Video Transcript: Mass Extinction – Solving the Dinosaur Mystery

Voiceover: How do we know what life on Earth looked like in the ancient past? What is your picture of how large dinosaurs lived and died? For centuries, paleontologists have been piecing together evidence of ancient life to answer this question. Fossils, mineral deposits and other clues from the past continue to reveal new facts about the large dinosaur extinction 66 million years ago. Join us for a conversation with paleontologist and Director for the National Museum of Natural History, Dr. Kirk Johnson, to learn what happened when the large dinosaurs went extinct. Now here's your host, Maggy Benson.

Maggy Benson: Hi. Thanks for joining us. I'm Maggy Benson, host of live from Q?rius, Smithsonian Science How. We're really excited to be back for a brand new season of Science How, and next week is National Fossil Day so we're even more excited to bring this show to you today about paleontology. With us now is Dr. Kirk Johnson, Director of Smithsonian's National Museum of Natural History and paleontologist. Thank you for joining us, Kirk.

Kirk Johnson: Thanks, Maggy.

Maggy Benson: So you're the director of the museum but you're also a paleontologist. Can you tell us a little bit about that and what you do here?

Kirk Johnson: I've worked my whole life in museums. I'm a fossil-finding paleontologist and after a while you become a director. So I'm here.

Maggy Benson: So as a paleontologist, what kinds of things do you do to problem solve? You're constantly asking questions as a scientist, I know.

Kirk Johnson: Exactly, and I'm a paleobotanist. I study fossil plants, and paleontology is a science that takes you back into time and the ancient lost worlds. And worlds are complicated places, so we collaborate with all sorts of people. Other kinds of paleontologists and other kinds of scientists and geologists, and other kinds of people that operate the logistics of field trips. So I've spent a lot of time digging out in deserts and working in large groups.

Maggy Benson: So you have to think of questions and then search for evidence to support them. And I know one of the mysteries that you've worked on with your teams is the mystery of the dinosaur extinction. Can you tell us a little bit about that?

Kirk Johnson: Sure. It's a great mystery. What caused the disappearance of the dinosaurs? And these are amazing animals. Every kid knows dinosaurs. Dinosaurs aren't with us today, except for the birds of course, but they disappeared and nobody really knew why until there was an idea proposed in 1980 that an asteroid struck the planet. And that struck me as such a strange idea when it happened, when it

was proposed, that I said I ought to check into this and see if I can figure out some scientific ways to test this idea.

Maggy Benson: Interesting. So when you said the large dinosaurs went extinct, we're talking about some of these dinosaurs that are here on the table with us today.

Kirk Johnson: Oh, yeah. We've got the great big duck-billed Edmontosaurus, and here's the skull of a little baby Triceratops. Here's the tooth of the biggest meat-eater of all times, Tyrannosaurus rex. That's just one tooth.

Maggy Benson: That's huge.

Kirk Johnson: Yeah.

Maggy Benson: It's the size of a banana.

Kirk Johnson: And a little bit more dangerous than a banana.

Maggy Benson: So these look like some marine fossils. Did some marine animals go extinct as well?

Kirk Johnson: That was kind of the interesting thing, was it wasn't just the dinosaurs on land but it seemed we lost the marine lizards, things like mosasaurs and plesiosaurs. But also these beautiful coiled shelled animals called ammonites, and here's one from the Dakotas. An animal who would have had an octopus or squid like animal coming out of the end. And these guys went extinct as well. So something happened that knocked off the big animals on land and a lot of the big stuff in the oceans as well.

Maggy Benson: Interesting. So I think this is a great time to ask our viewers what they think caused the extinction of the great dinosaurs. What do you say?

Kirk Johnson: Let's give it a shot.

Maggy Benson: All right, so this is your turn to tell us what you think. What caused the extinction of the large dinosaurs? Was it huge lava flows, sea level changes, asteroid hitting Earth or diseases? Take a moment to think about it and put your answer in the window that appears to the right of your video screen. This is the same location that you can enter questions for Doctor Kirk Johnson to answer during our live program today.

Maggy Benson: So, Kirk, the results are coming in and so far we're at 83 percent of our viewers think it's an asteroid impact. What do you think?

Kirk Johnson: Well, we didn't give 'em many other alternatives also, so that's one thing. When the idea came up, people thought, boy, an asteroid's pretty strange. Imagine an asteroid striking from outer space. And at the time, we didn't even realize that

big asteroids did hit the Earth. We thought that somehow our atmosphere ate them up. So there are other ideas as well. There are ideas that maybe a volcanic eruption, a really big one, could cause an extinction.

Maggy Benson: Why would they think a volcanic eruption?

Kirk Johnson: Well, you know there are some really big volcanic eruptions that have happened in the past. And when volcanoes erupt, they lay out this hot liquid rock that hardens and becomes lava. So there are certain places in the world like western India where there are huge deposits of lava that are more or less the same age as the extinction of the dinosaurs. So you have this great big huge lava flow about the time dinosaurs disappeared. Some people thought that was a pretty good idea for why dinosaurs might have gone extinct as well.

Maggy Benson: So what evidence did you find that showed that it may not have been volcanoes?

Kirk Johnson: So the original idea was that in 1980 there was a discovery of a thin little layer of clay that contained high levels of this metal called iridium. It's related to platinum, which is related to some of the heavier, more precious metals. And iridium is quite common in asteroids and meteorites. It's quite common in the center of the earth, but it's rare on the surface of the earth. So to find iridium at the surface suggested maybe an explosion of an asteroid blew iridium dust around the world.

Maggy Benson: And so would that be enough to be able to say that it was an asteroid impact, or did you have to find more evidence?

Kirk Johnson: It was it a good idea but it wasn't unique to asteroids. It turns out that you can get some iridium out of volcanic eruptions. So there were two groups arguing back and forth for asteroid, volcano. But then there was the discovery of these little tiny grains of quartz and other minerals that had their crystalline core quite shattered and skewed. And these are called shocked mineral grains. And those grains are not found in volcanoes, but they are found in asteroid impact sites and in nuclear test sites.

Maggy Benson: So you have this shocked quartz and you have the iridium found together in this location. Is that enough to be able to say an asteroid impact caused it?

Kirk Johnson: It starts to get to be pretty good. I can remember back in 1988 when we realized the shocked quartz was part of the picture, and a lot of the scientific community said, okay, that for us is good enough. It's not the volcano, it's the asteroid.

Maggy Benson: So did you find this in one location or did you find these two things together, the iridium and the shocked quartz, in other places around the globe?

Kirk Johnson: So initially just a few spots. But that was what we call a testable hypothesis. We could go out and look at the layers of rock that were above the last dinosaurs and search to find those layers. And I did that immediately 'cause I had been looking at those age rocks for fossils for other reasons. I said, "I can actually test this idea and I'll go out and look for this layer." And first season out I found it. It was amazing. I actually found the layer, I shipped it off for analysis and it came back with high iridium and high shocked quartz. Right where I was looking. I was like "that's pretty interesting" because I wasn't convinced, and I went out independently and tested that hypothesis.

Maggy Benson: And you came back with an actual piece that had that evidence right there inside it?

Kirk Johnson: And I've got a chunk right here. And this layer, it looks like almost nothing, right? It's just a little lump of rock. It's about as thick as my finger. But take a look really closely, and if you look closely you can see, about the size of little ballpoint pen tips, are little round balls.

Maggy Benson: Absolutely. I can see them.

Kirk Johnson: And those things are what are left from droplets of melted target rock that was sprayed across the world. And so imagine this. The asteroid strikes. It strikes in Mexico and it blows molten rock up into the sky, which as it flies through the air cools into little balls, little glass balls, that rain down on the landscape thousands of miles away.

Maggy Benson: Thousands of miles away?

Kirk Johnson: This rock was found in North Dakota. So these are little glass balls that were blown from Mexico to North Dakota on one day 66 million years ago.

Maggy Benson: That's incredible. So this layer is actually representative of this moment in time when this asteroid impacted Earth. And you can find this all over the world?

Kirk Johnson: Exactly. So if you are below this layer, you're in the time of dinosaurs and you can collect fossils and rebuild their world. But if you're above the layer, you're after the time of dinosaurs and you can see what happened after the extinction.

Maggy Benson: So my question is how did everybody, how did the scientific community, land on the asteroid impact hypothesis? What was the smoking gun?

Kirk Johnson: Well, the idea was based when researchers actually found this layer of iridium and they proposed the idea. And then that's the way science works, is everybody tries to disprove it. We were like that can't be possibly true, and we went out to try to disprove it. And in the act of disproving it, we found more evidence for it. So once we started doing that I was like, "Wow, this actually might be true. There might actually be evidence." But we would like to find, to

be sure, the actual crater. Because we had found the evidence of the debris that was blown out of the crater, but we hadn't actually found the crater itself.

Maggy Benson: So did you ever find the crater?

Kirk Johnson: It came after a decade of search. And people were looking for it, and remember there's lots of places where you can hide a crater. It could be at the bottom of the ocean, it could be in an area where there's lots of vegetation and you don't see it. But it turns out that one very persistent scientist found the crater in Mexico.

Maggy Benson: Wow. That's probably huge.

Kirk Johnson: It's a vast crater. It's 120 miles wide.

Maggy Benson: Wow.

Kirk Johnson: And it's filled in, so you can't really see much of the surface now. But if you use various tools that are used for searching for oil and project sound beams down into the ground, you can actually see this great big round crater that's over 120 miles wide.

Maggy Benson: Wow, that's huge. So with all the evidence of the iridium, the shocked quartz and this crater, then it has to be an asteroid.

Kirk Johnson: Well, at least we know an asteroid hit and we know it hit when the dinosaurs went extinct. Remember, those volcanoes are still erupting over in India too. So did the asteroid cause the extinction of the dinosaurs is still a pretty interesting question.

Maggy Benson: So I understand that you do a lot of work in the Hell Creek Formation in North Dakota. Why is that a good location to study this question?

Kirk Johnson: Well, if you actually want to study a question like what happened to the dinosaurs, you have to find a place today that has fossils from that time exposed at the surface. And you want a place where there's not too much modern vegetation, because you want to be able to look at the rock and find the fossils. And North Dakota, Montana, South Dakota have lots of beautiful places called badlands, which are rounded hills of muddy rock where there's not much vegetation growing. And you can walk around and just pick up little fossil bones, and dig in and find little fossils.

Maggy Benson: And they're exposed?

Kirk Johnson: Oh, yeah. You're walking along, you'll find something like this in the ground. And what this is is a dinosaur toe.

Maggy Benson: That's just a toe right there.

Kirk Johnson: It's just a toe.

Maggy Benson: And it may have been laying out on the sand.

Kirk Johnson: Wouldn't it be cool to walk along and find a toe?

Maggy Benson: It would be very cool, yes.

Kirk Johnson: And the way you do that is you go to a place where the rocks are the right age, there's not a lot of vegetation, and you just start looking. And you'd be amazed what you find.

Maggy Benson: Very cool. So do you have time to answer a question?

Kirk Johnson: Of course.

Maggy Benson: All right. This one comes from Jack from L.A. Jack wants to know how could an asteroid make things all over the world go extinct?

Kirk Johnson: Jack, that's a really good question because you know the question is how big was the asteroid? And remember, 200 years ago there was a giant meteor that came into Russia. It was about the size of a bus, and it blew up and it blew out a bunch of windows. But it didn't even kill that many things. And the question is how big would an asteroid have to be that it actually would be a problem? And it looks like the one at the end of the Cretaceous was six miles in diameter, and it was moving about 20 times the speed of a rifle bullet.

Kirk Johnson: So when it hit it made a big, big explosion. It made a huge hole, caused gigantic earthquakes, huge tsunamis. The explosion blasted heated gas. Chunks of the stuff that was blown out of the crater blew up into low earth orbit and rained back through the earth's atmosphere and heated up on the way in, creating a broiler oven in the sky which lit forest fires. And you had dust that blocked the sunlight out for four months.

Kirk Johnson: And those are a lot of different killing mechanisms. Like you wouldn't really want to be there the day that thing hit because if you were within 2,000 miles of it you'd be incinerated and exploded. But even on the other side of the planet, it would still be dark, you'd still have forest fires, you'd still have a lot of problems that would make it very difficult to stay alive.

Maggy Benson: It was a bad day on Earth.

Kirk Johnson: A very bad day. Maybe the worst day on Earth that we know about, actually.

Maggy Benson: So we have another question that is kind of pertaining to this, so we can do it quickly. How do you know how the crater in Mexico is the one that caused the dinosaur extinction? Simply by dating, or is there other evidence?

Kirk Johnson: Excellent question. So the way the guy found the crater was he looked where the largest beads of glass that were blown out of the crater were located. He made a map of where those beads were and he plotted the map. He said, "Well, somewhere in the Gulf of Mexico ought to be the crater." When he found the crater, then it was a matter of dating the melted rock in the crater and getting a date from uranium lead, which is a type of radiometric dating, of the actual crater, which is about 66 million years old, and dating it with the ejecta layer. He had the same age of the debris and the crater. Basically fingerprinting. And one further thing happened. They actually had pieces of the bedrock from the crater they found at the K-T boundary layer in Colorado.

Maggy Benson: Wow, that's incredible.

Kirk Johnson: So we actually had a fingerprint right back to the target rock.

Maggy Benson: And you need special lab tests to be able to do that?

Kirk Johnson: Oh, yeah. This is the whole point about having lots of different scientists working, is that in the K-T boundary the study of this extinction was the first real time that paleontologists realized that they were studying ancient worlds. They needed all the scientists to be working in the world, so physicists and chemists and geophysicists. All sorts of scientists worked together on this problem to solve this very complex equation.

Maggy Benson: So we've talked a little bit about the dinosaur extinction but, I mean, I'm a vegetarian. I eat a lot of vegetables. What happened to the plants?

Kirk Johnson: Well, I happen to be a paleobotanist and I study fossil plants. And so my idea was if you really want to understand what happened to the world when an asteroid hit, you should study the plants, not the animals. Because plants are really common. You just think about it. Go for a walk in the woods and what do you see?

Maggy Benson: Plants.

Kirk Johnson: Plants. They're everywhere.

Maggy Benson: Trees, shrubs.

Kirk Johnson: I once cut a tree down and counted the number of leaves on it just to see how many there were.

Maggy Benson: How long did that take?

Kirk Johnson: It took me 16 hours with one friend.

Maggy Benson: That's a very good friend.

Kirk Johnson: And we got 99,284 leaves. And what you realize is that leaves are pretty great as potential fossils. You take a leaf that falls off a tree like this, and this leaf falls into the sand in a river. It gets buried. The sand eventually gets buried even deeper, turns into sandstone. The leaf rots away and when you hit this rock with a hammer, there's a weakness in the rock the shape of the leaf. And it pops right open where the leaf was.

Maggy Benson: Does that mean you get two fossils?

Kirk Johnson: Exactly. The part and the counterpart, or the front and the back. Or two for the price of one.

Maggy Benson: Wonderful.

Kirk Johnson: Isn't that amazing? It's just a beautiful leaf that's 66 million years old. This is a leaf of a tree that was growing around Tyrannosaurus rex and Triceratops.

Maggy Benson: So we're looking at a leaf right now, but there are a lot of other parts to plants. I mean, there are stems, there's pollen. I mean, what else can you look at to help you be able to piece this together?

Kirk Johnson: Yeah, if you think about it, I mean, you get the fossilized trunks that tell you how big the forest was, how tall the trees were. But pollen, pollen grains are amazing. They're like one tenth or one hundredth of a millimeter in diameter. And a little tiny chip of mud, if you dissolve it in acid you can get 10,000 pollen grains. And you can look at them and say, well, that one is from this kind of tree and that one was from a different kind of tree. You can literally rebuild the forest from a chip of mud.

Maggy Benson: That's incredible. So are you looking at all of these plants before this K-T boundary, so when these dinosaurs roamed the earth, to be able to piece together what these ecosystems looked like?

Kirk Johnson: That's just it. We'll dig a hole in the ground, we'll find five or six hundred leaves. We'll reconstruct the world on that spot and that time. We'll go up the hill and get closer to the K-T boundary, do it again. Go up, get closer, and we basically look at how the forest changed up to and across the K-T boundary. Or before and after.

Maggy Benson: The dinosaur extinction.

Kirk Johnson: Exactly.

Maggy Benson: So we've looked at some plant fossils here. We're looking at some animal fossils. I would love to know which fossils are most helpful in recreating these ancient ecosystems.

Kirk Johnson: Maybe we should ask the people that are watching in right now.

Maggy Benson: I think that's a great idea.

Kirk Johnson: Fire it up.

Maggy Benson: All right. So we have another poll available to you on the screen. Tell us which fossils are useful for recreating what an ecosystem looked like. Insects, small mammals, plants, reptiles or all of the above. Take a moment to think about it and put your answer in the window located to the right of your video screen.

Maggy Benson: Kirk, I think we have some very smart students out there.

Kirk Johnson: What did we get?

Maggy Benson: All of the above is the most popular answer by far.

Kirk Johnson: And I would have picked that one too. Even though I lean towards plants, it really wants to be an analysis of everything. You want to know the whole world, look at the whole world.

Maggy Benson: So plants are just the perfect specimen to look at to be able to understand the forest, but you really need all of these other animal fossils to be able to recreate that whole ecosystem.

Kirk Johnson: Right. And one of the things that was kind of fun is that I used to think that these fossil leaves, that had holes in them, weren't very good fossils. Until I realized that these holes were made by insects when the plant was alive and growing. And that the fossil leaf actually even contains information about which insects were feeding on it. And we can even look at insects before and after the dinosaur extinction, and ask the question what happened to the insects? So the leaves give you more than just the story of what the forest had laid. It tells you about other animals that lived in the forest.

Maggy Benson: Well, that's even interesting that you say before you didn't know that it was insect damage. So are the depictions of these ancient landscapes actually evolving with the more knowledge that scientists obtain and the more evidence that's found?

Kirk Johnson: Oh, yeah. I mean, one of the things we know for a fact is that people love dinosaurs so much that when they make paintings of dinosaurs or movies of dinosaurs, they don't care about anything else. Think about Jurassic Park. They put a whole bunch of dinosaurs in Hawaii. Jurassic Park was in Hawaii. Well,

Hawaii is today. It's not 66 million years ago. And if you look at most dinosaur paintings, you'll find that they have lots and lots and lots of dinosaurs, and not a whole lot of anything else. It's not uncommon in a dinosaur painting to see just a dinosaur standing out there in a flat field with nothing in it.

Maggy Benson: So somebody wanted to draw a Tyrannosaurus rex, not the trees that it lived amongst.

Kirk Johnson: People love Tyrannosaurus rex. I get that. But I like the world that Tyrannosaurus rex lived in. And you look at this image that we're showing you right now, you can see there's a big, beautiful dinosaur right in the middle. And then he's standing in a big field of dirt. I think the world was more interesting than that big field of dirt.

Maggy Benson: So what are you and your colleagues doing to be able to help people like me, and like the visitors here at the Smithsonian, to better understand what those landscapes of the dinosaurs looked like?

Kirk Johnson: Well, we get scientists working with artists. Because we can collect the data. We know what the trees looked like by all the leaves and the trunks, the pollen grains. We know what animals were there 'cause of all the bones. We know what insects were there. So we can take all those pieces and put them back together again, and create a picture of what it looked like. And we'll work with artists to paint that image.

Maggy Benson: It sounds like the artist is just as important as the scientist.

Kirk Johnson: Absolutely. I mean, art and science in my mind are pretty close endeavors. They both involve curiosity and creativity.

Maggy Benson: So, there's an artist here at the Smithsonian that's been putting together a wonderful mural of your location, actually, in North Dakota. Can you tell us about that?

Kirk Johnson: Yeah, so we've been working with Mary Parrish. And the whole team was working with her. We took the team out to North Dakota, we collected the fossils, we brought them all back and we started to rebuild the world of North Dakota before the asteroid strike. And it's pretty cool. Here's the image. You can see it's got a lot of different things going on. There's a little stream and some floating aquatic plants.

Maggy Benson: This is very exciting. I feel like I'm looking in a window to the past, 66 million years ago.

Kirk Johnson: Well, you are. And everything in that painting is based on a real fossil. That's the cool thing about it.

Maggy Benson: So I saw a lot of dinosaurs. Were there that many dinosaurs around when I just would look out my window, or what's the story?

Kirk Johnson: See, if you go for a walk in the woods, chances are that you might see a chipmunk or a bird or something like that. But you don't usually see a cougar fighting a bear next to a giant elephant, and a moose nearby. Animals are sort of everywhere and they walk by. So this painting that we did is more like a time-lapse photograph. The scene is exactly as you see it, but this would be sort of all the animals that would pass by in the course of a day. And it's almost like you just left your camera up and watched the animals walk through, and snapped them as they came through.

Maggy Benson: So you've been able to coordinate all of these teams to be able to go to Hell Creek to create these fossils, to be able to put together this story for the museum visitors back here in D.C. That most certainly relates to your role as director.

Kirk Johnson: Well, it is if you think about what a museum does. It does scientific research. And we do research in a lot of areas, not just in paleontology but also all aspects of biology and anthropology. And we work in big teams and then our product are the collections that we make and store on behalf of the people. And then we make exhibits and educational programs. So this whole idea of doing science, making collections, sharing the information is what a museum does. It's just a big blown up version of what we've been talking about.

Maggy Benson: And we get to look at all areas of natural history, not just paleontology or botany.

Kirk Johnson: Exactly. Because the world is an amazing place.

Maggy Benson: It is. So we have a question. Are you ready for it?

Kirk Johnson: I think so.

Maggy Benson: So this question comes from Sandhill Academy. Are there places in the Hell Creek Formation where small groups can help at a dig site?

Kirk Johnson: Well, that's interesting, yes. You know, it turns out that Hell Creek stretches over broad segments of eastern Montana, western North Dakota, northwestern South Dakota, even into Wyoming. And there are a number of different small museums in that area, and a number of places that lead field trips into the Dakotas. So that's the kind of landscape that if your school wants to go out there, get online, type in Hell Creek Formation and see what pops up. And there's various opportunities.

Kirk Johnson: And also all over the American west there are really cool places to go see fossils. There's places like Dinosaur National Monument in Colorado, or Dinosaur

Provincial Park in Alberta. There are lots of places where fossils have been found and are on display, and people can go and participate in various aspects of the digging. And I'll tell you what, it's fun.

Maggy Benson: I want to go.

Kirk Johnson: Well, we can arrange that.

Maggy Benson: All right, this question comes from George. George wants to know how did you become a museum director?

Kirk Johnson: You know, the thing is that I started hanging out in museums when I was a kid. And I think I first met my first museum curator when I was 12, and I just showed up and started volunteering and saying "What can I do to help out here?" And after a while I was like, "This is a cool place. There's really interesting people, there's interesting stuff. People come here, people feel really good in museums." And so I met a guy who was a museum director. I said, "I want to be like that guy. One day I want to be like that guy."

Maggy Benson: So you always wanted to be a museum director.

Kirk Johnson: Strangely enough, that is true.

Maggy Benson: So now you're in your dream job.

Kirk Johnson: I am.

Maggy Benson: So it sounds like we should be volunteering at dig sites and going to our local museums to learn more about this kind of-

Kirk Johnson: It's a good place to start, that's for sure.

Maggy Benson: And this one comes from Brian. Is this the biggest extinction there's ever been on Earth?

Kirk Johnson: So that's a really good question, Brian. There have been a number of mass extinctions on Earth and this is probably the second largest, although there's some people that argue it's the largest. The one that is a contender is the one that happened 252 million years ago called the Permian-Triassic extinction. There are other ones as well. So one of the big questions we ask ourselves regularly as scientists is what causes mass extinctions? Maybe the Cretaceous-Tertiary one was caused by an asteroid, but did asteroids cause them all or were there other reasons? So it's a really good series of questions.

Maggy Benson: Great. So this question comes from Susie. Susie says if everything on earth was killed by the asteroid, how did the Earth get repopulated and why didn't dinosaurs repopulate?

Kirk Johnson: So, Susie, it's a good point. And the fact is that not everything did get killed. In fact, there's two kinds of killing. There's the killing of individual animals and plants. And if you kill every single animal or plant in a species, you cause that species to go extinct. And we had a lot of species extinction and a lot of mass death, but the fact is that lots of individuals did survive and, as a result, certain species didn't go extinct.

Kirk Johnson: And it's those species, the survivors, that lived on to populate the world. And everything that lives on the planet today is a descendant of one of those survivors. So we've got at our table things like turtles, crocodiles, birds, mammals. And you're listening to a couple of mammals here to tell you this story.

Maggy Benson: So we have another question. This one comes from Taylor and I think Taylor is a Jurassic Park fan, which I'm sure there are many of them out there. Is it possible to bring back dinosaurs using DNA that's possibly trapped in amber or some other kind of fossil?

Kirk Johnson: Well, like everybody else I loved the concept of Jurassic Park. The idea that you could actually bring back live dinosaurs. And at the time Jurassic Park first came out, we didn't really know what was possible with DNA or even if there was real dinosaur DNA. And right now we have not been able to actually find any good dinosaur DNA. It looks like DNA does fossilize, but the fossils that have DNA don't go back much further than a couple of hundred thousand years. And dinosaurs are 66 million years. And DNA is kind of a delicate molecule, and it kind of breaks apart over time and with acidic conditions and being exposed to oxygen. So I'm not optimistic that we'll get dinosaurs back from dinosaur DNA.

Maggy Benson: So Mary has a question about your experience with fossils. How old were you when you found your first fossil, and what was it?

Kirk Johnson: Ah, yes. I found my first fossil on a family picnic in Casper, Wyoming, when I was about five years old. And I walked over to this rock, and there was a little tiny fossil brachiopod. I thought it was a fossil of a rattlesnake's rattle, 'cause I was really interested in rattlesnakes too. It was just a little brachiopod.

Kirk Johnson: But then the next time we went for a hike I kept looking and I found another fossil. And once I found two I realized that you can find these things, and it's pretty cool because if you're a kid and you have the superpower of finding things, then you go crazy. And I went to the library, I went to the museums and I learned how to find more fossils. And every time I'd go out anywhere I'd find fossils. And pretty soon I was that kid that could find fossils.

Maggy Benson: Very cool. So I guess you didn't need any special training and you could still find 'em?

Kirk Johnson: Yeah, you're close to the ground.

Maggy Benson: So here's another question. Is there any kind of fossil record of dinosaurs or any other fossils around the crater?

Kirk Johnson: The crater's in Mexico and the crater hit in shallow seawater conditions. There was probably like 600 feet of salt water. So dinosaurs didn't live in the seas. They lived on land and the nearest land of the dinosaurs would have been somewhere in Texas. And we do in fact find dinosaur fossils in Texas, over in West Texas and in Big Bend National Park, for instance. So the closest place we could find fossils, we do find fossils of dinosaurs, to the crater.

Maggy Benson: Kirk, can you tell our viewers where they can learn a little bit more about your work?

Kirk Johnson: Sure. I mean, if you're in Washington, D.C., on November 25th, we're opening a new exhibit here called The Last American Dinosaur, right? About these very animals. If you're not in Washington, D.C., check out our webpage for references and resources. Or go to your local museum.

Maggy Benson: Thank you so much, Kirk.

Kirk Johnson: You bet.

Maggy Benson: Thanks again for joining us today on Smithsonian Science How. If you missed part of this program, it'll be archived later today on qrius.si.edu. Make sure to join us next time on Smithsonian Science How when we explore island ecosystems with Doctor Torrey Rick.

Voiceover: Thanks for watching. You can explore more Smithsonian Science How shows on our website, qrius.si.edu. We hope you'll join us again on Thursday, November 6th, for a conversation with archaeologist Torbin Rick, where we'll explore how native Americans and other humans have influenced island biodiversity over time. Register now at qrius.si.edu.