Ask-a-Biologist Vol 067 (Guest Don Johanson)

Looking into Lucy

It was the 70's and a popular Beatles song was playing in a hot and dry African camp filled with happy anthropologists who had just made an amazing discovery. Dr. Biology talks with Don Johanson the paleoanthropologist who first discovered the bones of one of our earliest ancestors who would fondly be named that night as Lucy.

Transcript

Dr. Biology: This is "Ask A Biologist," a program about the living world. I'm Dr. Biology. Today, we're going to talk about some bones. Not just any kind of bones. We're going to talk about some very old bones. My guest today is Don Johanson, Paleoanthropologist at Arizona State University and the Founding Director of the Institute of Human Origins. He's research includes a discovery of one of the oldest human skeletons fondly called "Lucy."

Now, how old you might ask? Well, let's say that for a little bit later on the show. Johanson is also an author of many scientific and popular articles along with books including "Ancestors: In Search of Human Origins" and has narrated a companion TV series as part NOVA. Welcome to the show Don Johanson and thank you for visiting with me today.

Don Johanson: It's my pleasure.

Dr. Biology: Before we jump in to the story of Lucy, let's talk just a bit about anthropology and in your case, paleoanthropology. What do you do as paleoanthropologist?

Don: Well, "paleo" is a Greek word and it's means "old" and anthropology is the study of human kind, so it is the study of old humankind. In my case, the study of human origins, our evolutionary ancestry, where our ancestors lived, when they lived, where they lived, how they acted and where they fit on the human family tree.

Dr. Biology: When I watched the typical show of the anthropologists out on the dig, it's dusty, it's desolate and there are usually a few tense up. Is that realistic?

Don: It's exactly what it's like. I live in the desert on these expeditions for two and a half, maybe three months and sleep in a little REI tent, smaller than this studio we're in. It's hot, so well over 100 degrees every day. It's dry. It's in a desert. We have a permanent source of water with a river that goes by but it's not everybody's cup of tea as we say.

Dr. Biology: Right. I gave a little teaser at the beginning about "Lucy." When did you discover Lucy and where did you discover Lucy?

Don: Well, it's quite a long time ago. It was in 1970 when many of our listeners probably weren't even born. But I was a young anthropologist working in Ethiopia at a site called "Hadar," which is a local place name. It was an area very fossil-rich in elephants, in rhinos, in gazelles, monkeys, rodents, crocodiles, snakes, fossil eggs of crocodiles and turtles and so on. It was my hope that we would find fossil remains of a human ancestor.

In 1973, I was fortunate in finding a piece of arm bone, actually part of the elbow, that led to about 40 percent of those single skeleton that is now dated at 3.2 million years and has become known popularly as "Lucy."

Dr. Biology: Well, that actually brings up a couple of questions that I had because we see this in television shows, not uncommon to see someone digging up bones and putting them back together. But first of all, they're not all in one piece anymore, right?

Don: That's correct.

Dr. Biology: You said it's 40 percent, so it seems like you're putting together like the ultimate jigsaw puzzle.

Don: It's an interesting puzzle because it's a puzzle that doesn't come with a box. It doesn't come with a complete picture so you have to know your anatomy very well. You have to know the shape of bones and how they fit together. In Lucy's case, every bones had had to be glued together again after 3.2 million years. Part of her skull had to be reconstructed and that takes a great deal of knowledge about the anatomy of these bones.

Dr. Biology: Did you get it right the first time?

Don: I think I got it pretty right. I think I got a 99 or something like that.

Dr. Biology: You got a 99? OK. When we think about early humans, we always have a tendency to think about what we think of humans today. The thing about Lucy is she wouldn't look like the typical human that we think of today at least in stature. She is not as tall as what we would think of as the typical adult human.

Don: Lucy was quite distinctive and different from us. The one thing that we recognize in all humans that I had mentioned was upright walking, walking on two legs. If our listeners think of every other mammal on the planet, they all walk on four legs, we're very peculiar and very unique. That's one of our defining features, walking upright. Lucy was an adult. We could tell that because her adult teeth had erupted or wisdom tooth, for example, so she had stopped growing.

She was only about three and a half feet tall, which is pretty short for an adult. Also, she had a very small brain -- a brain about the size of a modern chimpanzee. The other thing I think that would strike us if we saw her walking around the classroom would be the fact that she had a very projecting face like a chimpanzee, for example.

Dr. Biology: You say that Lucy was mostly an adult, any reasonable idea of how old she might have been or is that just way too hard to figure out?

Don: Well, if we look at a modern jaw like hers with the wisdom tooth erupted, she'd be about 18 years old, but some of my colleagues here at Arizona State University have looked at how teeth grow. We might not think of this but each day we lay down, a layer of enamel like a tree ring and they can count those rings and they can determine how fast they're laid down. Lucy probably died around 11 years old, as an adult.

Dr. Biology: Wow! That is different.

Don: That is very different from us.

Dr. Biology: It's also interesting, because when we talk about bones, when we talk about teeth, even though they have calcium, and they're very similar, they're not the same. Teeth are not bones. If you go up to our bone lab, for example, you can do an X-ray, a virtual X-ray of a human, and we have all the IDs, and we have the teeth in there. But whenever you click on the ID, they turn red, instead of blue, for the identification, just to remind everyone that teeth are not bones.

Don: They are the hardest substance in our body, enamel.

Dr. Biology: Was Lucy...Did she eat both plants and meat, or was she a carnivore, an omnivore?

Don: I think she was predominantly a vegetarian. I think she ate a lot of fruit that was abundant in the trees, and whether she ate much else, in terms of grass, or leaves, is hard to determine, but she undoubtedly ate wonderful things like termites, ants, bird's eggs.

There were fresh water crabs. There were turtle eggs, and crocodile eggs, found near where I discovered her, and I suppose the occasional lizard, or bird, that she could catch, she would eat. But she certainly wasn't a hunting carnivore, because she didn't make stone tools. This is pre stone tools, and she was predominantly a vegetarian.

I imagine a tasty crocodile egg, now and then, would be terrific.

Dr. Biology: You mentioned termites and other kinds of insects, very high in protein. Western diets, people can, they usually go, "Ugh," when they think about that, but a lot of other cultures in the world, that's really a mainstay of their diet.

Don: That's right.

Dr. Biology: When you're talking about what they would eat, what about the climate? What was the climate like when Lucy was walking around?

Don: The site is not far from the equator in Africa, in northeastern Ethiopia, so I imagine it was quite warm and sunny, from that perspective, but reconstructing the environment that other colleagues of mine here at the institute have worked on, suggest that it was more woodland, more wooded.

It wasn't a closed forest, like the Congo or something, but it was more wooded, and less grassy. Grasslands seemed to have developed much later, after Lucy.

Dr. Biology: Again, humans today, one of the things we're doing right now on the show is we're communicating. We're using language. When did humans start using language, and how do we know this?

Don: That's probably the most talked about question in anthropology, because it's another one of our defining features, because only humans communicate with this abstract, symbolic language. The only thing we can do is look at proxies, things we're able to do because we think in a symbolic way.

That would probably be rock art. The oldest rock art we have in Europe is probably close to 30,000 years in age. There are indications in southern Africa that engravings on pieces of soft rock, like ochre, might be as old as 70,000 or 80,000 years.

It's a fairly recent development. If Lucy lived 3.2 million years ago, and we didn't start speaking, in an abstract way, until maybe 100,000 years, that's a long gap.

Dr. Biology: That really is a long gap. We've used the word evolution here a few times, and this is one of those things where people incorrectly assume that human evolution shows we evolved from apes, when in fact, we evolved from a common ancestor. This isn't always easy to explain, but I think with your experience, maybe you can go ahead and give us the reason, and why we know that we come from a common ancestor, and why we haven't evolved from apes.

Don: Certainly we have evolved...I have to correct you and say that we probably did evolve from an ape-like creature that was what Darwin would have called the common ancestor to modern African apes and ourselves. He, way back in the 1800s, knew there were so many similarities, if you go to the zoo, and you look at chimpanzees, which are our closest living relative. You can see that there are lots of features that remind us of ourselves, particularly the same number of bones in the body, same number of teeth, the shape of many of those teeth, their behavior.

Jane Goodall, who studies the living chimpanzees, she sees that chimpanzees are not identical to us, of course, in behavior, but they do experience many emotions that we have. Of course, the most conclusive evidence we have is that our DNA, which really makes us who we are as individuals and species and so on, overlaps almost 99 percent with chimpanzees.

It means that there was a common ancestor that we postulate lived somewhere between six and eight million years ago in Eastern Africa. One lineage, some descendants evolved in chimpanzees and gorillas, and another lineage evolved into us.

Dr. Biology: Right, again the common ancestor. Well, you brought up DNA, how much we have in common, so there is this overlap and one of the questions I've always had is how do you choose the level of difference required to call them a different species? I mean, where do you get in there because it's kind of like splitting errors in some place, isn't it?

Don: Sometimes it's as you know defining what one specie is as compared to another specie is difficult because our modern biological development emphasizes the fact that members of a species can interbreed with one another and produce offspring. With fossils, we can't. What we have to do is look at a model like a chimpanzee and look at the range of variation. How big do the teeth get? How small do the teeth get? What is the range of variation in modern species that we know are species because they breed and produce baby chimpanzees?

We use that as a ruler to measure the coherency or the definition of a species. In the case of Lucy species which is a tongue twister, "Australopithecus afarensis." Australopithecus is actually a Latin and Greek means "southern ape," which is a bit of a misnomer and afarensis after the region where she was found. She has a great deal of variation within that species but it doesn't extend beyond the range of variation we see in modern species.

Dr. Biology: Have other important early human species has been found since Lucy?

Don: Yes. There is an immediate ancestor to Lucy which goes back to about 4.2 million years. There is another species back at 4.4 million and we're not sure if that's really on the tree that leads to us. There are some fossils that go back to about six million years but we don't know very much about them. We are getting closer to that common ancestor.

Dr. Biology: I want to go back to Lucy. A couple of things here and now, where are the bones of Lucy?

Don: I believe very strongly that we made these discoveries in a foreign country. We were a guest in Ethiopia. We were invited by the Ethiopian government and permitted to conduct this sort of research. Lucy and all of the other fossils, we've now have over 400 specimens of her species, all residing in the Ethiopian National Museum where they should. Scientist can go there and study these original specimens.

Dr. Biology: When I go over and visit the Institute of Human Origins, I get to see at least a cast of Lucy now, right?

Don: Exactly. We have made plaster replicas when the original bones where molded in rubber and then we made plaster casts. We have pretty accurate casts of those specimens in our labs.

Dr. Biology: Are there more than one of those around?

Don: Yes. I don't know how many there are but there are quite a number of them. There is one at the American Museum of Natural History in New York. There is one at the Smithsonian. There is one at the Field Museum in Chicago. There is one at the California Academy of Sciences. I believe there is one at the Science Center in Seattle and a number of other places for people to see.

Dr. Biology: One of the things that was intriguing to me because when I was doing some looking in to Lucy, one of the things I found is this first designation, "AL 288-1," but the name "Lucy" has its own neat little story.

Don: It does. AL means "Afar Locality." That was a 288 locality where we were collecting these bones. It was the first specimen we found at that locality. When we were celebrating her discovery in camp that evening under this beautiful African starry night, we were listening to a Beatles' tape and "Lucy in the Sky with Diamonds" was playing. Someone on the expedition, she said, "If you think the skeleton is a female, why don't you call her 'Lucy'?"

It really caught on. The next morning, we were out back looking for more of Lucy's skull, more of Lucy's arm and she's become a household word these days.

Dr. Biology: Do any of the Beatles know this story?

Don: I don't know. I've never met one of the Beatles.

Dr. Biology: I have a couple other side bits and these are just kind of like you say "Tomato" and I say "Tomato." Is it Neanderthal or Neanderthal?

Don: Well, we're Americans and we can say "the" and "think" and "kitchen sink" but if we were German, we would not be able to say "TH" sound. If you were speaking to a Native German speaker, he would not be able to make the difference between "sink" and "think." "I'm sinking" could be "I'm sinking in the water" or "I'm thinking in my mind." The real way to say it because it was originally named after a German valley, the Neander Valley, is Neanderthal.

Dr. Biology: Another one is hominid and hominin. Can we talk a little bit about those?

Don: Well, it's really how one classifies the relationships between the various primates. We are primates which includes humans, apes, monkeys and little funny things called "prosimians" like lemurs. Different people have their own classificatory schemes. Since we are so closely related to chimpanzees, they are sometimes called "hominids" meaning that they are sort of at a lower level in the classification when they're chimps, and we would be hominins but I still generally use the word "hominid."

As you know, Linnaeus came up with this classification and it's at the family level.

Dr. Biology: Right. It's actually a story we have on "Ask A Biologist" a nice piece about taxonomy.

Don: Yes.

Dr. Biology: Some people claim that humans are no longer evolving because we've removed a lot of the evolutionary pressures we used to have with modern medicine. What do you think about that?

Don: Well, certainly, culture and modern medicine are important buffer against natural influences but every time we have a union of an egg and a sperm, there is a new mixture of genes that's unique. Everybody is incredibly unique from one another. Evolution meaning "really change" continues to happen. We see some obvious examples like some mutations that have happened that have caused dramatic evolution in modern humans.

Some of the people who inherit a particular gene, they have a complete defense against malaria. Others who don't have those genes suffer from malaria and die. Evolution certainly is still going on in a way that is probably a little less natural selection and more artificial selection as we look at it.

Dr. Biology: On Ask A Biologist, one of the things we do is ask three questions of all our guest, so we're going to dive right in. When did you first know you wanted to be an anthropologist or if you really knew, you wanted to be a paleo...Anthropologist that's good too.

Don: Well I knew I wanted to be an anthropologist but I think when I knew that the word paleoanthropologist hadn't been coined yet. I was about 13-years-old and had access to a library of anthropology because of a mentor who was mentoring me when I was a young boy. My father died when I was two and I meet this man and he was an anthropologist and having the opportunity to peruse his library I was drawn to the section on biology. Because I loved to go out and collect salamanders and collect butterflies and watch the rabbits and try to identify plants and things like that.

I read a book which was called Mans Place In Nature and it was all about Darwin's ideal that we were closely related to the apes and that there was a common ancestor and that common ancestor would probably be found in Africa and that was a incredibly fascinating ideal to me. That we shared a evolutionary history with the modern African apes and the more I read about it, he pointed me to a number of other books and pictures of these early human ancestors the more interested I became.

I wanted to immolate him because he was an anthropologist who worked in Africa. Which is a very exciting place, captured by imagination and majored in anthropology as a undergraduate at the University of Illinois and for a PhD at the University of Chicago.

Dr. Biology: Very good, so we know why you wanted to become one but now I'm going to take it all away and I also know that you like to write which is very common. I'm going to take the writing away from you and any writing books and things like that. If you were not an anthropologist if you couldn't do that, What would you do and what would you be?

Don: Well, that is a difficult question. I was very good at chemistry and physics in high school and I actually started as a chemistry major. Chemistry did not continue to capture my imagination as an undergraduate but things like astronomy just blew my mind. I thought astronomy was just as interesting or even more interesting than anthropology and I think if I where to start it all over and do something else I wouldn't mind being an astronomer.

Dr. Biology: Oh, OK. That exploring of outer space...

Don: I had a telescope when I was 13-years-old with my newspaper money and went out at night and mapped the constellations and the craters on the moon and was very interested in astronomy.

Dr. Biology: You know its interested because I had one too. Actually mind I got when I was in sixth grade, it was mailed to me from my father was out of the country at the time and the post office was at least a mile away from the house or more and I went there not thinking about this. To get this giant box that I had to drag all the way home and I still have it to day and I still you it.

OK we know how you got to where you and we know what you might switch to if you had to. What advice would you have for a young anthropologist or perhaps someone who wants to move into the world of anthropology from their current job.

Don: Well, I have sort of a general bit of advice for, especially the younger people listening that it's really important the earlier you develop a great passion for something and I think that it's that side that's so important. I was so passionate about anthropology and had very few opportunities

to really get to Africa that I had to be proactive and go out and sell myself to an anthropologist. Clark Howl who was at the University of Chicago became my professor and toke me to African for the first time in 1970.

There's still ample opportunity for anthropologist to work in the field and especially in the laboratory. I think the best advice for someone who would like to be an anthropologist is take as much biology as you can. Study as much as you can about genetics'. Study as much as you can about how the body works and if you're going to do field work maybe even minor in something like geology.

Dr. Biology: When you were talking about you had your mentor, I wish there were more mentors around. So your mentor all the way through college or...

Don: My mentors name was Paul Laser and he was a German anthropologist. So I had to learn German as an undergraduate so I could talk to him. He spoke perfect English but it was wonderful to speak to him in his native language and he lived to see my discovery of Lucy. I brought it to him and showed him the actually skeleton and he lived until the late1980s so he saw a great deal of my career. And it was very rewarding for him to see that all the mentoring he had done had produced something as wonder as the fossils I found.

Dr. Biology: You talked a lot about Africa. It's like the place to be at least for the paleoanthropologist but do you have to go to Africa to do that or are there other places in the world that are hot spots as well?

Don: Well certainly Africa is where the earliest humans appeared. It's where the earliest upright walkers appeared, its where the oldest stone tools...Said about 2.6 million have been found. Its where we develop bodies like we have today, modern proportions. It's where the brain first grew big and it where we evolved as Homo sapiens, as supposedly thinking men. And we moved out of Africa in our present form probably about 50 to 60 thousand years ago and that is an event that is not thoroughly understood.

New discovers are being made particularly in the middle east but also in the far east as well as Europe and one can study in Europe, in the middle east, south east Asia. There are a number of other places and of course if you're interested in much more recent events.

An intriguing question that anthropologist and Archeologist talk about and debate is when did people first get into North America and we think that's probably around 18 thousand years about maybe as much as 25 thousand years ago. But there's still a great deal that can be don't right here in the United States.

Dr. Biology: Well Don thank you very much for visiting with me.

Don: Well thank you it's been a real pleasure.

Dr. Biology: You've been listing to Ask a Biologist and my guest has been Don Johanson a professor in the School of Human Evolution and Social Change and the founding director of the Institute of Human Origins. Those of you who might want to explore this topic further will want to visit the Becoming Human website that was developed by the Institute of Human Origins.

The address is becominghuman.org that all one word, becoming human. It's a great place to go explore they have some great interactive tools and you have a really neat documentary, I actually watch it periodically.

The Ask a Biologist podcast is produced on the campus of Arizona State University and is recorded in the grace roots studio, housed in the school of light sciences. Which is an academic unit of the Collage of Liberal Arts and Sciences and remember, even though our podcast is not broadcast live you can still send us your questions about biology using our companion website.

The address is askabiologist.asu.edu or you can just google the words "Ask A Biologist." I'm Dr. Biology...

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