Video Transcript – Human Evolution – Early Human Diets

Maggy Benson: [00:00:30] Have you ever wondered about your human ancestors that lived more than one million years ago? You may have images of ape-like people that sheltered in caves and used clubs. A special group of scientists, called paleoanthropologists, used clues from the prehistoric record to uncover the mysteries of what early humans were really like. The work of these scientists helps us understand what it means to be human and how we evolved to the unique species that we are today. [00:01:00] In this episode, we'll meet paleoanthropologist, Briana Pobiner, to learn more about early human life by looking at what was on the menu one million years ago.

Maggy Benson: Hi, thanks for joining us. I'm Maggy Benson, host of Smithsonian Science How? We have a really awesome show planned for you today, but before we get started, I want to ask you a question. You can respond using the poll that appears to the right of your video screen. [00:01:30] What makes humans different from other species? Is it: Talking? Walking upright? Using tools?, Thinking abstractly? or Having big brains? Take a moment to think about it, and put your answer in the window that appears to the right of your video screen. [00:02:00] All right, it looks like the answers are still coming in, so before we go to the results, I want to introduce our special guest today. Today we have with us, paleoanthropologist from Smithsonian's National Museum of Natural History, Dr. Briana Pobiner. Thank you so much for being here with us today, Briana.

Briana Pobiner: You're welcome.

Maggy Benson: Right now, we basically have three answers coming in that are top. Walking upright, thinking abstractly, and using tools are all answers that people are responding that make humans unique. [00:02:30] What do you think about that?

Briana Pobiner: I think in some ways all of those answers are correct, but really it's sort of an all of the above. It's the whole package that makes us uniquely human. We have these amazingly large brains, we have very sophisticated language and technology. And we walk upright on two legs, which is fairly unique among animals.

Maggy Benson: I have to ask you, what about chimpanzees? I know that we're really similar to them in all of our behavior. Does that make us really that unique?

Briana Pobiner: We're not only similar to chimpanzees [00:03:00] in our behavior, but the way that we look and also our genetics. We are 98.8 percent genetically similar to chimpanzees. They do a lot of the things we do, they walk upright from time to time, they use tools, they have fairly sophisticated communication, but actually humans and chimpanzees share a common ancestor that lived about six or

seven million years ago. We've had quite a long time to evolve on those separate paths. If we have 3.2 billion base pairs in our [00:03:30] genome, 1.2 percent is maybe 35 million difference.

Maggy Benson: Oh my god, so only 1.2 percent of our genetic code is different, but it really makes us uniquely human.

Briana Pobiner: It does, that makes us who we are.

Maggy Benson: And I guess 6.7 million years of evolution too.

Briana Pobiner: That's right. That's quite a long time.

Maggy Benson: Can you tell us what a paleoanthropologist is, and what you do to study human evolution?

Briana Pobiner: Sure. A paleoanthropologist us essentially a scientist [00:04:00] who's interested in early humans. What they did, how they lived, what they ate, all about their biology and behavior. Paleoanthropologists usually use three lines of evidence to look at early human lifestyles. We use the fossils of the early humans themselves, we use animal bones or fossils of animals that lived at the same time as those early humans, we can tell something about environments from those animals. Possibly something about diet. [00:04:30] We can also use the archaeological record, stone tools, pottery, anything that was left behind that early humans made.

Maggy Benson: Interesting. It sounds like there are a lot of different puzzle pieces across those three lines of evidence.

Briana Pobiner: There are, and it's really neat to try and fit those puzzle pieces together. We're never going to have every single piece, but really trying to make sense of the evidence we have.

Maggy Benson: Can you show us something ... I see evidence on the table here. Can you show us something that you brought?

Briana Pobiner: Sure, I brought [00:05:00] the exact replica of a skull of probably my favorite species on the human family tree. *Homo erectus*. One of the things that makes *Homo erectus* so special is that it started to incorporate a lot more meat into its diet. I'm really interested in meat-eating in early human diets. By about 1.8, 1.9 million years ago when this species evolved, it started to eat more meat and more marrow and other things from large animals.

Briana Pobiner: We can see that reflected in the shape [00:05:30] of it's skull. In comparison to a species like *Australopithecus afarensis*, which lived much earlier back to almost 3.9 million years ago. The slope of the face is much different. A lot of the face of *Australopithecus afarensis* was really used for chewing. But then once early

humans started using stone tools to butcher meat, they could basically process food outside of their mouths. So our teeth got smaller, but our brains got bigger.

Maggy Benson: Interesting. So what did we eat before [00:06:00] we started eating meat? What did maybe *afarensis* eat?

Briana Pobiner: Even back to the earliest human ancestors, back to six or seven million years ago, we probably had a very omnivorous diet. Eating plants and animals. Eating things like fruit and leaves and berries and probably small animals. Maybe insects, lizards, eggs, all sort of things. Kind of anything we could get our hands on.

Maggy Benson: You mentioned that there are other species, other than *afarensis* and *Homo erectus*, [00:06:30] how many human species were there?

Briana Pobiner: The family tree, our family tree, is pretty bushy actually. It's very diverse. There were maybe somewhere between 18 and 20 species on our family tree. At any one time, there were often several species living at the same time. It's fairly unique to be a modern human and to be the only species left standing. You can see right there, kind of on the top of the tree.

Maggy Benson: Did all of these animals live at the same time?

Briana Pobiner: [00:07:00] Many of them did, you can see where some of them overlap. In fact, modern humans, our time span overlaps with at least three different other early human species.

Maggy Benson: Interesting. The early humans that you study, where did they live?

Briana Pobiner: There are a couple places that I work. One site that I am currently doing research at is called Olorgesailie, it's a site in southern Kenya, in the southern Kenya Rift Valley. We actually have a beautiful photo of Olorgesailie right in back of us. This is what [00:07:30] the landscape looks like. It's very eroded, but I think it's quite beautiful. We're working at Olorgesailie under the direction of Dr. Rick Potts, who's also a paleoanthropologist here at the Natural History Museum.

Maggy Benson: What kind of things do you look at at Olorgesailie?

Briana Pobiner: I'm particularly interested in looking at the animal bones there. I've actually brought one with me today. This is a rib of some sort of large animal, maybe about [00:08:00] a zebra size, that's about a million years old.

Maggy Benson: Wow, that's so interesting. You may find some of these fossil bones here at your field site, in Olorgesailie. What else do you find at the field site here?

Briana Pobiner: We find lots of different types of evidence. It really takes a team to be able to put together the pieces of this prehistoric puzzle. We have archaeologists who study the stone tools. We have the paleoanthropologists, or physical anthropologists who study the actual fossils [00:08:30] of early humans. We have paleontologists that study the animal bone fossils, but geologists are also key. These are scientists who help us figure out how old the fossils and artifacts were. Also help us reconstruct the type of landscapes and environments that early humans lived in.

Maggy Benson: Wow. That's really interesting. We already have a student question for you, are you ready to take it?

Briana Pobiner: Sure.

Maggy Benson: All right. This one comes from Amy from Acacia. She wants to know, who is our [00:09:00] closest relative?

Briana Pobiner: Who is our closest relative? That's a good question. That's sort of a million dollar question. Right now, based on available evidence, we think that our probably direct ancestor is a species called *Homo heidelbergensis*. This species lived in Africa and in Europe. Dating back to about 800,000 years ago. Populations of this species in Africa evolved eventually into our species, modern humans or *Homo sapiens* about [00:09:30] 200,000 years ago. The populations in Europe evolved into Neanderthals. Neanderthals are our closest extinct relatives.

Maggy Benson: Wow, interesting. We have another question for you. This one comes from Ruth. Ruth wants to know, is there any way to know what we will evolve into?

Briana Pobiner: Wow, that's a fascinating question. A lot of that's hard to predict. The way that evolution works is that changes often happen or are selected for in response [00:10:00] to a particular selective pressure, in response to a particular environment or challenge. Not knowing what those challenges will be in the future, it's a little hard to predict how our evolutionary trajectory's going to proceed.

Maggy Benson: Great. I want to get back to this bone that you brought here, that was recovered from Olorgesailie one million years ago. You said that looking at marks on bones is your primary research. What do you look at when you look at marks?

Briana Pobiner: I'm particularly interested in trying to figure [00:10:30] out who made these marks on bones. Some of these marks were made by early humans when they used sharp stone tools to butcher animals. Some of these marks were made by carnivores when they were basically eating their prey and munching on these bones.

Maggy Benson: We see on this screen here, are those chew marks or what?

Briana Pobiner: Those are great examples of cut marks on fossil bones. Cut marks are linear, they're very narrow. They usually have a v-shape at the bottom. They're usually [00:11:00] either oriented right across the bone or kind of diagonally across the bone. In contrast, carnivore tooth marks, especially tooth pits, they're usually round. They had there, crushed on the surface of the mark. They can sometimes be scattered throughout the bone, or often concentrated on places where carnivores have chewed.

Maggy Benson: I want to know how you actually do the research to be able to understand what made that [00:11:30] on the bone, because we don't have a looking glass to look back a million years ago.

Briana Pobiner: I would love that. One thing I do is, I'm trying to determine what different carnivore chewing patterns look like. To do that research, I work at another site in Kenyan, called Ol Pejeta Conservancy, which is a site in central Kenya. It's a modern game reserve. I'm working their together with my colleague, Dr. Fire Kovarovic from Durham University in the U.K. We are basically looking at [00:12:00] kills that lions, leopards, hyenas, different carnivores have made, to try to determine if we can figure out what that lion-chewing pattern, that leopard-chewing pattern looks like. We go out in these modern landscapes, we follow these carnivores around. Then we pick up their leftovers and study those bones.

Maggy Benson: Is that scary? I mean you're out on this modern game reserve with these big carnivores.

Briana Pobiner: Not only with these big carnivores, these big meat-eaters, but elephants and rhinos and buffalo. [00:12:30] It can be a little scary, but we always go out with an armed guard, with an armed ranger, any time we're out of the car. To make sure that we're safe.

Maggy Benson: Interesting. Did you bring any objects here today that show what some of these chew-marks look like on the bones?

Briana Pobiner: I did. Here is one example of a zebra bone that has some nice chewing damage from a lion. You can see right here where the arrow is, there is basically a big carnivore tooth mark back here. And over here is all of this nibbling damage that happened [00:13:00] when a lion was chewing, trying to get this meat off and ended up chewing part of the bone.

Maggy Benson: You've done a great job helping us understand what a chew mark looks like and a bite mark and a cut mark, so let's go back to this rib bone that you brought.

Briana Pobiner: Sure.

Maggy Benson: I think maybe we should ask the students what they thing that these marks were made from.

Briana Pobiner: That sounds great.

Maggy Benson: Wonderful. Students, take a look at this bone and maybe Briana will point out what marks we're looking at. What do you think the marks [00:13:30] on the bone were from: Grass impressions? Tooth marks? Water staining? or Butchery marks? All right, Briana the answers [00:14:00] are coming in. 50% of our students think they are butchery marks. What do you think about that?

Briana Pobiner: I think that's a great answer. It's the fact that they're quite linear and straight and narrow that gives away that those are butchery marks.

Maggy Benson: They're butchery marks made by stone tools, that means that early humans were using stone tools a million years ago?

Briana Pobiner: Actually, early humans were using stone tools all the way back to about 2.6 million years ago. We have simple technology at that point, so we basically [00:14:30] have simple rocks with flakes that were knocked off of those rocks. Not very sophisticated, but they were really perfect at getting a sharp edge to be able to slice meat off of bone. By the time *Homo erectus* came around, there was a big innovation in stone tool technology. This is a hand ax, this is a real hand ax from Olorgesailie. This hand ax has a very specific pattern that the sharp flakes were taken off around the edge. It's actually a very [00:15:00] efficient way to use your stone tool raw material.

Maggy Benson: Great. We have another student question. This comes from Long Gone Daddy, is there any evidence that particular diet and nutrients contributed to brain or language development?

Briana Pobiner: That's a good question. Actually there is a lot of evidence or at least a good hypothesis that eating meat contributed to an increase in brain size. Meat is a great resource, it has a lot [00:15:30] of calories, it has a lot of fat and nutrition. Being able to get all of that in a smaller package, versus a lot of leaves or fruit, may have enabled our brains to grow bigger.

Maggy Benson: Great. This one comes from Brianna, from FIS. She wants to know, where do you take the fossils after you piece them together?

Briana Pobiner: Oh, that's a good question. All of the fossils stay in the country where they've been excavated. So all of the fossils from Olorgesailie stay at the national museums of Kenya. They go to the central museum in [00:16:00] Nairobi.

Maggy Benson: Great. You mentioned that these stone tools were sued for butchery. Does that mean that they were actually hunting with them too? Or were they just using them to butcher the animals and eat the meat after some animal may have gotten to it?

Briana Pobiner: That is another million dollar question. We don't have evidence for hunting technology in the archaeological record until about half a million years ago. You'll notice that's two million years after this evidence for meat-eating started. We think that sometimes actually, early [00:16:30] humans were coming in after carnivores were done with their kills, or maybe even chasing them off. And that's how they were getting meat from these big animals.

Maggy Benson: Were the early humans waiting in the bushes, waiting for these lions to get off their prey?

Briana Pobiner: It's hard to know, we don't have evidence for some of that specific behavior, but we can infer from where cut marks are on bones, if the early humans are getting the really juicy parts of carcasses, it's an indication that they may have been chasing carnivores [00:17:00] off of kills or somehow being able to get better access to the best parts of the animals.

Maggy Benson: Is that primitive, the scavenging, or is it actually advanced for that time period? To be able to be waiting and the butchering these animals.

Briana Pobiner: You know, I think it's funny, I think scavenging gets a really bad wrap, but I think it's actually a fairly sophisticated behavior. You really have to know your environment very well, know where the carnivores tend to hunt, have advanced planning and very sophisticated communication [00:17:30] and group dynamics and social interaction. I think it's actually a pretty advanced kind of behavior.

Maggy Benson: Interesting. Eating meat really was the critical changing point for us to be able to have all of these human unique qualities.

Briana Pobiner: I think that at least was a very big changing point. There's two other big shifts in early human diet. One is about by 800,000 years ago, we have good evidence that humans were using fire for cooking. Then [00:18:00] by about 15,000 years ago, it's late in the record as far as we're concerned, but we have good evidence for agriculture and domestication. Which is basically growing plants and tending animals for our own food resources.

Maggy Benson: Wonderful. You've done a really great job explaining to us what a paleoanthropologist does, about your fieldwork here in Kenya and ... Here, in Kenya. And the evolution really of our human diet. Let's go to some student questions.

Briana Pobiner: Sounds good.

Maggy Benson: [00:18:30] All right. This one comes from Louisa. Louisa wants to know, may early humans have gotten the idea of cooking meat from scavenging meat, from animal caught in wildfires?

Briana Pobiner: That's a really good question. We think there were probably occasional wildfires that lightning strikes or something. Ended up lighting these wildfires. It certainly could have been from something like that, that's a good idea.

Maggy Benson: This question comes from Hagen. Hagen wants to know, why were animals from millions of years [00:19:00] ago so much bigger than they are today?

Briana Pobiner: That's actually a really good question. We have really across the whole world, in almost all of our continents, there are big extinct animals that are no longer around today. I think it's complicated, but there's probably a lot of reasons for that.

Maggy Benson: This one comes from Harold Woods. Harold Woods wants to know, how many different types of food did we eat before we started eating meat?

Briana Pobiner: That's a very good question. We have a lot of types of food we were probably eating that don't preserve. [00:19:30] Things like fruit and leaves and berries. We can get preserved, and sometimes even preserved little bits of plants. But it's harder to look really deep back in the record and figure out what we were eating.

Maggy Benson: This one comes from Scott in Fairfax. Scott in Fairfax wants to know, did early humans eat raw meat?

Briana Pobiner: I think the answer is yes. We have meat-eating back to about 2.6 million years ago at least. But we don't have good evidence for cooking until [00:20:00] 800,000 years ago. It's possible that we'll find earlier evidence for cooking, but it looks like raw meat was being eaten for a long time.

Maggy Benson: Otto from Rapid City wants to know, what education do you need to do this kind of work?

Briana Pobiner: The first thing you need is a college degree, usually in anthropology, but maybe in biology or geology or even something like chemistry and physics, to do some of those dating techniques. Then most people do go on and get a masters and a Ph.D.

Maggy Benson: [00:20:30] Briana, what made you interested in paleoanthropology?

Briana Pobiner: I admit that I was not as interested in science when I was in high school than I am now. It was really a class that I took in college with a really inspiring professor that got me started on the anthropology path. Then I went to a field school in south Africa and absolutely fell in love with the discovery and thinking about human prehistory. Trying to find those pieces to that puzzle.

Maggy Benson: Great. [00:21:00] We have another question, and this one comes from Jacklyn. She wants to know, do we ever find painting on any of the bones that you find?

Briana Pobiner: Interestingly, sometimes we can find coloring. Pigments, either red pigments made of ocher or black pigments like manganese. Occasionally we do find staining on those bones.

Maggy Benson: Wow. And you think that that is then two lines of evidence together as one, both the human artifact and a fossil bone?

Briana Pobiner: Exactly. It's a little bit later in time, so we really [00:21:30] don't have the evidence for making art until a couple 100,000 years ago, but we certainly do find marks on stones and bones and certainly caves and things like that.

Maggy Benson: Great. Alex has a question, and Alex wants to know, did our bones get bigger over time?

Briana Pobiner: Our brains got bigger over time and that meant that our skulls had to get bigger over time, at least that part of our skull. In general, our body size did increase over time. [00:22:00] Our bones, our whole skeletons, got gradually bigger over time.

Maggy Benson: That was really because of meat-eating?

Briana Pobiner: It probably played a big part, yeah.

Maggy Benson: That's so interesting. I'm looking here at the models that you have out on the table, what order did they come in? Do you know?

Briana Pobiner: Yeah, so probably I would actually have to switch these two. The early fossils from *Australopithecus afarensis* leading into the earliest members from our genus, the genus *Homo*. You can see a little [00:22:30] bit of change in the size of the brain and the slope of the face. Then once we get past *Homo erectus* to Neanderthals, you can see they're much bigger and actually have a really large brain. And very big brow ridges.

Maggy Benson: Neanderthals, I mean in the geological record, they're kind of recent, aren't they?

Briana Pobiner: They are, and actually they evolved around the same time that modern humans did. About 200,000 years ago.

Maggy Benson: They were found in North America?

Briana Pobiner: They were found in Europe and in Western Asia.

Maggy Benson: Oh, okay.

Briana Pobiner: Modern humans, [00:23:00] when they migrated into Europe, encountered Neanderthals, they were living in the same place at the same time, and we

know from genetics that they occasionally interbred, that they mated with each other.

Maggy Benson: Great. We have another question from Patrick. Patrick wants to know, how did early man learn to make tools?

Briana Pobiner: Oh, that's a great question. I'm not sure we'll ever answer that question. It may have been initially just picking up sharp stones and using those as stone knives that gave people the idea to actually [00:23:30] make early stone tools and to manufacture them instead of to just go out and collect them. But we really don't know, that's a good question.

Maggy Benson: Wonderful. Okay, this one comes from David and David wants to know, when did the early humans learn to build shelters?

Briana Pobiner: Oh, so that's a good question. We have the earliest evidence for building shelters, back to about 400,000 years ago. At least that's what we can discern in the prehistoric record.

Maggy Benson: John B., what is your favorite fossil that you've found?

Briana Pobiner: Wow, [00:24:00] that's a hard question because I love all the fossils that I found, but probably some of the fossils that I found where I'm digging up in layers that are about 1.5 million years old, and I can pick up bones like this cut marked bone and I know that the last person that touched this, lived a million and a half years ago, wasn't quite like me. It's really reaching through the past and touching evidence of behavior.

Maggy Benson: Sounds exhilarating.

Briana Pobiner: It's amazing.

Maggy Benson: [00:24:30] Bryant wants to know, since the tools were made of stone, how hard were they to use?

Briana Pobiner: That's a good question. They actually weren't that hard to use, in the sense that you could pick one up, one that had a sharp edge and it's not hard to actually slice meat off of those bones. Tools were also used for pounding, for probably processing plants, and was probably hard to make them, but not as hard to use them.

Maggy Benson: This one comes from Jonathon, and he says, besides brain, [00:25:00] did any other organs change?

Briana Pobiner: Well interestingly, about the same time we see the brain size increasing, we actually see the size of our guts and our whole digestive tract decreasing. Those things might be related. Our brains take up about 2% of our body weight, but

they take up 20% of energy. Our guts take up a lot of our energy. Potentially, with eating meat, we didn't need guts as big, so they got smaller and brains got bigger.

Maggy Benson: Interesting. In a kind of related [00:25:30] question, Emma wants to know, did Salmonella or any other kind of disease exist back then that we have today?

Briana Pobiner: It's interesting, it's rare, but we do have evidence of diseases. There's actually cancer, or bone lesions on a Neanderthal rib from tens of thousands of years ago. There's actually a partial skeleton from northern Kenya where we know that this woman suffered from hypervitaminosis A, probably actually eating something that had [00:26:00] a really high concentration of vitamin A, which is especially concentrated in liver and actually carnivore liver.

Maggy Benson: Wow, so you can really actually see some of those diets in the fossil in the record too.

Briana Pobiner: And diseases sometimes, exactly.

Maggy Benson: This one comes from Lindsay and Lindsay wants to know, how do you feel about indigenous creation stories?

Briana Pobiner: I think that basically how we became human is a part of what it means to be human, but I think that [00:26:30] the stories that we have in a cultural context of how we became human, are also a really important part of who we are.

Maggy Benson: Great. This one is kind of funny, Sophia wants to know, will our pinky toe evolve away?

Briana Pobiner: It's funny, actually having five fingers and toes is a really primitive condition in a sense. That goes back really far in our evolutionary history, and unless there was really strong selection for some reason for our pinky toes to go away, [00:27:00] they're probably going to stay put.

Maggy Benson: It's a good question. Raymond wants to know, is there any difference in early human bones becoming fossils as opposed to animal bones?

Briana Pobiner: The process was probably the same. A lot of the bones, if you find human and animal bones in the same layers, they usually look the same. It's really just the size and shape of the bone that lets us know what type of animal or human they came from.

Maggy Benson: Going back to the size and the shape of the bone, Anthony G. He wants to know, how do you tell what kind of bone it is, [00:27:30] is there a spot on the bone that tells you what kind of bone it is?

Briana Pobiner: That's a good question. I actually spend a lot of my time trying to figure out what bones these fossils are. Sometimes on parts of the bones, there are very specific shapes. You can see some of these curves and ridges here. If you get chunks of bones that have these shapes, they're a lot easier to diagnose. But sometimes when you have really little pieces, it's really hard to tell.

Maggy Benson: So you're really kind of like a forensic anthropologist too, that we see on crime shows like CSI?

Briana Pobiner: In a way, trying to look at tiny [00:28:00] bits of bone and trying to find out what they are.

Maggy Benson: Thank you so much for being here today and teaching us about paleoanthropology, human evolution and early human diets. It's been really enlightening.

Briana Pobiner: Oh, well thanks a lot.

Maggy Benson: Is there anywhere that students can go to learn more about human evolution and the work you do?

Briana Pobiner: I would suggest going to our website which is humanorigins.si.edu. If you're on social media, you can follow us on Twitter, @humanorigins. Then you can also find us on Facebook, [00:28:30] Smithsonian Human Origins Program.

Maggy Benson: Thank you so much.

Briana Pobiner: Thanks.

Maggy Benson: So thanks again for joining us today, we're glad that you came. If you missed part of this broadcast or want to watch it again, it'll be archived at qrius.si.edu later tonight. Thanks for joining us and see you next time on Smithsonian Science How?