

But Why: A Podcast for Curious Kids

How Do Big Plants Grow From Such Small Seeds?

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[Jane] This is *But Why: A Podcast For Curious Kids*. I'm Jane Lindholm. In each episode, we ask you to come up with the questions and it's our job to help find interesting people to give you some answers. You can send us a question by having an adult in your life record you asking it using the memo function on their smartphone.

Just tell us your name, how old you are, and where you live and then ask your questions and we will try to find you an answer. We have so many great questions we can't get to them all, but we love hearing from each one of you.

All right, so here's today's episode. They come in all sizes. They're usually green but sometimes they can be different colors and they are all around us.

It's not a riddle, I'm talking about plants. We are answering some plant questions.

[Coco] How are seeds made?

[Miriam] How does germination work?

[Carson] Where does dirt come from?

[Jane] Keep listening for the answers to those questions, but before we get to them, let's meet Charlie.

[Charlie] I am Charlie Nardoizzi. I'm a garden consultant and coach based here in Vermont. But I do talks and tours all around the country.

[Jane] What does it mean to be an expert on gardens? How does that happen?

[Charlie] Well, you go to school for that. So I have a degree in horticulture and gardening and a master's degree and I have a lot of experience. I've grown a lot of plants in my lifetime.

[Jane] Have you ever grown anything? It can be a lot of fun and a little challenging too. You can spend a whole lifetime learning about plants and still not know everything. But we gave Charlie some of your questions to see what he knows.

[Corwin] My name is Corwin.

[Alexandria] My name is Alexandria.

[Corwin] We're seven year old twins.

[Alexandria] We come from Baltimore, Maryland.

[Corwin] And our question...

[Alexandria] No, it's me! And our questions are...

[Corwin] And why are there so many plants?

[Alexandria] And why are they so important?

[Charlie] There are so many plants because of the nature of plants themselves. When they cross with each other they create new plants and those new plants are a little bit different than the mother or father plant, kind of like kids, you know, kids are a little bit different than their parents. And as that keeps going on and on, and on, you get more and more plants and more, and more diversity or more and more differences in them. And then you have factors like some plants grow well on mountains, some plants grow well by the ocean, some plants grow well in hot climates, some plants grow well in cool places. So because of the weather and the climate conditions and the soil conditions it might be there, you'll get more diversity to keeps happening. So that's the beauty of our planet is that there's so much diversity depending upon where you are on the planet with all these different plants. And it's important because as the old saying goes, in diversity there's strength. The more diverse things are, the more different things are. That means if some kind of weather system comes through in and harms a certain kind of plant the other ones that are different from that plant may not get harmed, because they have a certain different constitution and a certain structure to them that will save them from whatever harm that's coming their way.

[Jane] Do you have a sense of what plants do? What their function is in our world? For one thing people and animals eat them. What else?

[Charlie] Well, we're breathing! Every time you inhale it's because of the plants because they, they let off oxygen, through their process of making the green leaves, in the photosynthesis, which is a big word but it's basically taking the sunshine and making a green leaf through that whole process they'll let off oxygen and because of oxygen, that's what we breathe that allows life to be here on the planet. So that's probably the biggest thing that they do.

[Jane] You mean we need plants in order to have our own lives? That is pretty that is pretty important. All right, let's tackle a few of the seed questions.

[Coco] My name is Coco and I am four. I live in California. What my question is how are seeds made?

[Charlie] Seeds are made through a process what we call pollination. So pollination, there's a little bit of that word called "pollen" and that's that yellow stuff. If you ever look in a flower, or if you ever look at bees flying around, you might see they have this little yellow stuff attached to them, or if you put your finger or your nose sometimes in a flower you have a little yellow on it? That's pollen and what that pollen does, is that pollen will actually pollinate, that's where that word comes from "pollination," the flower meaning that the pollen goes in and it finds the comparable part in the structure of the flower. So the pollen is male and the comparable part would be the female part of that flower. Through that process that actually makes that makes the flower pollinated. So then you get a seed, the seed is a result of that cross between the male and the female parts of the flower.

[Jane] So in other words you can't have a flower turn into a new flower, or make another flower unless it has another flower do the job with it. It's the way babies are made.

[Charlie] Exactly.

[Jane] You need two. But what blows my mind Charlie, is that you're saying is pollen is male. That's kind of hard to wrap my head around because when I think of, you know, a male and a female I don't necessarily think of some yellow dust as a male. So what does that mean?

[Charlie] But in a sense, in the world of plants, that's kind of how it is. So that dust has all of the material that it needs to actually fertilize that, fertilize the egg if you want to look at it more in terms of human terms, or mammals terms, you're fertilizing an egg that that is in that flower and that yellow dust is what does it. It sounds magical doesn't it?

[Jane] Yeah. It does.

[Charlie] And the other thing about it is there's different kinds of flowers, so you have what we call "perfect flowers" meaning that the pollen, and the egg that's in that flower all it needs is to have that pollen just gently drop down onto the egg and it's fertilized. So tomatoes for example, you don't need bees, you don't need anybody else to come in. All you need is the wind to jostle it or even your hands to move it a little bit. And then the pollen drops down like rain drops. And it fertilizes that egg.

The other one of course is what you were alluding to being that the pollen comes from a different flower so some plants will have only plants that don't have pollen on their flower or they have the wrong kind of pollen so they need the pollen from one flower to the next, it'll come. And that's where the bees and the butterflies and the hummingbirds and all these other creatures will pollinate the plants and the result of all that kind of goes back to our first question about diversity. That creates the diversity, the differences because you're getting a pollen from one plant into a pollen of another plant. So the

offspring or the babies will look a little bit different, a little like the dad, a little like the mom.

[Jane] So that's how the seed is made.

[Charlie] Yes.

[Jane] A flower gets the pollen inside of it. And that kind of creates a new plant, but how?

[Charlie] So the pollen goes into the egg into the ovule. That's another technical term but that's the egg that's in in there and it pollinates it, creates the little embryo the little baby you might say. And that would be what's inside that seed.

[Jane] And then that seed has to basically drop off the plant somehow and get into the dirt, right?

[Charlie] So once the flower fades those petals drop off you often will see a little structure that's left there that could be a seed pod and it may be the seed itself or maybe like I say a pod, meaning that it's covered by something and inside is the seed the covering is there really just to protect it.

[Miriam] My name is Miriam. I am eight years old. I live in Montpelier, Vermont. My question is how does germination work?

[Charlie] Germination is basically the seed starts to grow. That's the basic way to look at germination. And germination starts with just what we've been talking about, the male fertilizing the female, that little embryo gets fertilized and then the seed has that coat that protects it. And so for that seed to actually grow it needs the right conditions. And so nature has been perfect in figuring this one out. So, in a cold climate like up here in Vermont where we are, you have this happening during the summer in the fall and you have these seeds, and they drop to the ground, which is a natural process. You wouldn't necessarily, it necessarily work if they started germinating immediately because it's going into winter and the plant will die. So they have a process where they go into a thing called dormancy, like a sleep basically.

And so the seed is just going to sleep there and sleep there and wait till the right conditions occur towards the spring. And those conditions will be the right amount of moisture and the right amount of temperature, a nice warm temperature. Those are the two key things they have that seeds start to grow or germinate. Each seed is a little bit different about what they need and how much they need. But it is usually those two factors once they start growing and germinating then that seed coat will break open, the little embryo starts growing. It's almost like a little chicken and egg the chick starts growing starts pecking its way out of the egg. You ever seen that happen? The same

thing's kind of happening with the seed coat. The embryo starts growing, the seed coat breaks apart.

[Jane] Because there's so much pressure...

[Charlie] Right...there's pressure right, and the seed coat has kind of been weakened a little bit because of the warmth and the moisture. And then out comes the little sprout. And a nice way to watch this actually happen is if you get an avocado pit and you put the avocado pit with some toothpicks on it over a glass of water so the bottom's in a little bit of water and just watch. It'll take a few weeks or so but eventually that pit which is kind of like the seed coat will start breaking apart and out comes the shoot.

[Jane] Can you actually get a real avocado plant that will make avocados if you do that?

[Charlie] Well, you get the avocado plant but you probably won't get the avocados.

[Jane] Why not?

[Charlie] Unless you live in Southern California, or a warm climate. I should say that yeah because I know people are listening all around the world. If you're in a warm climate, yes you will eventually get an avocado.

[Jane] If you plant it...

[Charlie] If you plant it, you have to plant it outside. It can't be like an indoor plant, it has to be an outdoor plant. It's a tree.

[Jane] So those of us in colder climates we're just going to get a little sprout.

[Charlie] That's it.

[Kai] Hi my name is Kai. I'm six years old. I live in Ottawa, Canada. And my question is how can plants grow so big if they start from such a small seed?

[Charlie] Ah, good question, Kai. So yeah it's amazing when you think of like a redwood tree, for example. Big huge tree. If you ever see the seed of a redwood, it's tiny, it's small. So how does that, all that happen? Well inside that seed are things we call genes. So what genes are like information. It's all this information that's inside that seed and it tells that seed how big is going to grow. How wide it's going to grow. It's kind of similar to the genes that people have. So you have genes in a baby that is born and in those genes it'll tell you if that babies can have blond hair, or black hair, or if they have blue eyes, or brown eyes, or all the different changes, all different parts of what makes the characteristics of that people, so the same thing is happening in that seed. All that information is in there.

And once that seed starts to grow through that germination that we just talked about all that information starts to actually happen. And so even though the seed might be tiny, because it has the right information, it will tell it that it needs to grow this big, this wide, have this kind of fruit on it, this kind of flowers, whatever it is.

[Jane] Yeah it's kind of amazing that you can have such a small seed turn into such a big plant.

[Charlie] Right. And all because there's a little mechanism in there is telling it keep growing keep growing keep.

[Jane] I'm just going to break in briefly here to talk about something else that's growing, podcasts. Did you know that some of your friends don't know how to listen to podcasts? We are joining other podcasters all around the world this month to spread the word about audio. Tell a friend about the podcasts you like to listen to then have your adult spread the word on social media using the hash tag trypod. That's T-R-Y-pod. The idea here is that if you share the podcast that you like other kids might be able to hear things that interest them too and get enjoyment, or education, out of some of the things that you've been listening to. So again you can tell a friend about a podcast you love doesn't have to be ours and then your adult can share recommendations using the hash tag trypod. T-R-Y-pod Thanks.

[Jane] We've been talking about seeds and having the right conditions to grow. And one of the key conditions is they have to be in dirt or soil and we got this question from Carson.

[Carson] I'm five years old. My city is Fort Bragg, North Carolina. And my question is where does dirt come from?

[Charlie] Sure that's a great question because you know we think of the earth as being this living entity with all these trees and plants on it. But really most of the earth is rock. So we only have a thin layer of the soil or dirt that goes all around it where we grow everything and allows life to exist. But underneath that is all this rock. And that's where the dirt comes from. The simplest the answer would be rock. So rock is there all different kinds of rock and through a process we call weatherization, so it's kind of a big word but weatherization is the weather is having an effect on the rock. So through rain and through temperature changes and through glaciers scraping along it and through wind and all these factors of weather what happens is that rock starts to break down.

So if you've ever been by a stream especially at the end of the stream going into a lake or into an ocean you'll see a lot of these rocks, kind of rocks that have kind of broken down and into these little granule as we call it sand a lot of times because it's like little pieces all that is really just kind of pieces of rock. So that's where the dirt comes from

but that rock itself is not going to support life. You can't just kind of take that stuff up and put a seed in it and have things grow. So to actually make it soil to actually make it alive it needs organic matter and organic matter is what it sounds like something that was once alive.

[Jane] Because organic means alive.

[Charlie] Yes, exactly. So leaves and grass and dead bugs or anything that once was alive, as that material gets mixed in with this rock that has been broken down crushed and pulverized into this dirt. That combination creates soil and that's from that soil that we can grow all these seeds and all these plants.

[Jane] So if I take a handful of dirt what I'm holding in my hands is some pieces, very very, very tiny pieces of rock and rocks have minerals which are important. And I'm getting what used to be trees and leaves and bugs and dead animals and other things that were alive that have broken down. And that's basically the fuel for all of the new plants right?

[Charlie] Yes, exactly. That's where the moisture and the nutrients and all of that comes from and the old crushed up rock is really kind of the medium or is the material that all this can be housed in so it can grow.

[Jane] So that's one of the most amazing things about this life cycle we have on earth. The way I think of it, Charlie, is because we're all able to grow and live and play and have plants to eat and animals because of this soil that basically feeds the plants and then we eat the plants and then when we die we go back into the ground and we become this organic matter for new plants and when plants and trees die and when animals die, they turn back in to dirt. So it's essentially just this circle of life.

[Charlie] That's right. It just keeps going around and round. Yeah and that's the beauty of the planet is that this circle kind of works. And through this process of weatherization and creating soil and things alive and things dying you can create more and more life and more and more diversity of life, which is amazing.

[Jane] OK so we have a few more questions about plants.

[Harlan] My name is Harlan and I'm five years old. And I live in western New Jersey, Oxford Terrance and I want to know why flowers are different colors?

[Ori] Why are plants and trees green?

[Jane] So That was Harlan asking about flowers being different colors, and Ori who lives in Israel asking about why plants and trees are so often green?

[Charlie] Flowers have many, many different colors and the reason for all the different colors really is flowers are an attractant. They're trying to put on a show. It's like a beauty show. It's like, come see me! Come see me! And so they're trying to attract the bees, the butterflies, the hummingbirds, all those insects and creatures that will pollinate them. And we talked about pollination and creating the seed. They want to attract them in there so that they can have more seed and have more of their own kind of plants really their whole purpose in life is to make seeds so they can keep going, keep the lineage or their life or their family going.

[Jane] So that purple flowers saying, 'hey butterfly look at me I'm beautiful.'

[Charlie] Come over, and come over. And they come in and they pollinate and you get the seeds, and the seeds disperse, and the plant is very happy because it's like an old grandma saying oh look at all my grandchildren and great grandchildren, I've done so well. So that's really why there's color in flowers is to bring them. Why there's different kinds of colors really is just all about that diversity that we talked about at the beginning of why plants are so different and because certain insects, certain hummingbirds, certain butterflies will be attracted to certain color flowers, or certain kinds of flowers in certain shaped flowers. So in order to make their attractiveness the most attractive for the biggest group, they try to come up with a shape, or a color that can bring people to them or bring these creatures to them.

[Jane] Do you know why? What makes a plant purple and what makes another flower red. What are the different ways that colors are created within the plant?

[Charlie] Well, within the plant there are chemicals called pigments and so of based on what kind of pigments you have, those are the colors that will actually kind of exhibit. So the interesting thing about pigments, kind of goes into the other question, I think it was Ori, that had about why trees and plants are green is that when we have this visible light spectrum that you know the spectrum of light that we see is only a small spectrum of what's actually out there and within that spectrum is all the colors of the rainbow. And so certain plants will absorb certain colors and the way it works is that if it absorbs that color we don't really see it anymore, so if it absorbs blue or red we don't see that. But most plants can't absorb the color green. And so that's why leaves are green is because we're actually getting a reflection of that green spectrum of light back at us. And the same thing is coming true with all these different flowers so if you have a red flower it's reflecting the red back or the purple back. So the plants need those different spectrums of light to grow but they don't often absorb everything or all those spectrums. So that's why we see the different color flowers.

[Jane] I'm thinking back to my biology classes from when I was a kid. And one word keeps flashing in my brain and that's chlorophyll! Is there a connection between the green color and chlorophyll?

[Charlie] Yes, chlorophyll is the actual chemical in the leaves themselves that will absorb all that sunlight that's coming through and the chlorophyll is considered green. You know you think of chlorophyll, you think of green and it is because it's reflecting back then, that color spectrum.

[Jane] Plants are pretty neat but they're really important to not only do they feed us and provide oxygen so that we can breathe. But Charlie says there's another good reason to keep plants in your house. Things about well they clean the air too.

[Charlie] Well they clean the air too, we're talking about all the reason for plants and I love the NASA research that has been done around this where you have houseplants you know things that simple house you might have growing in your house and not only are they providing oxygen but they're taking toxins and taking chemicals that might come from your paint on your walls or your rugs and they're taking those and absorbing those so that we don't have to breathe them. And those are toxins that might not be good for our body. So plants are cool things.

[Jane] I was told you should talk to your plants. That it will make them happy.

[Charlie] Yes.

[Jane] That's true?

[Charlie] Yes, you can talk to them, you can play them nice soft music like classical music. They like...

[Jane] Charlie. Now you're just pulling my leg.

[Charlie] No no no. They like certain kinds of music.

[Jane] How do you know that?

[Charlie] Oh they've been research has been done. They played different kinds of music the plants and they saw how they react as far as their growth rates and their general health. They didn't like that I really like heavy metal, acid rock kind of stuff, didn't really go so well, but a nice classical piece, Mozart, or something like that worked very well.

[Jane] Why do you think?

[Charlie] I think it's all about sound waves. This is getting into a whole new thing. But there's sound waves that will affect the growth of plants. You know plants have a consciousness to them they have almost like a mind you might think.

[Jane] Well, they're alive.

[Charlie] They're alive, exactly. There's been a lot of research recently done about plants talking to each other through their root systems. And so for example if one tree over here is getting attacked by an insect it'll send a message to all the other trees through their root systems that they're in contact with under the ground to say watch out here comes this bug and they'll notice, the scientists will notice it in those other trees certain chemicals will start getting produced that will be raised warding off that bugs or they don't get it attacked. So trees and plants will actually talk to each other and it makes sense that if they're getting this information from each other that as we talk to them with our voices or through music or other things that will have an effect on them.

[Jane] So be nice to your house plants.

[Charlie] Be nice to your house plants, give them a little pat.

[Jane] Thanks so much to Charlie Nardozzi for answering all our plant questions.

We have a lot more questions that are specific to trees and we're going to do a separate episode all about trees. Now don't forget if you have a question have an adult record it. You can do this on a smartphone or an iPad or a computer or however you have a microphone and you can then e-mail the file. Don't forget to tell us your first name where you live and how old you are and then send the file to questions@butwhykids.org. We love hearing from you. But Why is produced by Melody Bodette and me, Jane Lindholm, at Vermont Public Radio. Our theme music is by Luke Reynolds. We had additional music this week from Ketsa and Podington Bear. We'll be back in two weeks with another question all about instruments. Until then, Stay Curious!