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HOW DID OUR ANCESTORS EVOLVE?

David Christian introduces the science of **taxonomy** and explains some of the important methods used to identify and classify different species and several key human ancestors. We see how the extinction of the dinosaurs paved the way for **evolutionary radiation** and for **mammalian radiation**, in particular. This lecture also speaks to the similarities and differences between humans and our ancestral species, including hominids (great apes), hominines (bipedal ancestors), and several others on the path from primates to *Homo sapiens*. After watching these videos, you should be able to explain how **mass extinctions** make room for other species, how scientists classify different life forms, and how some of our early ancestors compare to humans today.

Key questions

1 What is taxonomy?

2 What are three types of evidence that help scientists understand the relationships between and across species?

3 What are three defining qualities of primates?

4 What physical adaptation distinguishes *Homo sapiens* from other primates?

Transcript: Part 1

0:11-1:02

ALL LIVING THINGS CAN BE TRACED BACK TO LUCA: THE LAST UNIVERSAL COMMON ANCESTOR

Here we are in Ewha Women's University in Seoul, Korea, and we're talking about human ancestors — the ancestors of you and me. Every living thing on Earth is descended from a single organism. Biologists call that organism **LUCA**, which stands for the "Last Universal Common Ancestor." LUCA probably lived about, almost 4 billion years ago.

What this means strangely is that you and bananas share an ancestor. Now, that ancestor probably lived about 1.5 billion years ago and was an early form of eukaryote, but you and chimps also share a common ancestor. That ancestor lived much closer to today, a mere 7 million years ago, which is just an eye blink in geological time.

1:02-1:25

TAXONOMY CLASSIFIES LIVING ORGANISMS

Taxonomy is the branch of biology that **classifies living organisms** by their relationships to each other. And what taxonomy does is create a huge sort of **tree of life**; systems of classification that show the relationships between all living organisms. Every species has a place on that tree of life, including us, ***Homo sapiens***.

1:25-2:11

FOSSILS TELL US WHAT OUR ANCESTORS WERE LIKE AND HOW THEY LIVED

RADIOMETRIC DATING HELPS DATE FOSSILS

DATE FOSSILS

There's a lot we don't know about our ancestors, but there's also a lot we do know. What we know is based mainly on **three types of evidence**. The first is the **fossil record**. Fossils can tell us a lot about what our ancestors looked like and how they changed over time, but fossils can also tell us a surprising amount about how they lived. For example, microscopic studies of teeth can tell us what they ate. Did they eat meat, or were they eating leaves or fruit, and that can tell us quite a lot about how they lived. Were they hunting for example? Or were they just foraging for leaves or just looking for fruit? We can also use **radiometric dating** techniques to date fossils so we know when a particular organism lived.

2:11-2:41

GENETIC DATING COMPARES THE DNA OF DIFFERENT SPECIES

The second type of evidence is **genetic dating**. It's based on comparing the DNA or the genes of different species. Since the 1960s, biologists have discovered that genes — a lot of genes — change quite randomly. Now what this means is that by comparing the genes of two species you can tell roughly when they shared a common ancestor. So we can use genetic dating techniques to check out the evidence we get from fossils about dates.

Now, a third type of evidence comes from **modern studies of primate societies**; particularly, the studies of great apes — of gorillas and chimps. We're very close genetically to the great apes, but it's quite probable that our ancestors evolved more rapidly and changed more from the great apes. So what this means is that by studying the societies — the social relationships of chimps and gorillas — we can learn a lot about how our ancestors probably lived. So those are the three crucial forms of evidence we use in studying our evolution.

2:41-3:18

WE STUDY PRIMATE SOCIETIES BECAUSE WE'RE SO CLOSELY RELATED TO THE GREAT APES

Transcript: Part 2

3:22–4:19

THE DINOSAUR EXTINCTION LEFT SPACE FOR RAPID EVOLUTION OF VARIOUS SPECIES

To study the history of our species let's begin by going back 65 million years to the time when the **dinosaurs** were wiped out. After a **mass extinction** event like this, evolution very often happens very, very fast indeed. This is because the surviving species tend to experiment with all the new niches that are left empty by the removal of other species.

MAMMALIAN RADIATION

Now, we know that something like this happened because within 10 million years of the disappearance of the dinosaurs we find a whole range of **new mammal species**. This is what biologists call an **evolutionary radiation**. We find grass eaters. We find insect eaters. Some of them apparently could fly like ancestral bats. We find that some mammals are moving back into the water like ancestral whales or dolphins. And we find tree dwellers, such as our ancestors the primates.

4:19–5:09

PRIMATES APPEAR AROUND THE TIME DINOSAURS BECAME EXTINCT

Primates live in trees. Now, if you've ever climbed trees you'll know the sort of skills you need to climb them without falling out. First, you need **hands** that can **grip** and if your feet can grip too, that's fantastic. Secondly, you need to be able to see in 3D. You need **stereoscopic vision** so that if you leap for a branch, you can find it. Now what this means is the eyes have to move around to the front of the face. So primates tend to have flattish faces.

Thirdly, you need **big brains**. This is partly to process all that visual information, but it's also partly because a lot of primates seem to have really liked fruit and fruit tend to be harder to find than leaves. The order of primates includes lemurs, monkeys, and apes.

GRIPPING HANDS, IMPROVED VISION, BIGGER BRAINS

5:09-6:07

GREAT APES, GORILLAS, CHIMPS, AND HUMANS ARE HOMINIDS

The apes are large, intelligent primates that belong to the **superfamily of hominoids**. Somewhat confusingly, there's a **family** called the **hominids**, which is smaller within the hominoid group. The hominids include the great apes: orangutans, gorillas, two species of chimps, and you and me. We're so similar to apes that even Linnaeus, the founder of modern taxonomy, reluctantly classified us humans with the great apes. Darwin agreed and modern genetic studies have shown that they were both right. If you compare the genes of **humans and chimps** you find that about **98 percent of those genes are identical** and that's why modern biologists are convinced that humans and chimps shared a common ancestor about 7 million years ago.

6:07-7:26

HOMININES = ANCESTORS WHO STARTED WALKING ON TWO FEET

Then our lineages split and our ancestors started walking on two legs. They became **bipedal**. We call them **hominines**. Now, frankly we're not really sure why they became bipedal. One possibility is that our ancestors lived in Eastern Africa, which was drier. So there were grassy savanna lands rather than forests. If you live in savanna lands then bipedalism is great. You can travel faster and further. You can also see further. You can see your enemies coming. And also, bipedalism freed the hands to manipulate stones or perhaps even throw them at an enemy. Can you think of any other possible reasons why our ancestors might have become bipedal?

Then, for 6 million years our hominine ancestors flourished. There may have been 30 or 40 different species at some periods, but today there's only one. Now, **after an evolutionary radiation** this sort of **winnowing of species** is fairly common as one species that can adapt better than the others becomes a sort of a standard model and the others die out. But it's also possible that our ancestors played a role in eliminating our evolutionary cousins.

HOMO SAPIENS ARE THE ONLY REMAINING HOMININES

7:26-8:02

LUCY WAS AN AUSTRALOPITHECINE, LIVING 4 TO 1 MILLION YEARS AGO

One group of species, or "genus" as the biologists call it, was the **Australopithecines** or southern apes. The Australopithecines flourished in Africa between about 4 million and 1 million years ago. Best known of all the Australopithecines is **Lucy**, an individual whose remains were found in 1974 in the Hadar Valley in Ethiopia by an American paleontologist, Dan Johanson. Lucy had a brain about the size of a chimp's brain and stood about three and a half feet tall.

8:02-8:51

HOMO HABILIS, MORE SIMILAR TO HUMANS, LIVED 2.5 TO 1.5 MILLION YEARS AGO AND MADE TOOLS

More similar to us is a species known as ***Homo habilis***, which flourished between about 2.5 and 1.5 million years ago. They had larger brains than the Australopithecines and they also **made stone tools**. The first remains of a *Homo habilis* were found by the son of the paleontologist, Louis Leakey in Olduvai Gorge in the Rift Valley in Africa.

HOMO IS THE LATIN WORD FOR HUMAN

Louis Leakey was absolutely convinced that a crucial, key component of being human was the ability to make tools. So he immediately thought "these are humans" and he classified them within the genus *Homo*, using the Latin word for human. Now, this is his way of saying they are really more or less us. Do you agree?

8:51-9:46

HOMO ERECTUS APPEARED 2 MILLION YEARS AGO AND LIVED UNTIL 30,000 YEARS AGO

Even more similar to us is another group of species known variously as ***Homo ergaster/erectus***. They first turn up almost 2 million years ago. They had larger brains than *Homo habilis*, and they were almost as tall as us, and they traveled. You can find the remains of some *Homo ergaster/erectus* in the suburbs of Beijing. They survived until about probably 30,000 years ago. So they lived for a long period of time.

WHILE *HOMO ERECTUS* LIVED A LONG TIME, BUT INNOVATION WAS LIMITED

Now, let's think about *Homo ergaster/erectus*, this group of species. They were very intelligent; brains almost as large as ours. They made beautiful stone tools and they traveled into a wide variety of niches; different environments, and yet their **stone tools hardly changed over a million years.** Now what do you think? Should we call them humans?