The Evolution of the Earth and life
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Early Hominids

Welcome to the course, Evolution of the Earth and Life. Today we are going to talk about our own race, the human race.

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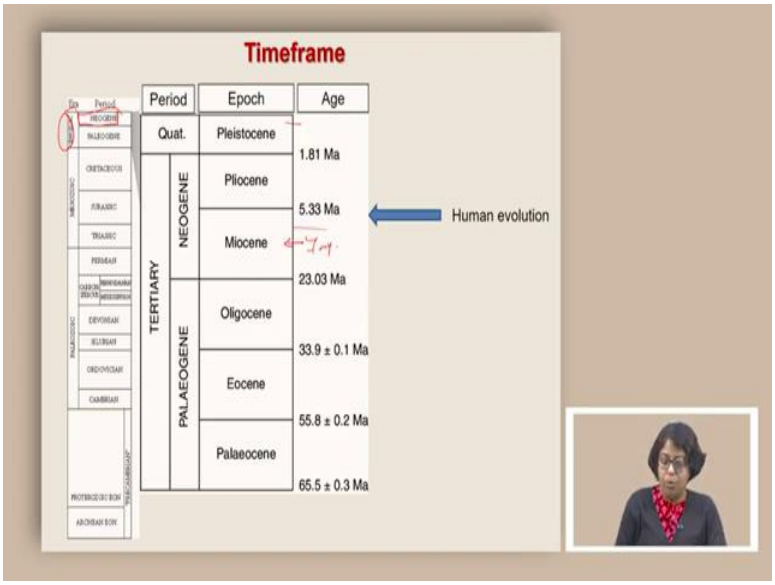

In terms of the timeline, we are going to focus on Cenozoic, and particularly in the period Neogene. So, when we look at the Neogene, we have Miocene and Pliocene. So, we are going to focus primarily around a time which is from mid Miocene to all the way towards the top of this timeframe. So around 7 million years ago, we started finding evidences of groups which are very closely related to our group.

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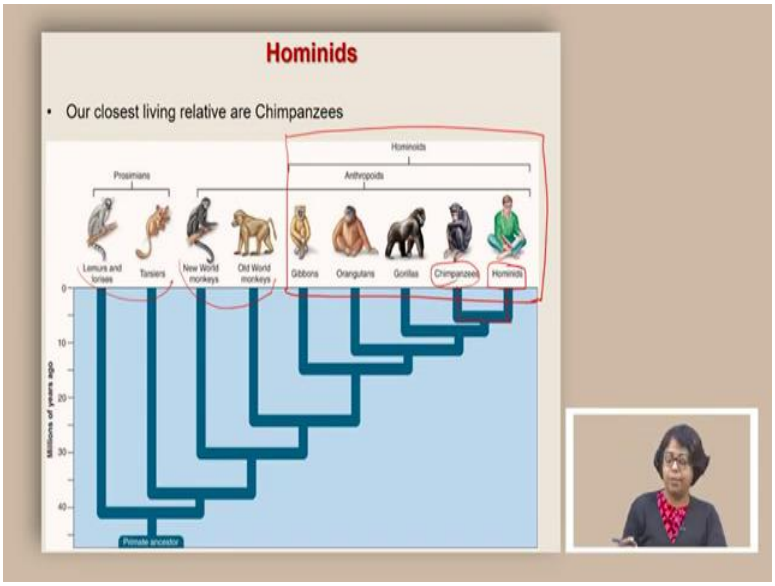

Now let us take a look at where we do we stand. So, these are primates that we are familiar with. Now there are different kinds of primates. There are these lemurs and lorises. These are in one end. On the other hand, there are monkeys, the new world monkey and the old world monkeys. But when we come to the right side of this plot, we start to see a bigger group called Hominoids.

And these Hominoids include gibbons, orangutangs, gorillas, chimpanzees and hominids. Now these are also called the apes, and these are somewhat similar in terms of what we do, how we do it. So there shows some sort of a similarity in terms of our shared ancestry. Our closest living relatives are chimpanzees. So, we basically share more than 90 percent of our genetic similarities with chimpanzee.

But we are quite distinct even though we share such a large amount of genetic similarity with chimpanzees. And it is worth questioning that where do we have this divergence? When do we start to have the record of our group called hominid diverging from the chimpanzees? And that is going to be a challenge.

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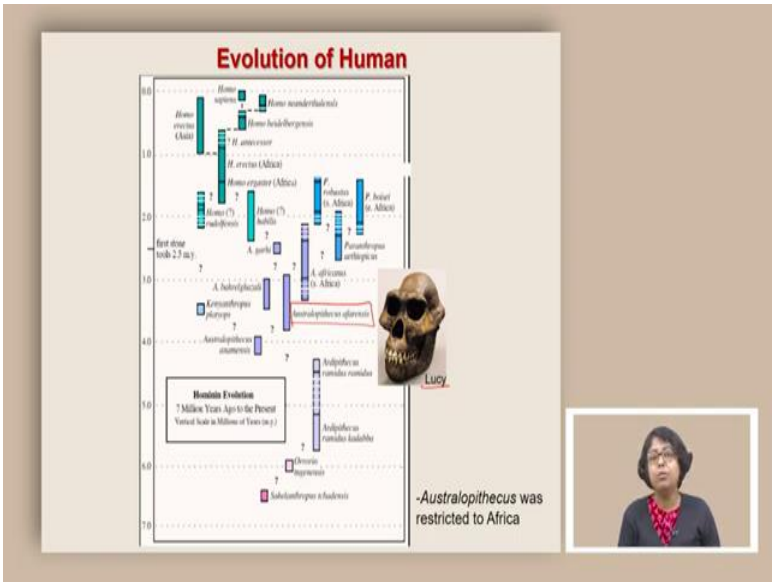

We understand that the first time the lightly footprints were discovered that demonstrates the appearance of bipedal organism. So, it was a hominoid, but it could walk by bipedally. But it is a trace fossil because it is only the footprints. We do not have the body fossils to go with it. The first time we started finding body fossil, and especially one where it is very clear that it can walk bipedally.

And it also has characters which makes it more human-like compared to the ape like ancestors is a time which is marked by this appearance of Australopithecus Afarensis and the particular fossil that was found as a representative of this is Lucy. Now let us try to look at the character that this particular fossil is showing.

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So, the name is Australopithecus Afarensis because it was discovered from a place called Afar in Africa. It is 3.2 million year old. It is pretty complete in terms of its fossils. Now it has a small brain. In fact, in terms of the cranial capacity, it is not very different from an average chimpanzee. It has a short height and it is obligated bipedal because you can look at the pelvic structure and it clearly shows that it cannot be an chimpanzee or an ape.

It walked bipedally and it was found from African rift, east African rift. Now again, it is not a human group in the sense that it still had some of the ape character. For example, if you look at this particular fossil called Lucy, which is the best representative of Australopithecus Afarensis, we will see that both in the fossil as well as the reconstruction, the arm is very long and such an arm we associate with ape character.

It is not common to find such a long arm in proportion to the leg to be found in human groups. And among the apes, this long arm helps them to grab tree branches and often to fend themselves. And it is not really useful when a group is no longer living in the trees or no longer doing the knuckle walking. But in Lucy we do find these long arm. The second important part is the long big toe.

So if you look at the reconstruction of Lucy, you will find that the big toe is coming out of the normal feet impression. So if you look at the normal human foot impression, you will see that it has this pattern and it has smaller digits and the big toe does not really come out of it. It has sort of a proportional parity with this. But if you look at a gorilla, what you will find that the

big toe actually comes out and it is quite distant from the other digits. And this is a typical ape character that we find in all groups of apes.

When we look at Lucy, it is somewhat in between, but it still has some of these part which is quite different from the modern human beings. So, it has this big toe long, big toe which represents an ape character. It also has a very small brain, as I mentioned, that its brain relative to its body size is not different from a chimpanzee's body size to brain ratio. But it is not a chimpanzee, it is not ape because it also has characters such as bipedalism.

Its skeletons clearly show that it does not really have the characters for knuckle walking, and that makes it a completely bipedal organism and therefore it actually has hominid characters and it also has broad pelvis. In fact, the shape of the pelvis is very different between the apes and the hominids. And we find the shape of the pelvis and the size of the pelvis to match more of a hominid character than the ape character.

So, it is definitely a transition between the earlier ancestors to a hominid group. And this is one of the best examples of a bipedally walking early ancestor of hominid.

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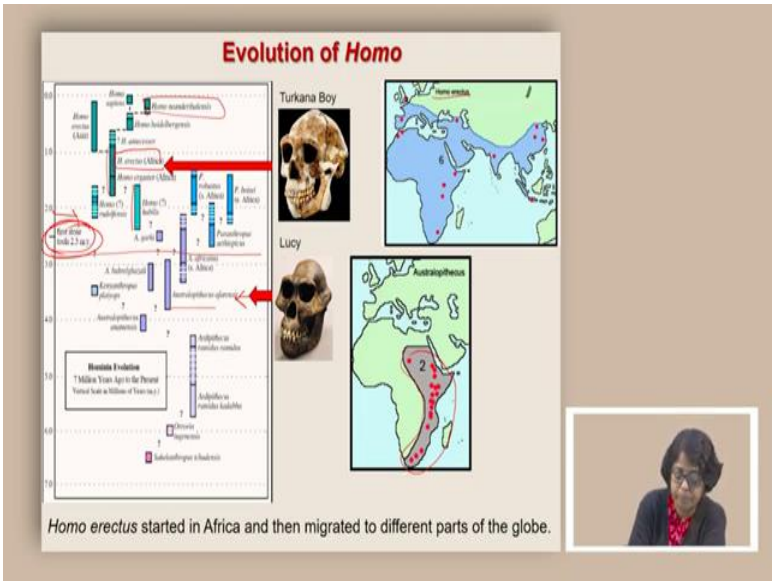

This is around 3.2 million years ago where we started finding Lucy. Once we go to the younger times, we started finding the group the genus where we belong to. So, our scientific assignment is homo sapiens sapien. Homo is the genus and sapien sapien is the species and subspecies now the first appearance of the genus we started to get around this time, which is close to 2 million years ago.

But interestingly, we actually start to find first stone tools from 2.5 million years. There was a time when everybody thought that tool using, any kind of tool using is a very human character. But later people realize that even gorillas or chimpanzees or certain types of monkeys can actually use tools.

Sometimes they can create their own tools by breaking a rock. But sometimes they can use the available tools such as for the monkeys they can pick up a straw and sometimes they put it in a termite, in an ant hill and let the ants stick to the straw and then take it out and eat it. This is a typical tool using behavior. However, they are not known to create very sharp objects or chisel the rocks to make quite effective tools.

So that is why these first stone tools are so important to indicate that the appearance of the first genus is also showing somewhat development in the behavior. Now, if we look at the very important homo species, we will have to think about this homo erects, homo habilis. These are all different homo species which are all living around the same time.

And one best example of this homo erectus is Turkana Boy because it was found from Turkana Basin in Africa. Now important question is where did they live in terms of the geography? So, as we mentioned that everything was to be found in Africa at the beginning, so Lucy or Australopithecus Afarensis we started to find various kinds of Australopithecus in different parts of Africa.

By the time we started to see around this time, by the time we are around 3 million years ago, we started to see a spread of these Australopithecus all the way around Africa, but it was primarily restricted within Africa. But when we talk about homo species, different types of homo species, especially homo erects, we started to find their fossils all over the globe.

We got them in different parts of Africa, in India, in far East in parts of the Arabian Peninsula as well as in Europe. These indicate that they definitely started to migrate in different parts of the globe. And homo is a genus. It has multiple species at that point of time, and many of these species were restricted in different parts of the world, but they all show this character, which clearly makes them part of this genus called homo.

We are only one species, but there were multiple species of homo that we see in the fossil record. Now the question is what were the other species and where did they go? Now, one

species which is very interesting is this Homo Neanderthalensis ands and we find majority of their fossil evidences from Europe.

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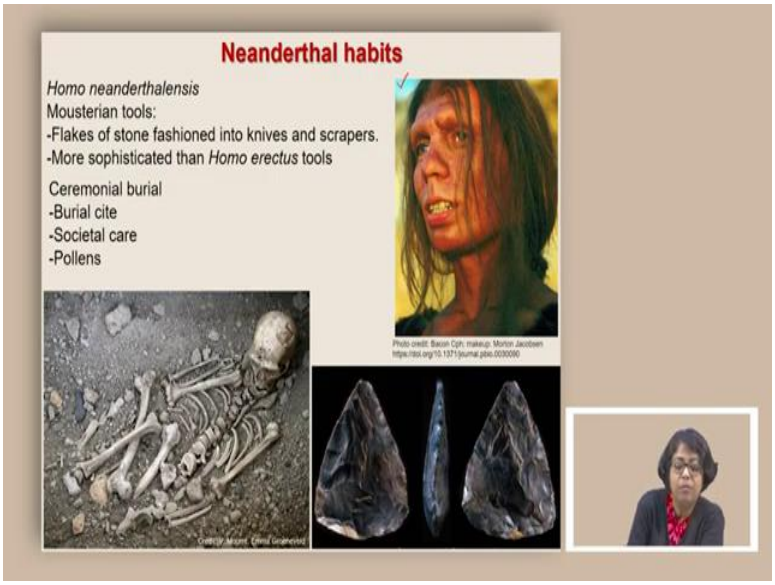

So, Homo Neanderthalensis was an interesting species because it often showed a larger cranial volume to say that if we go by the cranial volume, probably they were quite intelligent, probably more intelligent than the homo sapiens. They also shown development of tools and they have very specific tool making ability. So, they had flakes of stone fashioned into knives and other types of weapons more sophisticated than homo erectus tools.

So that clearly shows that they were quite advanced in making the tools. It is not only that they were also showing some other interesting behavioral component, which shows a pattern of culture, which was not there before in the other homo species, one of them comes from the burial sites of the and Neanderthals, it is preserved in France. So interesting points in the burial site was that often the skeletons show that they, the bones were fractured or bones were fractured and healed.

Now for specific such things where a person was injured and then it was later healed means that he needed to be taken care of. More importantly, many of the skeletons show death because of the old age. All of these indicates substantial injury where they cannot move, where they cannot really collect their own food, can survive till the old age. And therefore, there must have been there must have been some way of taking care of the old and injured in the society of the Neanderthals.

There were other interesting things too. In the burial sites people discovered lots of pollens and often these pollens correspond to flowers which are either fragrant or have a specific color. All of these are showing some development of culture ceremony, which are generally taken as the benchmark of human-like treats. This is a reconstruction of how Neanderthal woman might have looked like.

And the present day genetic analysis shows there are some component of Neanderthal DNA, even in the human population. Now the question is where did they go? Because we find a significant Neanderthal species record, fossil record in Europe. But after that it did not show anything. One idea was that they were attacked by homo sapiens and eventually killed them. The other argument was that probably it was not complete killing.

Part of it was yes, the homo sapiens killed a majority of the group, but some of them probably interbred and that is why they sort of mixed between the groups. But it is still awaiting the final data or final records to be resolved.

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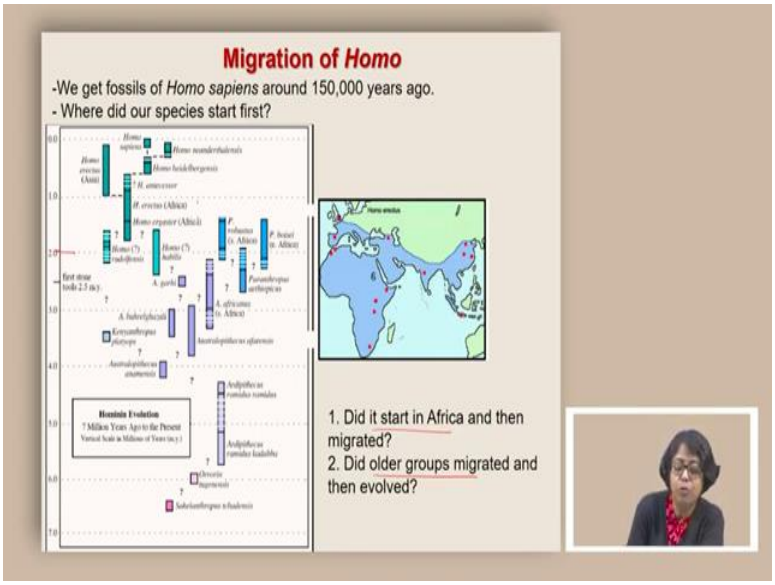

But one question remains that is that we find all kinds of species all the way from 2 million years to present day. There were these homo erects in Asia, homo heidelbergensis, then homo neanderthalensis, and then homo sapiens. Why do we have only homo sapiens today and where did it start first? So, we get fossils of homo sapiens around 150,000 years ago, and that is the first time we started finding the species of ours.

But the question is where did our species start first? As we know that the homo erects had a quite a bit of stretch. So, one argument was that maybe some of the older groups such as homo erects migrated and then evolved throughout, and it is an independent evolution which finally led to the development of homo sapiens.

The other argument is that probably homo sapiens started in Africa and then migrated, and for some reason they were successful in migrating overall and wiping out the existing homo species in the world over. And these are the two hypothesis which have been put forward.

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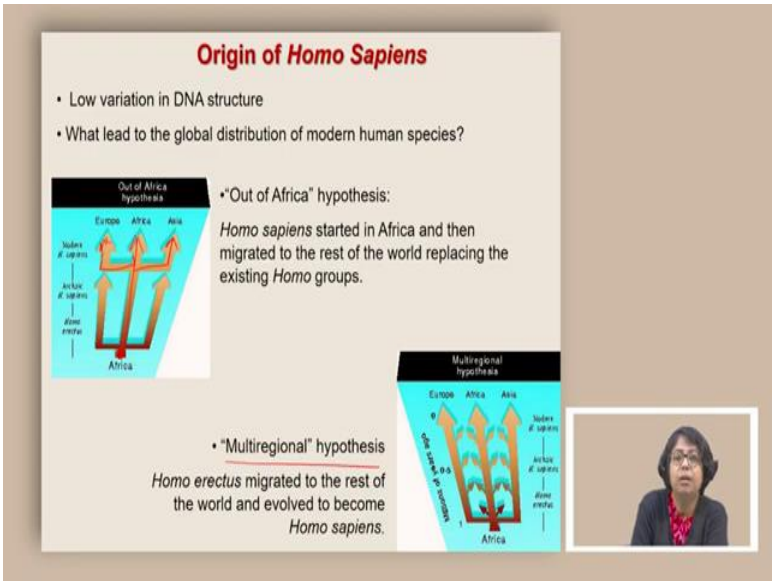

So, the multi-regional hypothesis is a relatively old hypothesis, which basically argues that homo erectus migrated to the rest of the world and evolved to become homo sapiens. On the other hand, out of Africa hypothesis argues that everything started from Africa, even homo sapiens started in Africa and then migrated two different parts of the world. And that is how we see them today in different parts of the world.

Now how do we resolve it? Well, in today's world, as part of the Human Genome Project, people have looked at the genetic structure of different human population from all over the world, and it shows a very low variation in DNA structure. And if it was a development of independent development of one species converting to another species in different parts of the world, probably we expect to see more variation in DNA structure.

The fact that we see such a low variation in DNA structure it indicates that there was an original population at some place where all of these groups can be tied down too. So, all the population that we see today on the earth can be connected to a single person in Africa, which lived 150,000 years ago. Now the question is why do not we find other groups, surviving other groups?

And one argument is probably species was successful in dominating over them and probably killing but it is again, not completely well resolved. As I mentioned for the Neanderthalensis, one argument is some of the Neanderthal population was also became part of the homo sapiens population through inbreeding.

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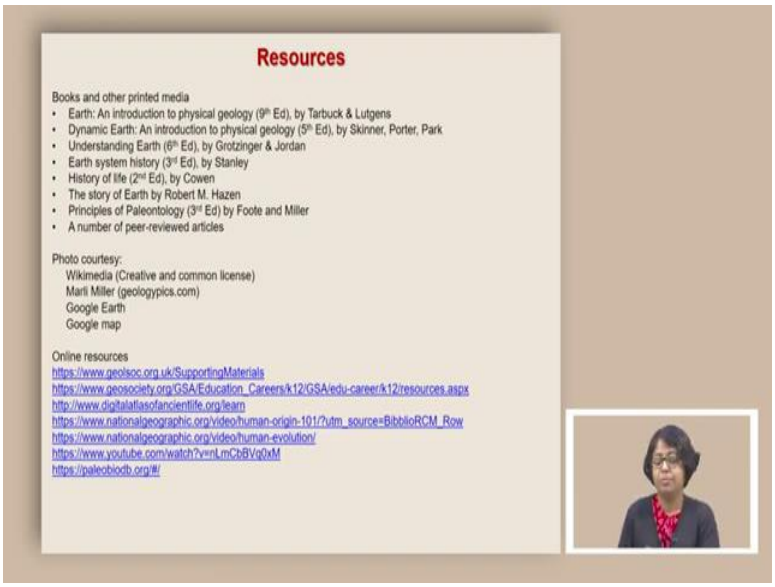

So, in today's class, we learned about the development of the first Australopithecus Afarensis where we see complete proof of body fossil, which can walk bipedally after that, and that is called Lucy. After that, we also see the development of our genus homo. There were multiple species of homo, which were spread across Africa as well as in Europe and Asia. But eventually we found only one species that survived throughout.

And that is homo sapiens. And in today's world, this amazing variety that we often observe is not really distinct genetically. So, if we look at the human population and look at their genetic variation, it is actually quite low, which indicates that all of us have evolved from a smaller group of population somewhere in Africa and therefore supports the out of Africa hypothesis.

Here are some of the resources that I use to create the slides. And here is a question for you to think about. Thank you.