Some live decades. Some live hundreds of years,
TOTTEN: and then there's Methuselah.

SCI SERVENS Methuselah?

GANSEL:

SANDEN Yeah, Methuselah is a bristle cone pine tree living in California's White Mountains. And it's believed by many to
TOTTEN: be the oldest tree in the world. Go ahead, guess it's age.

SCI SERVENS 1,000 years.

GANSEL:

SANDEN Molly.
TOTTEN:

MOLLY BLOOM: Uh, I'm going to go lower. I'm going to say 600.

SANDEN OK, good guesses, but this tree is more than 4,800 years old.

TOTTEN:

SCI SERVENS I was closer.

GANSEL:

SANDEN That's a lot of birthday candles.

TOTTEN:

MOLLY BLOOM: That is a lot of--

SCI SERVENS I was closer.

GANSEL:

MOLLY BLOOM: You were closer.

SANDEN Right. So this is a very old tree, and it's lived this long in part because it's in a remote area on this windy, barren
TOTTEN: mountain high up in the hills and not a lot can reach it or mess with it there. But other trees, they often live until they die, and they often die because of things like they run out of water. They run out of nutrients. Maybe they die when an insect or a disease gets them. They could be struck by lightning. They could be chopped down by humans. And sometimes they just get really old and heavy, and then they fall over.

MOLLY BLOOM: And, of course, some die in forest fires.

SANDEN Yeah, yeah. Where I am in California, we have lots of forest fires. But here's the thing, in some ways, forest fires
TOTTEN: are actually good for the forest.

SCI SERVENS How are they good?

GANSEL:

SANDEN They do kill a lot of plants. And, yeah, they're dangerous for animals and people, but they also help get rid of a
TOTTEN: lot of the dead material that sits on the forest floor. And once all that stuff is cleared out of the way, it's all burned off, new plants can grow there. And then some trees actually need a forest fire to help them reproduce.

MOLLY BLOOM: Right. Like the Jack Pine in Minnesota.

SANDEN And the giant Sequoia near me in California. I spoke with Dominic Papia, a ranger at Sequoia and Kings Canyon
TOTTEN: National parks. He said these trees have a really thick bark. It's like armor, sometimes three feet deep.

And the bark is full of a chemical called tannic acid. And that basically keeps the trunk from burning. It's a chemical that makes the trunk fireproof. So the plant is actually fine during a fire. But Papia said that all that heat actually triggers a special reaction in the cones up above in the Sequoia tree.

DOMINIC It's the heat that rises up from a fire and envelops all the cones on the trees and the canopy. And by doing so, it
PAPIA: dries those cones out and opens them. And when these cones open, of course, they release their seeds. And so millions of seeds are raining down from the canopy during a forest fire.

SANDEN And he says each tree can have upwards of 30,000 of these cones. And Papia says around a fire, there's often

TOTTEN: lots of wind and weather, and that can scatter all these tiny seeds.

DOMINIC These seeds, they're about the size of a grain of oatmeal. And they have one dark black line to the center that's

PAPIA: really like the lifeline of the seed. And the other light brown parts of the seed are really the wings, so to speak. And they carry the seeds on a breeze, and they'll move around the grove.

SANDEN Sometimes these tiny seeds can fly hundreds of meters this way. So it's like imagine all these seeds are like little

TOTTEN: paratroopers and waiting, the heat opens the door, gives them the signal, and then it's like, go, go, go, go, and they'll jump out and glide and fly off to settle their own patch of land somewhere.

SCI SERVENS Well, then why aren't there trees everywhere?

GANSEL:

SANDEN That's a very good question. Only a small number of these seeds actually grow into a tree. A lot of them just

TOTTEN: never find a good spot of land. They don't get enough nutrients. Maybe they get eaten by a hungry critter. So it takes millions of seeds like this to just get a couple of trees going. But since the fires burned off most of the other plants on the ground wherever they land, those seeds that do make it get into the soil and germinate. They're going to have very little competition.

MOLLY BLOOM: That's amazing. So the trees basically take advantage of the fire's destruction.

SANDEN Yeah, exactly. And trees, they can't walk like you or me, so they need clever systems like this to spread their

TOTTEN: seeds around. Sci, can you think of other ways that trees spread their seeds?

SCI SERVENS Maple trees drop helicopters.

GANSEL:

SANDEN That's right. They drop little seeds with helicopter wings, and they sputter off into the distance. That's a good

TOTTEN: one. Some trees, they actually grow fruit, which is delicious, and animals love to eat it. And then the animals eat the seeds, and then walk away and go somewhere else and poop the seed out somewhere else, and the tree can grow there. So that's one way to spread.

Other seeds, they have these tiny hooks like Velcro, and they latch on to animals, and they can hitch a ride for a long distance, and then go populate some other place that way. One of my favorite seeds is the coconut, which is round, big, heavy ball. It falls from a tree. It rolls down into the ocean, and it floats. And it just floats off to a tropical island somewhere else and washes up on the shore and becomes a tree there, which sounds like a pretty nice way to start your life to me.

MOLLY BLOOM: A tropical beginning, sounds awesome.

SCI SERVENS Thanks, Sanden.

GANSEL:

SANDEN You're welcome, guys.

TOTTEN:

MOLLY BLOOM: Obviously trees are really creative about the ways they spread their seeds. Now it's your turn.

SCI SERVENS We want you to think of some cool ways for seeds to travel far and wide, maybe a seed with wheels attached to it.

MOLLY BLOOM: Or a seed that jumps or swims.

SCI SERVENS Invent a seed and draw a picture, then send it to us.

GANSEL:

MOLLY BLOOM: We'll post our favorites.

[MUSIC PLAYING]

SCI SERVENS Trees are very cool and very important.

GANSEL:

MOLLY BLOOM: Through photosynthesis, they make food for themselves.

SCI SERVENS And take the carbon dioxide that we produce--

GANSEL:

MOLLY BLOOM: And turn it into the oxygen we need to breathe.

SCI SERVENS The energy they get through photosynthesis helps them grow.

GANSEL:

MOLLY BLOOM: Trees use lots of techniques to make sure their seeds spread out and grow into new trees.

SCI SERVENS And those seeds come packed with all the energy that new trees need to start growing.

GANSEL:

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

SCI SERVENS This episode was produced by Marc Sanchez, Sanden Totten, and Molly Bloom.

GANSEL:

MOLLY BLOOM: Many thanks to Rick Stossel, Chris McElroy, Robin Elms, Becky de Merrill, Lila Retina Sabah, Juanito Velasco, Jeff Severance Counsel, Lorna Benson, and Delia Bloom.

SCI SERVENS You can hear past episodes of *Brains On* at our website.

GANSEL:

MOLLY BLOOM: Brainson.org.

SCI SERVENS Or in your favorite podcast app.

GANSEL:

MOLLY BLOOM: And if you're a fan of *Brains On*, consider leaving a review in iTunes.

SCI SERVENS It really helps other kids and parents find out about the show.

GANSEL:

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

SCI SERVENS We're at brains_on.

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MOLLY BLOOM: Or by subscribing to our newsletter.

SCI SERVENS And you can always send your questions, mystery sounds, and high fives to us by email.

GANSEL:

MOLLY BLOOM: That's brainson@m-- as in Minnesota-- pr.org.

SCI SERVENS Thanks for listening.

GANSEL:

[MUSIC PLAYING]