Video Transcript - Forgotten Elephants of Deep Time

Maggy Benson:	Welcome to Q?rius, the Coralyn W. Whitney Science Education Center, which is right in the heart of the Smithsonian's National Museum of Natural History, right in [00:00:30] Washington D.C.
Emmanuel Kyei-Baffour:	Yes. Right here, you get to interact with over 6,000 real museum objects and you get to be the scientist or even meet a real scientist like today.
Maggy Benson:	Yeah, totally. So today, we're going to be exploring the real science of fossil elephants. Here on Smithsonian Science How, we're connecting you to the science and the scientists of the Smithsonian. I'm Maggy Benson.
Emmanuel Kyei-Baffour:	I'm Emmanuel Kyei-Baffour and [00:01:00] I'm so excited to talk about elephants, and I didn't know we could learn so much about elephants from just looking at their teeth.
Maggy Benson:	Yeah, fossil teeth. Students, did you know that you can learn a lot about an animal just from its fossils? Today, you're going to be paleontologists and we're going to help you learn some of the tools to be able to learn about body size, diet, and even where an elephant is from and who else it's related to just by looking at its fossils,
Emmanuel Kyei-Baffour:	[00:01:30] Just like our expert. And students, if you like to find patterns, make observations, or ask questions, you're already thinking like a paleontologist.
Maggy Benson:	Totally.
Emmanuel Kyei-Baffour:	Mm-hmm! I'm so excited, and speaking of polls, we actually have a poll to kick off our broadcast. Our first poll question of the day is: What elephant fossil do you want to see first in our webcast? Would you like to see [00:02:00] the fossil skull? Or the fossil elephant teeth? Let us know in the poll and we'll share the results with you shortly.
Maggy Benson:	So, while you're thinking about that, we do want to introduce you to our expert, Dr. Advait Jukar. Hey Advait.
Advait Jukar:	Hey Maggy. Hi, Emmanuel, and a big hello to all of our students out there. I'm a paleontologist here at the NMNH. A paleontologist is a scientist who uses fossils to understand past life, and I study fossil elephants, and I'm super excited [00:02:30] to share with you how I use these fossils to understand the biology and ecology of fossil elephants.
Emmanuel Kyei-Baffour:	So, why do you study fossil elephants if elephants still exist today?

Advait Jukar: That's a great question, Emmanuel. So, today, we have three species of elephants on the planet. There are two in Africa and one in Asia, but their evolutionary history goes all the way back 60 million years, when there were about 160 species. And if we have to [00:03:00] understand their past, and their life, we have to look at fossils.

Maggy Benson: So, today, we have students in Virginia, Colorado, Connecticut, D.C., Florida, Georgia, Iowa, Indiana, Kansas, Louisiana, Maryland, Missouri, Michigan, North Carolina, New Jersey, New Mexico, New York, Ohio, Oregon, South Carolina, Tennessee, Utah, Virginia, Washington, and West Virginia.

Advait Jukar: Wow.

Maggy Benson: Thank you so much for joining us today from all [00:03:30] of those states.

Emmanuel Kyei-Baffour: So, did elephants live in all of those states?

Advait Jukar: You are absolutely correct. Elephants lived everywhere in the United States. We had elephants from Alaska to Florida and from Maine to California. You will find them everywhere, there is a pretty good chance that there were elephants living right by your town.

Maggy Benson: So, if there were so many elephants living here, how many elephants were there in the past?

Advait Jukar: So, there were about 160 or so species of elephants in the full 60-million year history of the group. In the last, you know, 50,000 years or so, there were about 17 [00:04:00] species on the planet, and seven of them were in North America alone. Can you imagine seven elephants right here?

Maggy Benson: Wow!

Advait Jukar: And some of them lived in D.C.

Maggy Benson: Wow! And in all of the states that we just mentioned.

Advait Jukar: Yes.

Maggy Benson: How cool is that?

Emmanuel Kyei-Baffour: When you're studying these are fossil elephants, what exactly on the fossil are you studying? Are you trying to figure out how they died?

Advait Jukar: So, I try and use [00:04:30] these fossils to understand how many different kinds of extinct elephants there were, what they ate, how big they were, and how they may have lived.

Maggy Benson: Interesting.

Advait Jukar: But also how they died.

Mmm!

Emmanuel Kyei-Baffour: That's a great point.

Maggy Benson: Well, speaking about how they died. If there were so many elephants in the past and seven species in North America alone, umm, why? What happened to them? Why are there only three species today?

Advait Jukar: You know, that's a great question and a kind of sad story. So, we know at least for about a million years that the diversity of elephants starts to [00:05:00] decline as people start to leave Africa and start to grow in their populations. And we know from poaching today that that we are adversely affecting elephant populations, the last three species.

Maggy Benson: Taking elephants for their ivory.

Advait Jukar: Taking elephants for their ivory, destroying their habitat, it all affects their survival. If we lose them, we lose a very enigmatic and long-lived group of mammals.

Emmanuel Kyei-Baffour: Wow.

Maggy Benson: And so you're studying a little bit about the elephants that came before them?

Advait Jukar: Yep.

Maggy Benson: [00:05:30] So you actually showed us how you do some of your work here at the Smithsonian's National Museum of Natural History, behind the scenes.

Advait Jukar: Yeah.

Maggy Benson: And it gave a really nice overview of how you do use these fossils to study them.

Advait Jukar: Yep. Do you want to take a look?

Maggy Benson: Totally.

Advait Jukar: Do you all want to take a look?

Emmanuel Kyei-Baffour: Let's do it.

Advait Jukar: Welcome to my office. This is where I study fossil elephants. I measure different kinds of elephant teeth to try and figure out how many different kinds of extinct elephant there were and what kinds of food they may have eaten.

Advait Jukar: What I'm doing now is studying [00:06:00] a group of extinct elephants called Deinotheres. They're very, very old and very, very large. They had strange bulbous trunks and downward pointing tusks, and what I'm doing is measuring their teeth with tools called a caliper and then I take these measurements and put them into a computer program, where I can then analyze them for patterns. What I'm trying to do is figure out how many different kinds of Deinotheres lived in India millions of years ago.

Advait Jukar: This is just one [00:06:30] of the things I do here at the museum as a paleontologist. I have other projects, where I study larger specimens like skulls of extinct elephants. Why don't you come down with me and I'll show you how I study them.

Advait Jukar: Welcome to our oversized collection space here in vertebrate paleontology. This is where we keep our really big specimens like giant skulls. Here's a big skull from an extinct elephant that was found in Hagerman, Idaho. As I mentioned to you before, I study skulls and teeth of extinct elephants to try [00:07:00] and figure out how many different kinds of extinct species lived in Deep Time. Because this skull is so big, I have to use big calipers like this to try and measure it. I take measurements like the total length of the skull or the width of the skull or the size of their teeth, and then I'll take these measurements and compare them to other kinds of extinct elephants to try and figure out exactly what kind of extinct elephant species [00:07:30] this was.

Maggy Benson: All right. Those are some great questions. Keep them coming. But first, I think we should go to what kind of fossil on the table you want to see first.

Emmanuel Kyei-Baffour: Da-da-da-da-da! The results are in! And the students would like to see - 75% say, the skull!

Advait Jukar: Awesome! Skulls are great. And elephant skulls are super weird.

Maggy Benson: All right. Which one should we start with? There's so much on the table.

Advait Jukar: There're two skulls here. Let's start right over there with the strange skull.

Maggy Benson: All right.

Advait Jukar: So this belongs to a . . .

Emmanuel Kyei-Baffour: Whoa!

Advait Jukar: . . . [00:08:00] species called *Palaeomastodon beadnelli*. It lived about 37 million years ago in North Africa. This is kind of a weird skull because it's got these two pointed teeth coming out. Those are its tusks. This big hole back here on the skull, that's its nostril and its eye sockets are on the side right here. So its eyes would go there and the trunk would start right on top of the skull here and keep going down, kind of like my arm is doing.

Maggy Benson: Wow!

Advait Jukar: This is its lower jaw. You can see all of its teeth here, and right in [00:08:30] front, it's got a pair of lower tusks. So, this elephant had four tusks, which is very different from elephants today.

Maggy Benson: Especially the part with the tusks on the bottom.

Advait Jukar: Yeah. Yeah.

Maggy Benson: And there's so much smaller than the tusks of elephants alive today.

Advait Jukar: Yep. Elephants have a great diversity of tusks. Having four tusks is actually pretty common in the fossil record. Having two tusks is a more recent phenomenon.

Maggy Benson: So, you told us that there have been many [00:09:00] species of fossil elephants in the past and this one doesn't really look like the elephants that we're really familiar with that are living today.

Advait Jukar: No, no it doesn't.

Maggy Benson: Where does the elephant story start? How many millions of years ago?

Advait Jukar: The elephant story starts about 60 million years ago in North Africa, which is where we find the first representatives of the group, the Proboscidea. They're about rabbit-sized animals and, over time, they get a lot bigger and a lot more complex. They start to evolve trunks and tusks and they get to be big like the elephants that we see today. So, the earliest [00:09:30] ones, like this *Moeritherium* right here . . .

Maggy Benson: Oh, another skull!

Advait Jukar: Here's another skull. This is an animal called a *Moeritherium*. It lived, again, about 30–something-odd million years ago in North Africa. But, unlike most elephants, it didn't have a trunk. It's got these short tusks in the upper jaw, which point downwards. But there are lots of other features in it, like the presence of the tusks and these really wide cheekbones that suggests that it's an elephant.

Emmanuel Kyei-Baffour: So what do all of these creatures [00:10:00] have in common?

Maggy Benson: Yeah, you said a word back there, Probo- ?

Advait Jukar: Proboscidean, yeah. That's a great word. It's a fun word. A proboscis is a trunk, and proboscidean refers to a group of mammals that have trunks. Now, as I just said though, not all elephants have trunks, but when this name was coined back in the day, we didn't know about some of these elephants without trunks. But for the most part, most elephants have trunks.

Maggy Benson: But when you go back . . .

Advait Jukar: When you go back

Maggy Benson: [00:10:30] Some may have had snout-like noses.

Advait Jukar: Yep. Some may have had, you know, short taper-like trunks, but not the long trunk like we see in modern African and Asian Elephants.

Advait Jukar: Look, I put together a slideshow of some of these extinct elephants. So that's an animal called the Gomphothere. These have long trunks, but they have four tusks, like I was talking about. Four tusks are fairly common. That's a weird one with really long tusk on the upper and lower jaw. That's a Deinothere.

Maggy Benson: Oh, there's the Deinothere.

Advait Jukar: Yep. That's a Shovel Tusker.

Maggy Benson: Oh, that one has the short tusk.

Emmanuel Kyei-Baffour: A Shovel Tusker.

Advait Jukar: And that's a Mastodon. [00:11:00] That's the American Mastodon.

Maggy Benson: So it's so interesting to see how all of the body plans are kind of similar, but that trunk and those tusks are all a little bit different.

Advait Jukar: The tusks, the trunk. But they all have the basic, the same basic shape, which means that they all have four legs and they are all pretty big. And it starts off with these Moeritheres as well.

Maggy Benson: That skull we just saw!

Advait Jukar: Yeah, which, while they're stocky, they're still fairly robust. They're still chunky animals.

(laughing)

Advait Jukar: And then they just start getting taller. That's another [00:11:30] one, which lived at around the same time. Short trunk, four tusks, chunky thing.

Maggy Benson: A little bit longer... Yeah, now ...

Advait Jukar: And this is a modern African Elephant, so you can see how that body plan has evolved. The trunk gets longer. You lose lower tusks, but overall, big, tall animals.

Maggy Benson: So, we saw, we heard a little bit about their body size there, but you made a significant discovery, using collections of fossil elephants, about understanding their size, their mass.

Advait Jukar: Yep, yep.

Maggy Benson: Can you tell us about that?

Advait Jukar: Sure. So, body size is a very [00:12:00] important ecological characteristic of an animal and the reason for that is because how big an animal is determines how much space it needs to live, how many of its kind live on the landscape, how much food it needs, how many offspring it produces, and the list goes on and on. It's very hard to figure out how big an extinct species is. But what paleontologist can do is we can study living species and extinct ones and try to understand if there are some parts of the body that correlate with how big the animal actually [00:12:30] is. And that's exactly what I did for elephants. So, I looked at their skulls and I use a part of the skull . . .

Maggy Benson: Here's our *Moeritherium* again.

Advait Jukar: Yeah. . . . called the occipital condyles. These are two bumps at the back of the skull and you have them as well.

Maggy Benson: So this is one?

Advait Jukar: Right there.

Maggy Benson: Okay.

Advait Jukar: And those two bumps connect the skull to your backbone. Right there.

Maggy Benson: So, all elephants have these, and do all animals with [00:13:00] a backbone have them?

Advait Jukar: All animals with a backbone have them. And they all connect-

Emmanuel Kyei-Baffour: Can you feel ours?

Advait Jukar: You can't feel ours because ours are tucked under lots of muscle, but they are back there in your skull and they attach your skull to your backbone.

Maggy Benson: So, you take a measurement of these.

Advait Jukar: Yep.

Maggy Benson: What kind of measurement?

Advait Jukar: What I did is that I use a tool called the caliper. It's basically like a ruler and I measured the width of the occipital condyles from a lot of these elephants.

Maggy Benson: So then, this is kind of like a two-pronged ruler . . .

Advait Jukar: [00:13:30] Yep.

Maggy Benson: . . . like Advait said. And if you can see that, there's a measurement coming out of it.

Advait Jukar: Yep. And then, what I can then do is take this measurement and correlate it with known weights of elephants and then I can get a good equation where if I can plug in the length or the width of the occipital condyles, I can get an estimate of the animal's weight.

Maggy Benson: So, you did this by looking at elephants that maybe were in zoos and had died and understanding how much they weighed when they were alive and ...

Advait Jukar: Exactly, [00:14:00] and I compared their occipital condyles to their actual weight and we got a nice equation which now I can use to predict the weight. I did that for our elephant, Henry.

Maggy Benson: He's a very famous resident of the Smithsonian's National Museum of Natural History, if you've ever seen him, he's right in the rotunda and he is huge.

Advait Jukar: He is huge.

Maggy Benson: So how big is Henry?

Advait Jukar: That is Henry's skull. It's sort of upside down. You can see his teeth but you can also see his occipital condyles down there and, right there in the blue circle, and I [00:14:30] measured them with these calipers and they came up to be about 248 millimeters in breadth, so across the condyles.

Maggy Benson: And that meant that it was ...?

Advait Jukar: About seven tons in weight. So based on my equations, Henry weighed about seven tons, which is about the maximum size for an African Elephant.

Maggy Benson: That's very big.

Advait Jukar: Now we have a couple of other elephants in our collection. They belong to two ... So we have a couple of skulls that we measured as well. They belong to a couple of mammoths.

Maggy Benson: And [00:15:00] I think this is a turn for you students to be able to think about how some of these patterns are related to body size and we're going to give you an opportunity to think about how big these animals were.

Advait Jukar: Exactly! We're going to use-

Maggy Benson: So what are we looking at right now?

Advait Jukar: That's a Columbian Mammoth. It's one of the large elephants which lived in North America up till about 12,000 years ago. And Maggy got a chance to go and measure the Columbia Mammoth skull.

Maggy Benson: I did! I played doubled over with those calipers, but I did get to use them and I got [00:15:30] to measure this huge Columbian Mammoth, which was really fun. I found the occipital condyles . . .

Advait Jukar: Yep.

Maggy Benson: . . . Measured them with the calipers and I came up with a measurement of 233 millimeters, which, looking at Henry, the African Elephant, it's just a smidge smaller.

Advait Jukar: Yep, but based on the equation that I came up with, this animal ...

Maggy Benson: What is your estimate?

Emmanuel Kyei-Baffour: I think that the Colombian Mammoth is smaller!

Maggy Benson: There we see, so we see, that the smaller the breadth [00:16:00] that measurement is, then the smaller the elephant is.

Emmanuel Kyei-Baffour: Yep!

Maggy Benson: So, students, we have another measurement for you and we're going to ask you to apply this same idea . . .

Advait Jukar: To a Woolly Mammoth!

Maggy Benson: A Woolly Mammoth!

Emmanuel Kyei-Baffour: Oh, I heard those are huge. Like have you seen Ice Age?

Maggy Benson: Totally!

(laughing)

Maggy Benson: Really big! So let's take a look at what that measurement was.

Emmanuel Kyei-Baffour: That's a skull!

Maggy Benson: I got to measure that one, too.

Advait Jukar: Yeah.

Maggy Benson: It was pretty cool, measuring a Woolly Mammoth. Okay, so that measurement is 196 millimeters, which is smaller than the Columbian Mammoth [00:16:30] and Henry the African Elephant, so think about what that means for how big, what the body mass was, of that Woolly Mammoth, and tell us what you think in the poll.

Emmanuel Kyei-Baffour: Yes. We actually have another poll opening up. Let us know. Is the Woolly Mammoth larger or smaller than Henry?

Maggy Benson: We can still see some of your results coming in. If you haven't answered, you still have time. Put your answer in there. But so far, what have we got?

Emmanuel Kyei-Baffour: 88% [00:17:00] of our students believe that the Woolly Mammoth is smaller than Henry the African Elephant.

Maggy Benson: Can that be true? Can the Woolly Mammoth be smaller than an elephant alive today?

Advait Jukar: Well, let's just look at the data. We know that the size of the condyles correlates with the weight of the animal. So if the condyles are smaller, that means it's going to be a smaller animal. And Woolly Mammoths actually weren't all that big. They were only about as big as modern Asian Elephants are, which is a lot smaller [00:17:30] than an African Elephant.

Maggy Benson: So it's a lot smaller, but it's still a pretty big animal.

Advait Jukar: It's still a pretty big animal.

Maggy Benson: It's like a ton!

Advait Jukar: Yes, yes.

(laughing)

Maggy Benson: And here are their skulls there, the Woolly Mammoth and the Columbian Mammoth.

Advait Jukar: The smaller skull is the Woolly.

Maggy Benson: Before we started working with you, Advait, I didn't even know what a Columbian Mammoth was.

(laughing)

Advait Jukar: There are lots of species of mammoth in North America alone. There were four species and one of them was a Pygmy Mammoth, which lived off the coast of California.

Maggy Benson: And was it small?

Advait Jukar: It was tiny. It was only about as high as I am, [00:18:00] and I'm about six feet tall.

Maggy Benson: Very cool, so cool.

Advait Jukar: Yeah.

Maggy Benson: All right. So we've looked a little bit at the skulls and we looked at them to be able to figure out body size. Now, we have a couple things in front of us. What are these?

Advait Jukar: So, all of these are teeth from extinct elephants. These are all . . . This is just one tooth. That's a tooth, that's a tooth. That's a tooth, that's a tooth, and that's a tooth.

Maggy Benson: Wow!

Advait Jukar: It's huge!

Emmanuel Kyei-Baffour: Why do we have so many teeth here?

(laughing)

Maggy Benson: These are so huge. So this is one tooth?

Advait Jukar: Yep, that is [00:18:30] a molar or a tooth from the back of the jaw and that's the third molar or the elephant's wisdom tooth. And this one is from a mammoth, which lived in Virginia.

Advait Jukar: You can pick it up.

Maggy Benson: What were these animals eating with these teeth? They got so big!

Advait Jukar: They did get big. So let's look at some patterns in these teeth.

Maggy Benson: That's a big tooth. It's as big as Emmanuel's head. Is it heavy Emmanuel?

Emmanuel Kyei-Baffour: Yeah, it's really heavy. And trust me folks at home, my head is pretty big, so this is a big tooth.

(laughing)

Advait Jukar: Well, let's [00:19:00] look at some patterns here, right? And if we can figure out what these animals were eating. There are some teeth here, which are quite tall and they kind of wear flat. And then there are some teeth here which are bumpy. Now, elephant teeth, just like our teeth, have bumps or ridges called cusps. If you take your tongue and feel the back of your molars, you will see or you will be able to feel bumps, which are called your cusps. What elephants do is they just keep adding [00:19:30] these cusps and they form these plates in some of them like the mammoths.

Maggy Benson: So if you can see, there's like lines, so these are all ...

Advait Jukar: Yep. That is an individual cusp and they just keep adding them. Compared to that, a Mastodon doesn't have-

Maggy Benson: Let me hold this.

Advait Jukar: Can you hold that?

Maggy Benson: Yep. Let's point it right over here.

Advait Jukar: So, a Mastodon doesn't have that many cusps. It only has about four of them.

Emmanuel Kyei-Baffour: Do you need help?

Maggy Benson: Mm-hmm.

(laughing)

Advait Jukar: And the shape of the cusp is different. These are a lot sharper. These are a lot more blunt.

Maggy Benson: Emmanuel was right, it is very heavy.

Advait Jukar: [00:20:00] It is heavy.

Maggy Benson: So, how does an elephant fit these teeth in its mouth? Because I have a lot of teeth in my mouth.

(laughing)

Maggy Benson: What's going on here?

Advait Jukar: Some of these early elephants actually had all of their teeth in their mouth at the same time. But when you get to other groups, like the modern African Elephant or even mastodons and mammoths, they had very, very different kinds of teeth in their jaw. They had these very, very long teeth.

Maggy Benson: This is so cool!

(laughing)

Advait Jukar: This is a lower jaw from an African Elephant. What you are seeing here are two teeth [00:20:30] in the front. That's one tooth and that's a

second tooth and then, if you look behind it, there are teeth that are forming at the back of the jaw.

Maggy Benson: Right here.

Advait Jukar: Right there. So if you think about when you were growing up, you had a baby tooth which fell out and then a permanent tooth came up in its place. These guys don't do that. They have a tooth in the jaw, which starts getting worn down.

Maggy Benson: One tooth.

Advait Jukar: One tooth, and then, there's going to be a tooth on top in the upper jaw and as they grind food up, these teeth get worn down from the front to the back [00:21:00] and from the top to the front. So they just keep getting pushed and then the tooth on the back pushes its way up, like a conveyor, kind of like that. So, once this tooth is all gone, this tooth from the back will come and take its place. And they do this five times in the elephant's life, which means that they have six teeth in each side of their jaw, 24 teeth in total.

Maggy Benson: And that is it?

Advait Jukar: And that is it. Once the last tooth is there and wears down, the elephant can't eat anymore but that's typically at the end of its life.

Maggy Benson: Wow! So that's how an animal [00:21:30] is able to fit these teeth into their mouth because they are very big.

Advait Jukar: (Yeah, mm-hmm.) And we can learn a lot about what these animals were eating based on the shape of these teeth.

Emmanuel Kyei-Baffour: Yeah, I was about to say, like the top of this tooth kind of looks like the bottom of a tennis shoe.

Advait Jukar: Yeah, it does.

Emmanuel Kyei-Baffour: While these ones . . .

Advait Jukar: They're bumpy, right? Yeah

Emmanuel Kyei-Baffour: . . . kind of look like cleats, right? [crosstalk 00:21:47].

Advait Jukar: Yeah, yeah, yeah.

Maggy Benson: Hey, that's a great analogy!

Advait Jukar: It is a great analogy. So, based on modern animals, we know that there are two kinds of herbivores, which are animals which eat plants. All elephants and their relatives [00:22:00] are animals which eat plants. Today's elephants eat lots of grass and some leaves. Their ancestors ate a variety of plants. Some of them fed almost exclusively on grass. Some of them ate lots of leaves and twigs. There's Swarna right there eating some grass.

Emmanuel Kyei-Baffour: Whoo-hoo Swarna!

(laughing)

Advait Jukar: She is grasping the grass with her trunk and eating it.

Emmanuel Kyei-Baffour: She is actually my Secret Santa.

Advait Jukar: Nice!

(laughing)

Advait Jukar: So, what we see from modern-day animals like horses is that they have [00:22:30] very, very tall teeth and they eat lots of grass and it turns out that an animal with very tall teeth, that is quite well-adapted for eating grass. And the reason for that is that grass is abrasive and it grows close to the ground. So when these animals pick it up, they're getting lots of grit and dirt in their mouths along with the grass. When you chew all of that up, it's like chewing up sandpaper.

Advait Jukar: So, when you have those very tall teeth like you're seeing right now, it takes a long time for the tooth to [00:23:00] wear down so that animal can keep eating grass for a long, long time. But, if you are like us, we don't have very tall teeth. And if we start eating grass and grit, our teeth would wear down and then we can't eat anything else.

Advait Jukar: Animals like deer have shorter teeth with pointier cusps. And those cusps are great for cutting up leaves and twigs. That's basically what these animals eat and they're called browsers. And even in elephants, we have two kinds. We have grazers and we have browsers.

Maggy Benson: So, grazing grass ...?

Advait Jukar: And browsing leaves. [00:23:30] And the browsers, like this Mastodon, have cusps that are similar to the cusps on a deer. They are kind of sharp.

Maggy Benson: So this is a deer on the screen and now here, this is what?

Advait Jukar: That's a Mastodon. You can see that they're all pointy, just like the deer because they're great for cutting up leaves.

Maggy Benson: So, can you show us an animal that was grazing on grass then?

Advait Jukar: Mm-hmm. Sure. These are mammoths and mammoths fed almost exclusively on grass. If you look at this mammoth tooth, it is very tall. That's the height [00:24:00] of the crown, which is the white part that sticks out of your gums. So it takes a very long time for the grass to actually wear this tooth down all the way up, which means that this animal could have lived a long time and would have been happily eating on grass until its grand old age of 70 or 80.

(laughing)

Maggy Benson: Okay, so this is another great example of how you're using living animals, and this time . . .

Advait Jukar: Exactly.

Maggy Benson: In this case, not even elephants . . .

Advait Jukar: Not even elephants, yeah.

Maggy Benson: . . . To be able to understand that grazers, grazing in grass, have long teeth

Advait Jukar: Yep.

Maggy Benson: for wearing [00:24:30] down

Advait Jukar: Yep.

Maggy Benson: and then browsers, if you're browsing branches and twigs . . .

Advait Jukar: Yep, short, sharp cusps

Maggy Benson: . . . Short, sharp teeth.

Advait Jukar: For cutting leaves.

Maggy Benson: So, students, we've actually prepared another activity for you to test your pattern recognition skills on a mystery tooth.

Advait Jukar: Yep, I've got a mystery tooth from our collections right here.

Maggy Benson: Right here it is!

Advait Jukar: Here it is!

Maggy Benson: Another real fossil elephant!

Advait Jukar: Yep. And take a look at the shape of the tooth. Look at the cusps [00:25:00] and try and figure out if it's tall or not, or if the cusps are just kind of short and blunt or more like that of a mastodon or more like that for mammoth. And you guys need to figure out if this animal was a grazer or a browser.

Emmanuel Kyei-Baffour: All right, students! We have a poll up on your screens right now. Let us know! Do you think this elephant . . . Was this elephant grazing grass or browsing the branches? Let us know in the poll and we'll share your results. [00:25:30] Shortly!

(upbeat music)

Maggy Benson: All right, we can see your results coming in. What do we have?

Emmanuel Kyei-Baffour: 93% of our students believe that our mystery elephant was browsing the branches.

Advait Jukar: And they are correct! This tooth belonged to an extinct elephant called a Gomphothere. This one was from Kansas, I believe. I know, It's kind of crazy to have elephants in Kansas, right?

Maggy Benson: I don't even know what a Gomphothere is.

Advait Jukar: It's this big elephant with kind of a short trunk and four [00:26:00] tusks. It may have looked something like that, just bigger. But they were browsers because they have those short, almost pointed cusps and they were great at crushing up leaves and twigs.

Emmanuel Kyei-Baffour: Nice.

Advait Jukar: Exactly! So, we know that everything in life is related and everything has a common ancestor, but some things have a more recent common ancestor than others and the way we figure this out is by looking at similarities. When we find similarities in fossils, there's a pretty good chance that those animals are more closely related to each other [00:26:30] than others. Paleontologists use characteristics like skulls and teeth all the time to figure this out.

Advait Jukar: So here we've got a mammoth and a mastodon. Which of these two do you think is more closely related to an Asian Elephant?

Maggy Benson: I think this is another great idea for our paleontologists watching at home to be able to apply some of the skills that you are giving them today . . .

Advait Jukar: Exactly.

Maggy Benson: . . . to be able to make a prediction. What do you think?

Advait Jukar: Yep. I think that's a great idea. Paleontologist use their skills of observation and pattern formation all the time to [00:27:00] try and solve these problems but we also look inside the animal and we look at things like their teeth. Teeth are super-important. So what I want you guys to do now is compare the teeth from an Asian Elephant to those from the Woolly Mammoth and the Mastodon. Look at the shape and structure and then, try and figure out which of these extinct elephants is more closely related to the Asian Elephant?

Emmanuel Kyei-Baffour: Okay students, [00:27:30] 79% of you out there said it was A, the mammoth. Is that correct?

Advait Jukar: That is correct. mammoths are the closest relatives to Asian Elephants. And what's crazy is that Asian Elephants are closer to mammoths than they are to African Elephants, and Mastodons are even further off.

Maggy Benson: Wow! You know, when you look at that picture, it's just so clear that once you add that tooth to the equation, it just allows you to see the connection so much better.

Advait Jukar: Definitely.

Maggy Benson: [00:28:00] It really shows you that it's what's on the inside that counts.

Advait Jukar: Yeah.

(laughing)

Maggy Benson: Now, does that mean that our elephants today came from mammoths? How does that connection work?

Advait Jukar: What that means is that elephants today shared a common ancestor with mammoths about six million years ago and we found fossils back then which show that both of these were part of the same group.

Maggy Benson: Thank you, Advait, so much for sharing your work about fossil elephants here.

Advait Jukar: Thanks for having me. This was awesome!

Maggy Benson: We have a lot of great programming coming up and [00:28:30] we really hope we can see you then. But for now, we're going to sign off from the Natural History Museum. Thanks for joining us.

Emmanuel Kyei-Baffour: Bye bye.

Advait Jukar: [00:29:00] Bye.

Return to the video, "Forgotten Elephants of Deep Time."