This is But Why: a Podcast for Curious Kids from Vermont Public Radio. I'm Jane Lindholm, I host the show. Here in Vermont, where I and my friend and fellow But Why maker Melody Bodette live, we've just hit the date where it's safe to put just about any plants you want to grow in your garden into the garden, because there's very little chance of frost or below freezing temperatures even overnight anymore. So many of us are planting seeds or putting seedlings we started indoors into the nice warm soil to grow. Perhaps some of you are doing the same thing, because we've been getting lots of questions from you about seeds. And even if you're not a gardener, or a farmer, and even if it's winter, where you live right now, or you have a much longer growing season and planted things weeks or months ago, seeds are always fascinating to learn about.

Some of the largest seeds, I'm not even sure I could lift one, they're so big. And then there's tiny little ones that you can hardly see with your eye. And then there's ones that are really weird looking, you know, they have like all sorts of spikes and different ways of getting around, you know, seeds travel. They're made to be able to be transported by different kinds of animals, to stick to different kinds of fur. Some seeds are made that you have to first to be eaten by an animal and then poop out again, until they can grow. Different species have very different kinds of seeds and very different conditions to grow. Some grow with very, very little wetness, and some need to be submerged underwater for a while until they can grow. Some need to be frozen first before they can grow. Seeds are amazingly complex.

That was Hannes Dempewolf. He's a plant scientist in Germany, and he works for an international organization called the Crop Trust. Hannes is going to help us answer a few of the questions you've been sending us about seeds. But there are a lot of seed questions we're not going to get to in this episode. And that's because we have a whole other episode we already did, where we tackled so many plant and seed questions. But Melody and I have loved getting to listen to your great questions on this subject lately. Do you want to hear the voices of kids who've been sending us seed questions? Yeah, let's listen.

My name is Rowen and I live in Wisconsin. I'm seven years old.

Hi, my name is Olivia. And I'm seven years old, and I live in Bradenton, Florida.

My name is Maddox. I live in Vermont.
Hi, my name is Maddox. I am seven years old. And I live in western Massachusetts.

**Finley 02:55**
My name is Finley and I'm five years old, and I live in Maine. My question is, how do plants make seeds?

**Penelope 03:05**
Hi, my name is Penelope Rose. I live in Fernandina Beach, Florida.

**Ashna 03:09**
My name is Ashna and I'm seven years old and I live in Sunnyvale, California. My question is how did seed how do seeds form?

**Sol 03:19**
Hi, my name is Sol. I'm four years old. I'm from Brooklyn. And my question is, how do seeds sprout?

**Foster 03:29**
My name is Foster. And I'm three years old? I live right here in Colorado. Why do plants grow from seeds?

**Meredith 03:42**
My name is Meredith. I live in Oshkosh. I'm five and a half years old. And my question is why do seeds grow?

**Ethan 03:51**
Hi, my name's Ethan. I live in North Carolina. My question is how does a sunflower fit into a tiny little seed?

**Job 04:04**
My name is Job and I'm six years old. And I live in Hartford, Connecticut. My question is, how do seeds grow into trees?

**Jane 04:19**
Those are all such great questions and so important. How does a tiny little seed become a great big tree, or a cucumber vine, or an invasive weed, or a beautiful sunflower? You can find answers to those questions, in an episode we did called "How do big plants grow from such small seeds?" Don't worry if you missed it, we actually made it four years ago. We'll put a link to it in the show notes for this episode. That means if you look at the description for this episode in whatever podcast app you and your adults are using, you should see a link that will take you right to the episode on our web page. Or you can search for it by title in the app you already use. So since we've already answered those questions, what are we going to focus on today? In this episode, we're going to hear more about how the Crop Trust works to help protect the world's seeds, including by storing thousands and thousands of them inside a vault inside a mountain deep above the Arctic Circle in Norway. And we're also going to learn about a seed saving project in Vermont that aims to find and preserve some of the native seeds.
that the Abenaki people who've lived on this land for thousands of years used to grow, that have kind of
gotten lost over the years. But first, let's get back to Hannes Dempewolf, who is he exactly?

Hannes 05:40
And most appropriately, I think you'd call me a plant geek. I've always been interested in plants. And
I've, throughout my career, and my education always focused on plants. And still doing that today.

Jane 05:53
Technically, Hannes is a senior scientist and director of External Affairs for the Global Crop Diversity
Trust, Crop Trust, for short.

Hannes 06:02
We are an international organization that was founded by the United Nations more than 15 years ago,
with the idea to be supporting seed conservation to make sure that the seeds that feed us all are
conserved, old varieties, different types of seeds are there for many, many generations to come. And
we are located in Germany, but we are owned, if you want, by the world.

Jane 06:29
Is there a worry that seeds will go away or that there won't be seeds?

Hannes 06:34
Yeah, there is a lot of seeds around still, thankfully, and luckily. But if we look at it globally, how many
seeds there used to be just 100 years ago and be compared to today, we think we've lost about three
quarters of all seeds around the world - three-quarters of the diversity of different varieties of seeds.
And that's a huge reduction. That's a huge loss of seeds, that we've, most of which we cannot ever
bring back. Because once you have lost a seed, a certain type of seed or a certain type of plant, it's
gone forever. And that's why we put so much effort and money and brain capacity and plant nerdiness
and interest into the, into the preservation of that diversity, which we feel is so important for humanity.

Jane 07:30
Why have three-quarters of all the types of seeds been lost?

Hannes 07:34
It's actually, that's a really good and very complex question to answer. If you think about plants, you
know, there's wild plans that occur in nature. And then there's plants that make up our food and those
plants, we call them domesticated plants. So that means that these plants have been selected over
many, many, many, many, many, many, many, many hundreds, thousands of years from these wild plans to
be more like plants we like to eat. That process is called domestication. And what domestication does is
it narrows down diversity, it automatically means selecting over and over, it means we only choose the
best one to grow every generation. And that means that automatically through that process, we're
losing diversity. But the biggest loss and diversity over the last hundred years comes through the fact
that many farmers and many people only grow a small set of varieties. So it's a part of just agricultural
production. But the downside of that is also that less diversity means that agricultural production
systems are more vulnerable. If you grow many different types of plants, they can respond to different
challenges much better. You know, if you have a variety that's really resistant to drought next to one that's really resistant to flooding, then if there's a flood, the one that's resistant to flooding will survive. And if there's a drought, the one that is resistant to drought will survive. And so you will always have something to survive. And that's what scientists called resilience. It increases the resilience of our food systems, which is so important.

Jane 09:19
Yeah, I mean, I was going to ask you if the, if one of the things that we do in farming in agriculture is select for the best seeds, the things that are going to maybe grow the biggest plants, maybe not always the ones that tastes the best, but hopefully, and ones that can withstand pests and that can travel well if you have to grow your crop in one place and then feed people hundreds or thousands of miles away. Why do we need more if we're growing for the best? It seems like, well, that's fine. We just have one one best tomato one best banana. That sounds good.

Hannes 09:56
Yeah, but the answer to that is also a really interesting one. It's because the world is so different, you know, different countries or even you know, within a country, different regions have a very different climate, very different soils, very different pests. The way, where we grow seeds is very, in itself a very diverse environment. And that means we need many, many, many different kinds of seeds that are adapted or that you know, do well in many different conditions. And with climate change, what we're seeing is that these conditions change over time, really rapidly, much faster than they ever have. And that means that some of the old seeds that we used to be able to grow in one area, we can't grow them there anymore, because the climate has changed so much, that now there's different seeds we need, from maybe a different area that now grow really well there. And that's where seed banks are really, really important.

Jane 10:58
Have you ever heard of a seed bank? It's a place or an organization that preserves, safely keeps, all kinds of seeds. There are lots of different seed banks and seed libraries all around the world. Some seed banks give out seeds to farmers or scientists who need them. But these are different from a store where you go to buy seeds for your garden each year. For the most part, seeds stay in the seed bank unless they're needed because seeds aren't available for some reason, a natural disaster or a problem with another seed library or seed bank, or because they're not available in stores anymore.

Hannes 11:35
Those seed banks have an enormous wealth of seeds. So even though we've lost a lot, we still also have conserved a lot. One of the biggest examples I think, I know of is rice. There is the International Rice Research Institute in the Philippines has the international rice gene bank. And I believe there's more than 120,000 different varieties of rice conserved just in that seed bank. And that's still not, not a complete collection, there are still many, many varieties of rice around that are not conserved there and that we need to conserve in the future.

Jane 12:09
Well, more than 120,000 varieties of rice. And that's not even all the kinds of rice that are out there. The International Rice Gene Vault keeps all of those rice seeds in case there's a time when we might need one of them. There are seed banks all over the world. And the organization that has works for, the Crop Trust runs an international seed vault, Hannah says it's a little different from a seed bank, because the seeds in the Global Seed Vault are designed to stay in there as a backup, in case the seed banks in other parts of the world don't have the right seeds that countries or farmers or researchers need. So they don't give out the seeds unless there are no other options at the other seed banks around the world. Hannes has actually been inside the Global Seed Vault. So I asked him to describe it for us so we can all pretend we're exploring this amazing place with him. He says first we'd have to get to Norway. And then we'd have to travel up into the most northern part of the country up above the Arctic Circle, then we'd have to get to a group of islands called Svalbard. It is very, very, very cold there with lots of glaciers and not very many people. Sometimes there are polar bears, though. On one of the islands, there's a town called Longyearbyen, which is sometimes called the northern most town in the world. There we'd find a mountain. And inside the mountain is the seed vault.

**Hannes 13:39**
You get there and it's very, very, very cold almost all year round. It's so cold that the ground underneath your feet never really stops being frozen.

**Jane 13:51**
Is that what's called permafrost?

**Hannes 13:53**
That's called permafrost, that's right. So it thaws in the summer a little bit on top but the deep ground never thaws. And, so you get there and it's cold and you sort of wrap yourself up and you go up this mountain. And all of a sudden you see this big portal building, it's like a, looks like spaceships landed you know, it sort of jags out of the mountain. It's a beautiful thing to look at. But it also looks like it's from another planet. And you go into the big portal doors that are there to secure the seeds and you walk slowly down a really long tunnel down into the depth of the mountain. And the further you walk, you understand the colder it gets. So it's cold outside but it's even more cold in the mountain. You go further and further down until you're finally at, at another big door that protects those seeds. You open that up and you come into this entrance hall. It's like this, this big hall in the middle of the mountain. And from that hall, there's three big chambers that are accessible. And you can get, you open this door, which is sort of encrusted with ice crystals. And at that point, at this point, it's about minus 18 degrees cold. And that is, because the perfect conditions for seeds to be stored for a really, really long time is that about minus 18 degrees.

**Jane 15:24**
Celsius?

**Hannes 15:25**
Celsius, yeah, sorry, it's minus 18 degrees Celsius. And you go get in through this ice encrusted door, and you open it, and all of a sudden, you see these huge floor to ceiling shelves. And on these shelves, are all these different boxes that different countries and different seed banks have submitted. And many
of those seed banks have also put their little flag on it, you know, and you can see these different boxes from all over the world, that contain that wealth of diversity that has been domesticated and you know, attended to and selected by farmers over thousands of generations. And when you think about that, I mean, it's, you look just at boxes, but it makes, it always brings me makes me a little silent. You know, I'll think in awe about what diversity we have here in front of us. And it makes me just be really, really thankful for, the fact that this facility exists.

Jane 16:23
How often do countries or different groups put seeds in?

Hannes 16:28
Yes, the seed wall itself is, you know, it's usually it's a very secure facility. And it's, it's locked up. But it opens about three to four times a year for new deposits. And so we've had one earlier this year, in February, there was the latest deposit. And there's a new one coming up in June, we'll see seeds submitted from again, many different countries, including from the United States actually,

Jane 16:52
Has anybody ever taken seeds out or are, is the only way that seeds would come out if something really bad happened, a catastrophe somewhere in the world, is the only way that there would need to be a withdrawal from the seed vault?

Hannes 17:06
You know, it really is it is not there for a global doomsday as some some people call it, the doomsday vault. Really, the idea is, if anything troublesome happens to any particular single seed bank out there. And we've had one case of one withdraw already, back a number of years ago in 2015, the International Center for Agricultural Research In The Dry Areas, it is one of the biggest international seed banks out there. And that is located in Syria. And they could no longer operate because of the the civil war in Syria, they decided to reestablish their seed bank in Morocco and in Lebanon. And to do that, you know, they basically have to go back to Svalbard to get their material, their seeds back and be able to grow them out again in in Morocco, in Lebanon, to reestablish their collection there. And they did that with many, many, many tens of thousands of different seed varieties that they requested back from Svalbard. So they were then sent back to Morocco and Lebanon grown out, and then they put that new, those new seeds that are being grown out in back into the seed bank. And then they resent a copy to Svalbard to make sure that even in the future, if something else should happen, they can go back there and get their material.

Jane 18:31
And that's the only withdrawal so far?

Hannes 18:34
So far. Yeah, I mean, you know, it shows the worth of the vault and the fact that it is that it's working, but really, we hope that it will never have to be used again. You know, it's a facility as ironic as it is that we don't want to use because it means that something really terrible has happened to the original seed bank.
Jane 18:55

Don’t you wish you could go see this seed vault? I can almost picture the thousands and thousands of boxes with flags from the country they came from filled with so many different kinds of seeds that are important to our world. In just a minute we’re going to learn about a seed saving project closer to home. Well, closer to my home anyway. And Hannes will answer a few questions about seeds. What’s in them and Are they alive? This is But Why: a Podcast for Curious Kids. Today we’re learning about two different kinds of seed saving projects. Before we go back to Europe with Hannes Dempewolf, I want to introduce you to someone else who’s concentrating his seed saving efforts on a much smaller but no less important scale. Fred Wiseman is a researcher, professor and activist in Vermont. For a number of years now he’s been involved in a project called Seeds of Renewal. The idea is to find seeds that used to be grown by the Abenaki people, Native Americans who have lived in Vermont, New Hampshire, Maine and parts of Quebec, Canada, since before Europeans arrived. Fred calls this the seed chase because he has had to hunt high and low to try to find the crops that the Abenaki cultivated or grew. I met up with Fred Wiseman on a bright and warm spring day at a garden site at the new indigenous Heritage Center in Vermont. And I asked Fred to describe how the garden was set up, with mounds of dirt every couple of feet in the lawn garden plot.

Fred 20:26

We’re out in the middle of a beautiful day, and a field that we just planted with seeds of indigenous or native crops to this region. Each mound was traditional made in a family to fit the size of the children. The mound starts small so when you’re three four or five, you can reach into the very center of it to weed. As you get older, you never get done weeding, the mound gets bigger and bigger so you can reach farther in. Basically, what we do is we put corn in the middle, and then out at the edge of where the mound starts sloping off, right near there is where we put our beans. And then where the mound is sloping down on the sides, that’s where we put things such as summer squash, winter squash, even pumpkins, because what we do is we train the pumpkins, then to kind of the vines will radiate out from there, and they fill up the whole area in between. What I’d like to share with you a little bit today is talking a little bit about seeds, what the Abenaki seeds are, where they came from, how you find them. And then more importantly for us, of course is planting them, and then being able to think about how they relate to the rest of us and our society, our culture. The Abenaki people, are communities of indigenous people that lived in Vermont, New Hampshire and Western Maine. And also, more recently, in the 18th century, and 19th century, there are communities up in Quebec, basically the native people of Vermont, and this part of New England. What I’m trying to do here is bring back as much as we can what’s called a food system. Now, what is the food system and how the seeds fit in? Well, the food system is everything from where do you get the seeds? What’s the origin of the seeds? How do you select to be able to plant them? Where are you going to plant them? What kind of a field are you going to plant them in? And then once you plant them, what do you do to make sure they grow? When we think about seed saving, and agricultural saving, we also are thinking about ceremonial saving. Native people consider that nurture also comes from the spirit world. And so we have a whole series of ceremonies that we do right on this property, to assure that the spiritual nurture of these crops are attended to as well as the fertilizing, there’s a lot of kind of sayings that, you know, if you don't know your past, you’re not going to know your future. And memory is the essence of identity and who you
are, if you couldn’t remember, you know, what your name, or you couldn’t remember your family, you wouldn’t have an idea who you are.

24:38
You see each of these seeds has its own story, but also the people and the dances and the language. So it’s all together and like if the story about these being inaccurate, Passamaquoddy if that was lost, that would be just another seed. And yeah, it’d be interesting. But you see maybe in the future, one of the things we’re thinking about with climate change and things like that: What about these crops? What if they’re all 500-1,000 years old in this area? They have been through climate change huge amounts now. And so potentially they have what we call a reserve or a climatic resiliency. These crops have been here, through what was called them with a medieval warming period when it’s warmer than it is. And the Little Ice Age one is colder than it is here. So if we forgot that the name of these things and that they were indigenous, you know, maybe 50 years from now, people wouldn’t realize that there might be some really interesting genetic diversity or interesting, little weird, you know, characteristics of these things. And so you never know, to what use they will these things will come.

Jane 26:04
That was Fred Wiseman, at the Vermont Indigenous Heritage Center in Burlington talking about a project called Seeds of Renewal that aims to connect Abenaki people to traditional crops, customs and food systems. Before we end the episode today, there are a few questions you’ve been sending us that we haven’t already answered in this episode, or our previous one. So I asked Hannes Dempewolf, who we were talking with earlier, to help us understand some of the most fundamental things about seeds. Like this question.

Evie 26:35
My name is Evie. I live in Holiewa, Hawaii. I’m five years old. And my question is, are seeds alive?

Hannes 26:44
Yes, seeds are very much alive. At least the seeds that we use to grow food. Seeds do die. So if they’re not properly cared for, or they’re stored, you know, in too humid environments, or too cold or too hot conditions, they can die and then we can no longer use, they can no longer grow into plants, but they are very much alive. They’re just in what scientists call a dormant state. It means that they’re not, they’re sleeping basically, it’s like animals you know, sometimes so animals sleep in winter, and they’re dormant then it seeds are also dormant and they need to be activated to grow. But they’re still alive even while they’re dormant. And they need, as you probably know, light to grow, you know, that’s when humidity and warmth that’s the, that’s the conditions that allow seeds to grow. So yeah, they’re very much alive.

Jane 27:46
Humidity includes moisture so, you know, not always lots of rain but some kind of moisture, right?

Hannes 27:52
That’s right some kind of wetness usually seeds, most seeds, need. The seeds are very, very different. Different species have very different kinds of seeds and different types of seeds also need very
different conditions to grow. Some grow with very, very little humidity with very little wetness, and some
need a lot. Some need to be submerged in you know under water for a while until they can grow. Some
need to be frozen first before they can grow. Seeds are amazing, amazingly complex.

Eisley  28:23
Hi, my name is Eisley. I live in Downers Grove, Illinois. My age is six and I'm asking what are seeds
made out of?

Desmond  28:31
My name is Desmond, and I'm four years old and this is where live: Kansas City. And my question is,
what are seeds made out of?

Rishab  28:41
Hi, my name is Rishab. And I'm from Austin, Texas. What in seeds makes plants grow?

Hannes  28:50
So seeds are actually quite complicated. There's a little thing in there, which we actually call a plant
embryo, just like we have embryos in humans, in the womb. At plant also have little embryos and
they're usually connected to a starch. A starchy, we call a tissue starch, starch resource, which
basically gives them the strength to grow.

Jane  29:17
Is it kind of like food? Like food for the seed?

Hannes  29:20
That's right, it's like food for the seed. Exactly, yeah. And then there's something else we call proteins
that are very important to allow the seed out there and to grow. And then there's many different kinds of
you know, chemical compounds in there micronutrients, you know, different kinds of things that the
plant needs to develop. And you can, it's actually this the starch of those seeds that for example,
makes bread. You know, the wheat or the wheat seeds, if you ever looked at a wheat seed, you know if
you can cut it open, you can actually see this the starch and that's what is ground into flour, and then
we use that flour to make bread.

Jane  30:02
So you have all of this stuff inside seeds. And you know, anybody who has seen seeds knows that
some seeds are very large. But some seeds are so tiny, you can barely see them. It's kind of amazing
to think about all of that material, the genetic material, the starch, the proteins, all of this that is in that
teeny, tiny little seed that in some cases could become a giant tree. It's amazing.

Hannes  30:03
Yeah, it's absolutely amazing.

Valo  30:30
My name is Valo. I'm four years old. I live in Walla Walla. What are the biggest seeds on Earth?
What is the largest seed in the world?

In some of the largest seats, you know, there, I don't know if you've ever heard of them. It's called the Coco de Mer, which is a type of coconut. They're, they're huge. I mean, they're, I'm not even sure I could lift one. They're so big.

Oh, really? That big?

Oh, yeah. They're really enormous. And then there's tiny little ones, as you said, that you can hardly see but your eye. You know, there is, it's absolutely fascinating. Seeds are wonderful.

And to Rishab's question, it kind of goes back to what you were talking about with Evie's question of are seeds alive? You know, it's, it's all of this stuff that's inside the seed. But then you also need other things you need light and warmth and moisture and sometimes other things.

And water. So humidity, you know, to make them, to make them grow like little, little leaves, often the first little leaves and that kind of thing you can, the nutrients are that are packed very densely in a seed are actually all you need and a little bit of warmth and a little a little bit of light. But actually for them to grow into a real plant or sometimes a tree, you know, sequoia trees come from seeds, tiny little seeds, you need a lot more, a lot more different kinds of resources that are in the soil. And also you know, a lot more water and a lot more light, a lot more energy that is that is given to seeds for light. And so the, you know, the more a plant grows, the more of those other types of things other resources it needs to grow.

This is so cool, because it's so neat to think about the origins of plant life and, and all of the things that we see out in our neighborhoods, and when we go for walks, is there anything else that you think we should be thinking about or knowing about or that's really cool about seeds that you'd like us to take away from this.

Seeds are so fundamental to all of us that I think we should be making sure that we always take good care of them, and make sure that the diversity of them stays alive, whether anything you can do to, to help that, I think is a great thing for the planet. And some very practical things you can do. For example, you can establish your own little seed bank, you can, you know, keep some of the seeds that you collect from a garden or from the roadside. And, you I did that actually, when I was a little kid I had I had lots of little paper bags that I put into a wooden box and I kept them from year to year and I tried the little experiments to try to see whether they germinated the next year, that's a really fun thing to do.
Another thing to do is to eat different kinds of plants, you know if you have to be open and interested in eating different things. So next time you go to supermarket or to a farmers market don't just you know, buy the apple that you usually buy, but try a different one. Because the more we eat the more different kinds of plants we eat. That means that farmers will also grow different kinds of seeds and different plants and that in the end helps us maintain a more diverse food system and more diverse agriculture, which we really need in the face of climate change.

Jane  34:03
Thanks to Hannes Demewolf, a senior scientist and director of External Affairs for Crop Trust, for telling us about seeds and for describing the Svalbard Global Seed Vault. And thanks to Fred Wiseman for helping us understand the importance of seed and food to our cultures and senses of selves. I think I'm going to try to save some seeds from my garden this year, or maybe even just from the weeds that grow at the edge of my yard. How about you? If you save seeds and plant them next year? Let us know what you discover. That's it for today. As always, you can send us questions about the things that you're curious about. Have adult help you record yourself telling us what you want to learn more about. Tell us your first name, where you live and how old you are. If your adults have a mobile phone or a tablet, there's usually a free app for recording voices that you can use. Then send your recording to questions@ButWhyKids.org. If you can't record yourself or you're feeling shy It's okay to have your adult type out your question instead. But Why is produced by Melody Bodette, and me, Jane Lindholm at Vermont Public Radio. We're distributed by PRX. Our theme music is by Luke Reynolds and we had additional music in this episode from Blue Dot Sessions. We'll be back in two weeks with an all new episode. Until then, stay curious.