The Evolution of the Earth and life
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Dinosaurs Footprints

I will be talking a little bit about something about these trees fossils that I was talking about. So, I am sure that many of you are interested in dinosaurs.

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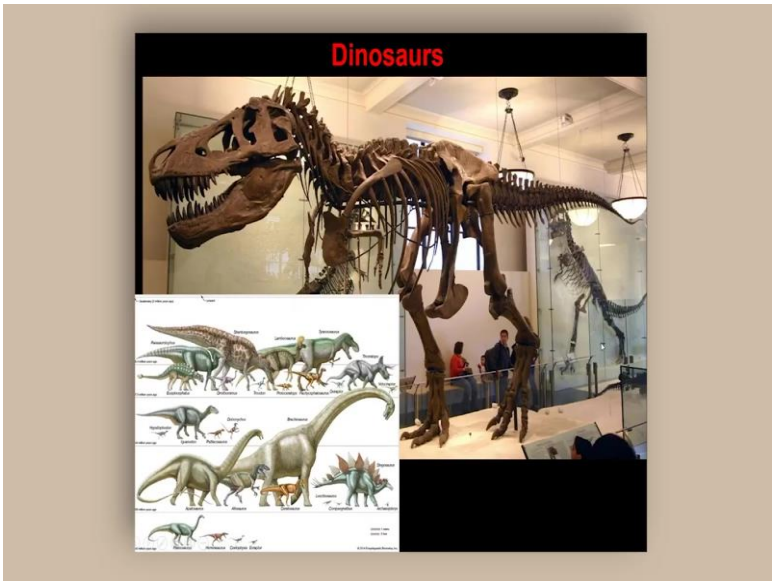

So, let us take a look at the picture. This is a skeleton of the dinosaur. And in the left hand panel, you can see the dinosaurs of different kinds. Now, we are so curious about dinosaurs. People are also interested, how did they move? How fast did the move? So, they started to look at their trackways.

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If you go to the next slide, you will find that there are many dinosaur trackways that you can find. The questions that people had using these trackways, is it possible to look at dinosaur speed? Or how do we do it?

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Now, to start this thing, first, we have to understand that when an organism moves, it leaves footprints. And if there are footprints, then the distance between footprints are pretty good indicator of how fast or how slow they are moving. So, I got a very nice video, which shows this in action.

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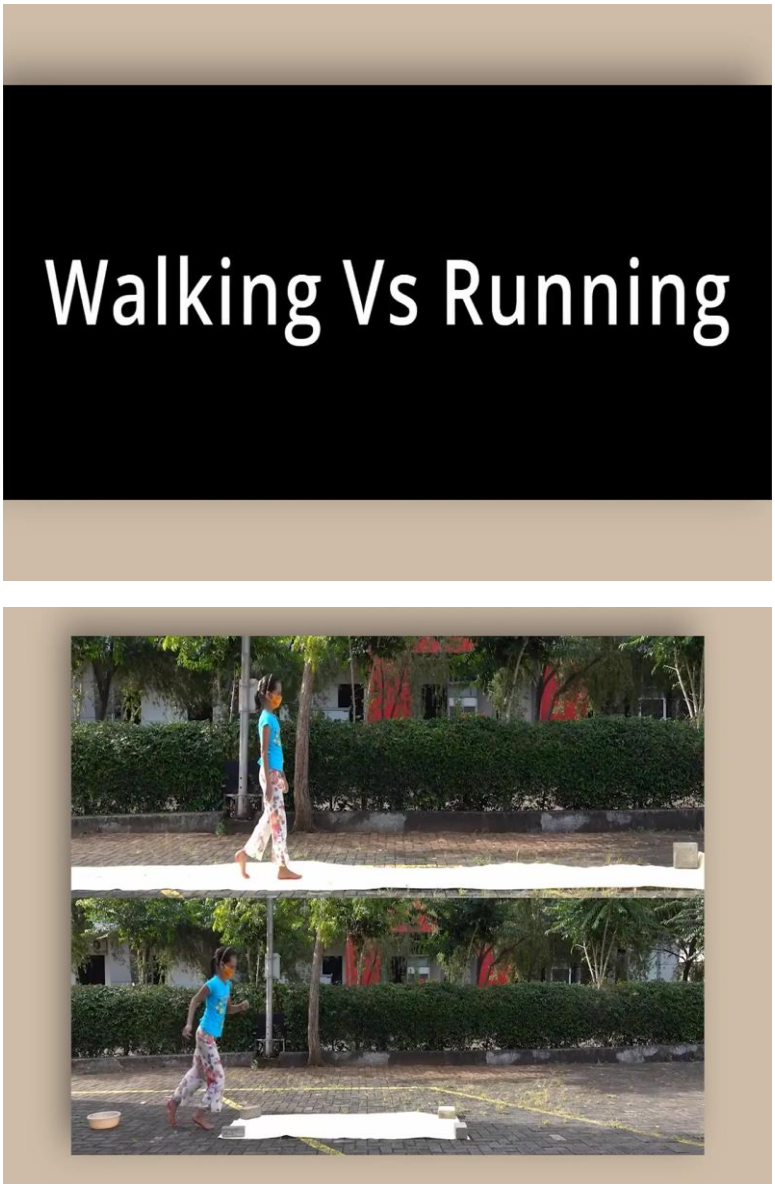

So, if you can play this video, you will see that there is a little girl walking and running. So, the top panel shows that she is walking, the bottom panel shows she is running, and we are looking at her footprints. So, let us take a look at her footprints, and how it differs when she walks versus when she runs.

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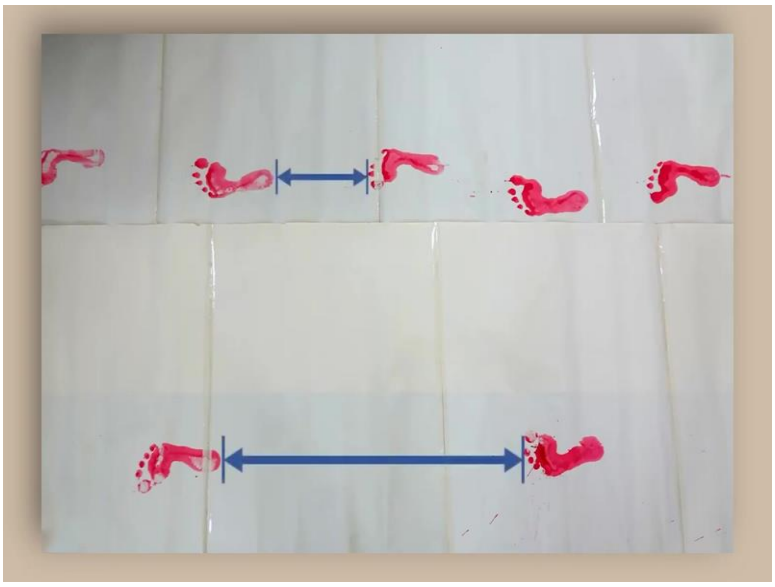

So, if you look at the top panel, you will find that the footprints are much close by when she is walking. But when she is running the footprint, the stride length, as we call it, is much bigger compared to when she is walking. And using this principle, we can actually try to understand how the dinosaurs moved.

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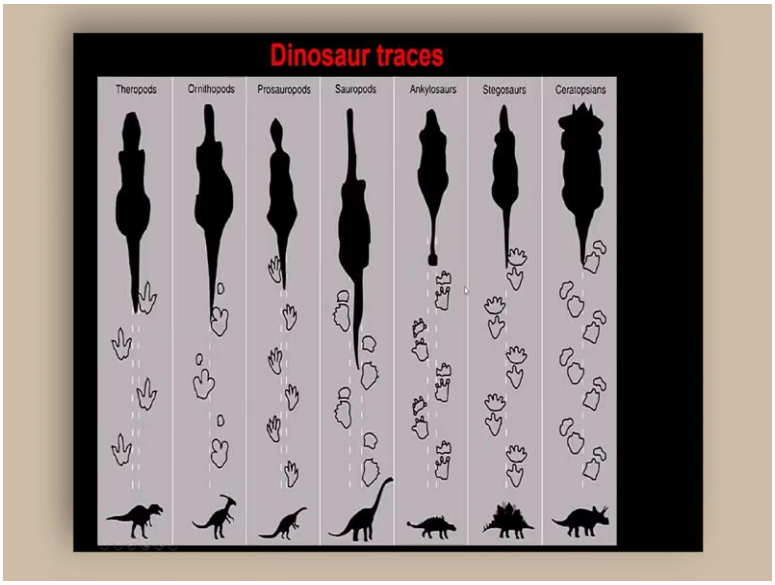

You will find that there are different kinds of dinosaurs, which leaves different kinds of footprints. Using that we move to the next slide.

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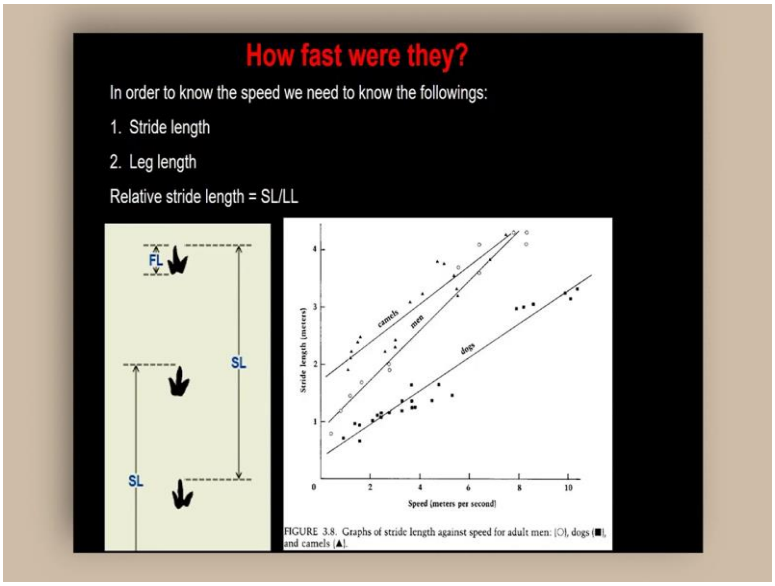

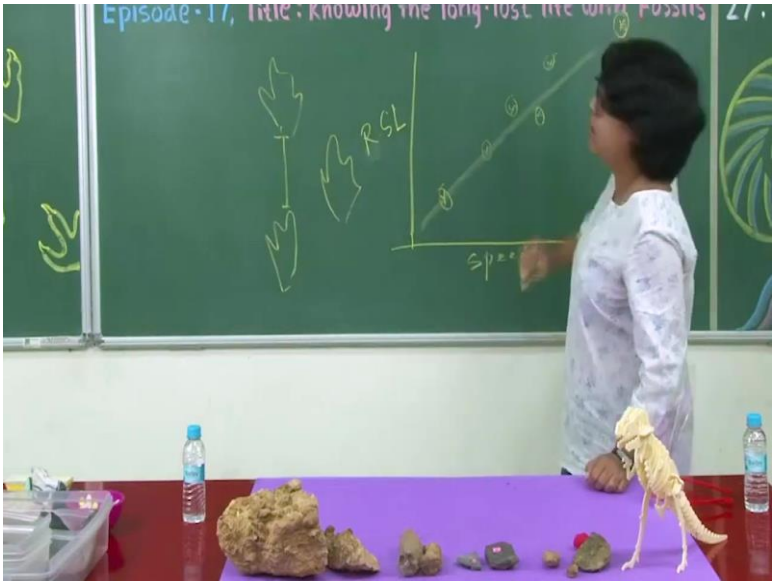

You will find that there is a stride length, which tells us something about in a dinosaur, whether it is walking or whether it is moving, or whether it is running. But because animals are very different, and they have different heights, we have to calculate what is the relative stride length, and that we do by dividing stride length by the leg length. Leg length can be calculated by looking at their foot impression. So, if we use the relative stride length, and if we look at the leg length, we can come up with a measure of relative speed.

So, let us say we are measuring all of these things. And we are calculating the speed the relative stride length, and we are measuring the speed every time an animal walks or runs. There is a general linear relationship. So, all it means every time I am looking at the relative stride length, from the footprints, and I am plopping it here along with the measured speed. And this is I am doing by looking at animals that are living today, all kinds of animals, some of them only run, some of them run intermittently. And some of them walk very slowly.

If I put all of them, it comes up like this relationship and we can probably draw a line through it. So, it is a linear relationship. And then next thing that we can do, we can try to calculate the relative stride length from the trackways of a dinosaur and eventually try to calculate what would be the speed. And as it turns out, if you just look at the relative stride length from the trackways of dinosaur, it actually closed somewhere here, which basically means it is a very, very high speed.

In fact, some of the trackways give you a speed of 12 meter per second, which is almost similar to Olympic medal winner in sprints.

Now the question is, did they run like this? Were they so fast? The only problem with this is we are calculating instantaneous speed. So, yes, there are some trackways, which are quite long, and it gives us some confidence at least, they could continue to run like this for some time, it still has to see the final scrutiny, whether they could run at that speed 12 meter per second for hours. If that is the case, probably we missed the animals which were the fastest. But just by looking at the very simple trackways and using the simple principle, we could come up with an idea of how fast and how slow they were.

In fact, when it comes to the relative speed, in other sense, when we are comparing different groups of dinosaurs, whether some of them are fast, or some of them are slow, we found a very nice relationship with the dinosaurs, which we know were carnivores, they were hunters, they were always faster. And the dinosaurs, which were big bodied, which were not hunters were slower. So, it sort of gives us a general sense that they were fast, and they were slow, although we have doubts in terms of the final number of how fast or how slow they were. I will end this talk with the final last bit of things that what else do we know from these trackways?

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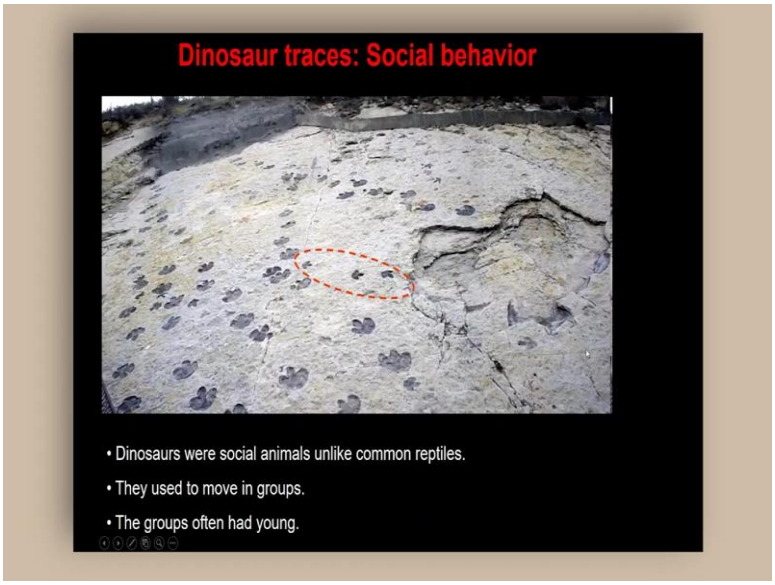

We will see that there are trackways. And now that you know that these trackways are built when somebody puts their weight and leaves this footprints on the mud, and then the mud quickly dries retaining the shape. So, if you walk after the mud has dried, it will not keep any impression. So, these trackways show that whatever trackways were made, they were made instantaneously or in other words, they went together when they were leaving these impressions.

And that tells us that these dinosaurs actually walked in groups, which is very unusual, because they are still part of the group that we call lizards. Generally, lizards are not found to be especially the land lizards, they are not found to be group people, I mean, animals, which love to be in a group. So, this was unusual.

The second unusual fact was that probably you have seen this red mark region, which shows smaller footprints. And this is not a single one. There are multiple such trackways where we found smaller footprints. Obviously, the smaller footprints have been related to smaller individual dinosaurs.

The interesting part is most of the trackways whenever there are smaller footprints, they are always in the middle, they are not at the sides. So, the conclusion or at least what we think is the most possible scenario is they were moving in groups. And when they were moving in groups, if there were smaller individuals the juveniles, the babies, they were always kept in the middle, not at the sides, the sides are guarded by larger dinosaurs.

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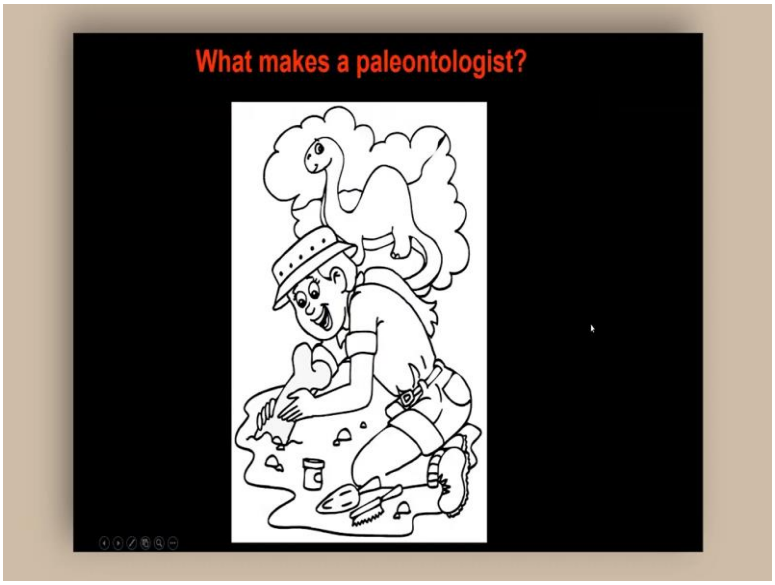

So, I hope that this session gave you a general sense of how we can conclude something about the long lost life using fossil record. And just to give you a sense that paleontologists are people who are interested in long lost life. And to become a paleontologist, you can have different trajectories. Some people specialize in biology and eventually become paleontologists. Some people study geology eventually become paleontologist. But I think one important part that you have to have is a love for the nature. You have to be curious and

you have to be observant, and you have to at the end, have to love what you are doing. And that is the science that you want to do.