

But Why: A Podcast for Curious Kids

What are fossils?

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Jane 00:20

This is But Why: A Podcast for Curious Kids from Vermont Public. I'm Jane Lindholm. On this show, we take questions from curious kids just like you, and we find interesting people to answer them. But we're doing things a little bit differently today. We have a live audience with us. Can you say hi so they know I'm not making that up? We are at the South Burlington Public Library, just down the road from our studio here in Vermont, and we are part of a statewide summer reading program theme in libraries across Vermont this summer called "Unearthing a Story." So when the South Burlington Library asked us if we'd like to participate, we knew exactly what we wanted to do an episode on... fossils. There are fossils on every continent, and in most places on Earth, although some places have a lot more fossils than others, and it usually depends on what kind of rocks are in that place. Have you ever seen a fossil? I'm seeing a lot of nods, and I am imagining a lot of nods as well. Often we think of fossils as full skeletons, usually of dinosaurs, preserved and pieced together in a museum. But fossils can take a lot of different shapes and forms, which kind of makes me start to think that I'm not sure I actually know for sure what a fossil is. Is it just something old? What makes a bone or a piece of wood or a shellfish become a fossil? Well, we're going to get into all of that today with your questions and our guest to help us out. Since if I don't even know what a fossil actually is, I am not an expert, is Charlotte Mehrtens. She's a retired geologist from the University of Vermont, and she is our expert today. Charlotte, thank you so much for joining us.

Charlotte Mehrtens 02:18

Very happy to be here.

Jane 02:19

All right, what is a fossil?

Charlotte Mehrtens 02:22

Well, the best definition that I think I could come up with is to say that it's evidence of ancient previous life, and the key is that it should be naturally preserved, which means a mummy is not a fossil. And ancient is kind of a vague word that probably means really old. Now that could be somebody in your family you probably call ancient, but to us in the geology profession, we usually think about 10,000 years ago is the cutoff for anything older than that we'd call ancient.

Jane 03:00

And is a fossil rock?

Charlotte Mehrtens 03:04

Well, a fossil can be a direct fossil, which is samples of which I have here, which is the preserved shell or skeleton or bone, or it can be indirect, like a footprint. So there are many different types of fossils, and it would depend on how the fossil is preserved. But usually, the material that we see as a fossil is no longer the original material. In the past 10,000 years, the chemistry or the physical properties of the material have changed.

Jane 03:38

You said you have some here, and my eyes are immediately darting to two things that look like clams. Can you pick those up and describe them and tell us what they are?

Charlotte Mehrtens 03:48

Well, one of them that I have here is about 30 million years old. Whoa! But you could look at this and say, "Wow, that looks like a seashell, because it is, in fact, the preserved remains of the inside of a clam or a pelecypod, and the other one I have that looks like a seashell is a brachiopod, which is like a clam, but the way they feed is slightly different. But the modes of fossilization are really different between the clam and the brachiopod, this is recrystallized original shell material for the brachiopod. This is mud that infilled the inside of the clam shell, and the clam shell dissolved away. But the mud preserves the very good detail of the shape and size of the original animal, so those are two ways that we do make fossils.

Jane 04:48

And you said a fossil is coming comes from something natural, something that was alive.

Charlotte Mehrtens 04:54

Right, it's a living organism. Yes, or was a living organism.

Jane 04:57

Or part of a living organism,

Charlotte Mehrtens 04:58

Or part of a living organism.

Jane 05:00

A very interesting fossil you have right here that looks a lot like poop.

Charlotte Mehrtens 05:05

Yes, in fact, the technical name for fossil poop is a coprolite, and I have one here. And surprisingly enough, we have a really good collection of these in the geology museum up at UVM. People like to collect them, I guess, and then at some point they donate them to us. This is many, many millions of years old, probably in the neighborhood of about 40 million years old or so. We don't know who it came out of.

Jane 05:38

Not a wombat because it's not square.

Charlotte Mehrtens 05:42

It's, it's hard to determine what animal made it, but the shape would probably be recognizable to most of you. I'm not going to go into any further detail than that, but the mode of preservation of a copper light, this is going to get a little earthy, Jane. Okay, I'm ready. Obviously, it's all soft material, right? Comes out of you, and you know how that feels. How does something that soft get preserved? Well, the key for making most fossils is the material has to be buried under sediment really fast because it's all soft and gushy organic material. It really has to get buried very fast, like literally maybe the next day. And once it's buried under sediment, the water between the sand grains starts to infiltrate into the material, the organic stuff will break down and dissolve away, but the sand grains or the mud flakes will keep the shape of the original material, and that way of fossilization is called petrification. It basically fills in empty spaces, and the organic material dissolves away, and you're left with something that preserves what it looked like.

Jane 07:04

That's very cool, and also interesting to think about that, in order to become a fossil at all, the conditions have to be exactly right, especially for something like that.

Charlotte Mehrtens 07:14

Absolutely, the fact that something ever becomes fossilized is just amazing to me.

Jane 07:19

Really, still?

Charlotte Mehrtens 07:20

Oh yes, still, still, because you need to have the material that becomes the fossil. So you need a bone, a shell, or something like that. Then you need to bury it in sediment before it breaks down physically or chemically, and then it has to ultimately come to the Earth's surface through geologic processes, where we can find them.

Jane 07:46

Right. It's a little bit like that saying: If a tree falls in the forest, does it make a sound if no one hears it? It's like, is it really a fossil if there's no one there to find it and say:

Charlotte Mehrtens 07:54

"Oh, aha, I found a fossil!"

Jane 07:57

Yes. All right. Well, I have lots of questions, but I promised I would get out of the way and let you ask some questions. So if you have a question, raise your hand, and Melody will come around, and and we'll answer them. Let's go to the questions.

Avril 08:12

My name is Avril, and I think that fossils are fossils because the cartilage goes bad.

Jane 08:22

Oh, interesting. Okay, cartilage is softer than bone, and a lot of animals, including humans, have cartilage in our body. If you want to touch your nose right at the tip, and you feel and kind of wiggle it right where it's soft, that's cartilage. Does cartilage get preserved as a fossil ever, or is that one of the things that is really hard to find in fossil form?

Charlotte Mehrtens 08:46

That's super hard to find because cartilage is an, an organic compound, and organic compounds break down or decay really easily, and it's possible that something cartilaginous can get preserved, but would have to be in conditions lacking oxygen, which usually means very rapid burial out of contact with oxygenated ocean water or air.

Jane 09:16

This actually brings us to a question we got earlier from one of our listeners, not in Vermont, named Chris, who has some questions about specific kinds of dinosaur fossils.

Chris 09:28

Hi, my name's Chris. I live in Austin, Texas, and I'm six years old. Why do some dinosaur fossils come with skin while others don't?

Jane 09:38

Why do some fossils have skin, and how? If we just, we're understanding that that's really hard to preserve.

Charlotte Mehrtens 09:46

Right. Well, preservation of things as delicate as feathers or skin happens through the petrification process, so that the organic material itself breaks down, but it leaves a region behind it that's infilled with chemical precipitate or mud flecks or something that preserve its original shape and texture. So we can find incredibly delicate things like feathers, and in some cases, if they again, if the animal died in an environment that is anoxic, that lacks oxygen, that decay process can be really slow, and so we actually can find organic tissue. But that's really rare and very precious when that happens.

Kid voice 10:40

How old are dinosaur fossils?

Jane 10:43

How old are dinosaur fossils, Charlotte?

Charlotte Mehrtens 10:45

The oldest dinosaur fossil that we found is 243 million years old.

Jane 10:55

That's pretty old.

Charlotte Mehrtens 10:56

Pretty old.

Jane 10:57

Older than you?

Charlotte Mehrtens 10:58

Yeah, even older than me too.

Jane 10:59

Older than me, too.

Willoughby 11:01

My name is Willoughby. How do fossils get shaped that way?

Jane 11:08

How do fossils get shaped, Charlotte?

Charlotte Mehrtens 11:11

Well, the shape reflects the shape of the animal or plant that made them, and so that's really the way that we identify them. Is that corals have very specific shape to them that differentiates them from sponges or brachiopods look different from pelecypods, so the shape is the shape of the living animal or plant that made them.

Felix 11:39

My name is Felix, and I live in Vermont. And I'm four years old. And my question is, how did dinosaurs die?

Elfin 11:50

I'm four years old. My name's Elfin. Why were dinos right before us and they died.

Jane 12:01

Oh, how did dinosaurs die?

Charlotte Mehrtens 12:03

Well, okay. There's been quite a lot of debate about that over the past or over my career. I'll put it that way and leave it vague. The current theory, which seems to have much supporting evidence, suggests that there was a cataclysmic event precipitated by the impact of some asteroid object, whether it was a meteor, an asteroid itself, but an impact that profoundly affected the entire globe in terms of its temperature, in terms of the opacity of the atmosphere, how cloudy it was, how much dust there was in the air, and in fact the chemistry of the oceans. And the evidence from that is mostly in the rock. We have a horizon, a layer of mud that has a ton more odd elements in it, like iridium, that is just not common on Earth, but it's common in outer space. And so we believe that some object impacted the Earth when the dinosaurs were at their peak abundance, and along with impacting their entire food structure and the global climate, not only dinosaurs but many other animals and plants were extinct as a result of this huge environmental change.

Jane 13:47

If you're interested in learning more about that, we have an episode that we did just a couple months ago. I think the title is "How did bird dinosaurs survive?" And some of the dinosaurs that did survive were the ones who were birds, and the birds that we see today are direct descendants of dinosaurs. In fact, some people say birds are dinosaurs.

Jane 14:10

Hi, I'm Jane, and I live in South Burlington. And who dug up the first bone in the world?

Jane 14:21

Ooh, ooh! Who's who dug up the first bones? Who's the first paleontologist?

Charlotte Mehrtens 14:24

You know what's really this is a very interesting story. If it's interesting to me, it's probably really boring you. But...

Jane 14:31

Good start, Charlotte.

Charlotte Mehrtens 14:31

The first the first bone that we recognized was a fossil, and it happened down the road to be a dinosaur was in the 1600s. A fellow that worked at the museum in Oxford, England, found this huge bone, and he recognized it as being part of a leg, but it was bigger than any cow, or oxen, or anything that he knew around England, and so he just decided it had to be a huge elephant that they hadn't found yet, and so he didn't know what to do with it. He worked at the museum. He gave it to the museum, and it sat there for over 200 years before somebody else looked at it and said, "Oh, that's not anything that's

living, and he's a pretty famous paleontologist, the person who studies fossils, and he recognized that it had to be from an animal that was extinct, and so he had only gotten a name as a fossil in 1842, I believe, and it was called Megalosaurus, and Megalosaurus was a dinosaur, and there was only this one bone, so we really didn't know that much about it. But he was the first one to actually recognize it as a dinosaur.

Jane 15:59

That's so cool.

Kid voice 16:02

If dinosaurs live like everywhere on the planet, then why are their fossils so hard to find?

Charlotte Mehrtens 16:08

Yep. Good question. Yes, we believe dinosaurs did live everywhere, and we have found them. I don't know if we found them on Antarctica, but that's only because of ice cover, I'm sure. They have been found worldwide. Why they're hard to find? It's great part of that question. Your potential for becoming a fossil goes way up if you happen to die in water, and so dinosaurs, for the most part, there were some that actually did swim, but for the most part, dinosaurs ran around on land, and consequently, when they died, very often they died in a place where they weren't going to get buried under sediment really quickly, and if they sat on the landscape under the sun, rain, wind, the organic material decayed, and the bones got scattered. You know, scavengers came along and ripped the piece off here, and somebody else grabbed some and flew somewhere else. So the bones got scattered, and consequently, you can find dinosaur bones pretty easily if you look in sedimentary rocks the right age, but they're going to wind up being pieces like the one I have here for display. This is a hunk of dinosaur bone that I found in New Mexico, and I was pretty sure I was going to find something because of the age of the rock that I was looking at. So finding a whole dinosaur on another matter is really hard because it's got to get buried under sediment pretty quickly before that scavenging and that breakup can happen of the skeleton, and those places are pretty rare. You have to be next to a lake, or maybe next to a big river, or a thing, a delta top. You know, like a swampy area, but a lot of dinosaurs lived in a whole range of other environments, and they just didn't fossilize.

Jane 18:28

Coming up, if you want to find a fossil, how do you find one?

Jane 18:35

This is But Why a podcast for curious kids. I'm Jane Lindholm. We're at the South Burlington Public Library in Vermont today for a live episode all about fossils. We're talking with , a retired geologist at the University of Vermont. She's also the volunteer curator at the Perkins Museum of Geology at UVM.

Xander 18:54

My name's Xander. I'm eight years old. I'm from South Burlington, Vermont. What is the rarest fossil that has ever been found?

Jane 19:04

Rarest fossil, Charlotte.

Charlotte Mehrtens 19:06

Rarest fossil that I've ever found, or rarest fossil period?

Jane 19:10

Try both. Oh,

Charlotte Mehrtens 19:15

Oh, wow, rare. Well, hmm.

Jane 19:19

I think you've stumped her.

Charlotte Mehrtens 19:20

Yeah, you might have stumped me on that one. I love all my fossils.

Jane 19:25

For a while, nobody had had thought they had found a feathered dinosaur, and then we saw preservation of feathered dinosaurs.

Charlotte Mehrtens 19:33

Yes, it's hard. I mean, there's... rare could be something that is like one of the first fossils on Earth? You know, that's three and a half billion years old or so. That would be rare, or rare could be there just weren't a lot of those plants or animals around, and you happen to find one of them. So there are a couple of different ways to define what rare means. I think, honestly, probably this hunk of dinosaur bone is the most rare thing I've ever found because it's not something I see every day. Versus these brachiopods, these little seashell creatures here, they're a dime a dozen if you know where to look here in the Northeast, so rare for me would be the dinosaur. To a professional paleontologist, probably rare would be finding a fossil that represents an intermediary evolutionary step between one animal and another, like the intermediate step between a dinosaur and a bird, that was an incredibly rare find when we did identify that animal.

Jane 20:55

For early hominids, early humans, as we were transforming into the kind of humans we are today?

Charlotte Mehrtens 21:01

Yep, that would be another. The other would be the evolution from fish to a tetrapod that walked on land. The so-called missing link of between those two, Tiktaalik. Boy, when that was first identified, that was that was fabulous. So I guess that's what I would say it would be rare.

Jane 21:22

All right, let's go to another question.

Clara 21:24

Hi, my name is Clara, and I'm from Ferrisburgh, Vermont, and I'm seven years old. How do animals turn into fossils?

Jane 21:34

Yeah, so let's talk again a little bit about how an animal will turn into a fossil when you're thinking about preserving that whole animal.

Charlotte Mehrtens 21:43

Okay. How about you give me the name of an animal you'd like to have fossilized? A cow? A dog?

Jane 21:53

A frog?

Charlotte Mehrtens 21:53

A frog. Frog.

Jane 21:55

There's a complicated one.

Charlotte Mehrtens 21:56

Good call. Okay. Well, that's actually kind of a good one because frogs tend to live around water, right? And so the frog meets his mortal end and and dies. And we'll assume he's not attacked by somebody, but he just dies of old age. Odds are pretty good that the frog body is going to fall to the bottom of the pond that he lives in, and if that frog's body sits there on the bottom of the pond for very long, other things are going to kind of come around and start to nibble on him. Kind of gross, but if there is a pretty big rainstorm and some sediment washes into the pond and buries the frog, the frog's body will be preserved. Then, decomposition or the chemical breakdown of the soft, gushy part of the frog is going to happen. Microbial bacteria, kind of nasty things, will eat away at the soft stuff, but the bones of the frog are going to be intact in the shape of the frog, and over time, with more sediment getting dumped on top of it, the bones will be surrounded by sand and mud, and will start to chemically react with the composition of the water that's in the sand. And over thousands and thousands of years of another layer of mud coming and another layer of sand coming, the frog is going to be completely encased in this material, and the composition of the bone is going to start to change from its original. And you're in the process of making a fossil, but again, 10,000 years would have to pass before you could dig up that pond, and it would be a pile of mud, and you would see the frog fossil in it. Takes a long time, and a lot of things can happen in that 10,000 years. Most likely, somebody is going to come along and eat it before that entire process can begin, but not always, which is how we get a fossil.

Cal 24:29

My name's Cal. I live in Winooski, Vermont, and my question is, what's the state that has the most fossils?

Jane 24:37

Which state has the most fossils?

Charlotte Mehrtens 24:38

Ooh, competition. Well, I think that kind of depends on what rocks a particular state has, and here in the Northeast we have a lot of igneous and metamorphic rocks because we built a lot of mountains over the years. But if you go out west to places like Colorado, Utah, New Mexico, Kansas, Montana, Wyoming, they have not undergone the plate tectonic collisions that build mountains, and so it's mostly sedimentary rock, and that means you can find a lot of fossils. So I think probably there'd be a competition between oh Wyoming, the Dakotas, North and South Dakota, New Mexico, Utah. They'd probably be fighting it out.

Nora 25:42

Hi, my name is Nora, and my question is: Who found the first ichthyosaur?

Charlotte Mehrtens 25:48

Who found the first ichthyosaur? Well, I believe that might be Mary Anning. I suspect, and on the south coast of England, I think she certainly became the most prolific fossil hunter of that particular group of organisms. But that's a great question. I don't really know.

Jane 26:12

I mean, I'm pretty impressed that you had a name at all. That's like one of those trivia quizzes that most people couldn't answer. But oh yeah, yeah, you asked the right person.

Charlotte Mehrtens 26:20

You want me on your team.

Molly 26:27

My name is Molly, and I'm seven, and I live in Essex, Vermont. And my question is, who found the biggest fossil?

Charlotte Mehrtens 26:39

Whoa, biggest. Well, I suppose that would be one of our dinosaurs, wouldn't it? Okay, who did find the biggest fossil? I'm going to lose this bet. I don't know that I come up with a name, although there were two geologists in the 1880s who they also had a competition for who could find the most fossils and the biggest fossil, and one of them was named Edward Drinker Cope, and the other was called Othniel Marsh, and I think they found the first T. Rex, so I don't know that that would be the biggest dinosaur, though. I don't know. Good one.

Jane 27:25

It also seems like a school-age competition that they never grew out of. Like I'm going to find the biggest one. No, I'm going to find the most.

Charlotte Mehrtens 27:33

They, they. It's, it's a classic story of clashing egos. But between the two of them, they identified over 130 new species of dinosaurs.

Jane 27:44

All right, so their competition, their inability to work together, benefited humanity.

Charlotte Mehrtens 27:48

They're pros. Yep.

Jane 27:50

This is Sora. She's 12 years old and she lives in Essex. And her question is:

Sora 27:55

What's the biggest fossil you found in Vermont?

Jane 27:58

Ooh, what's the biggest fossil you've found in Vermont, Charlotte? Good question.

Charlotte Mehrtens 28:03

Big, huh? Okay. Well, it is an animal called a cephalopod, which looks like a squid. Actually, the shell looks like a huge ice cream cone. Okay, narrow and then big opening, and the soft, gushy part, which looks a little bit like an octopus was in the opening, and I found one up on Isle of Mott that was about three feet long.

Jane 28:29

Whoa, three feet long.

Charlotte Mehrtens 28:31

Three feet long. Actually, this was the what we call the apex predator of the Ordovician Seas. Not somebody you'd want to tangle with, but that what that was the most impressive thing I've personally ever found in a rock.

Jane 28:48

That's a great place to end this episode. We had such a great time at the South Burlington Public Library with Charlotte Mehrtens, retired geologist at the University of Vermont, and a great group of inquisitive kids and their adults. As always, if you have a question about anything, we'd love to hear it at a live show or just send us a voice memo. You can have an adult record you asking using a smartphone or other device, and then have your adult email the file to questions@butwhykids.org. Tell us your first name, where you live, how old you are, and what your question is. Try to record in a quiet environment unless you're intentionally trying to give us some extra sound because it's related to your question, like if you're asking about crickets, maybe you're in a field of chirping ones. But Why is produced by Sarah Baik, Melody Bodette, and me, Jane Lindholm, at Vermont Public, and distributed by PRX. Our video producer is Joey Palumbo, and our theme music is by Luke Reynolds. Special help on today's episode from and , and huge thanks to Natacha Liuzzi at the South Burlington Public Library for inviting us. If you like our show, please have your adults help you give us a thumbs up or a review on whatever podcast platform you use. It helps other kids and families find us. We'll be back in two weeks with an all-new episode. Until then, stay curious!