Basics of Biology
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Lecture No. 01
Introduction to Living Organisms

Hello everybody. This is Doctor Vishal Trivedi from department of Biosciences and Bioengineering, IIT, Guwahati. And in the course Basics of Biology, we are going to discuss and understand the different properties of the living organisms and how you can be able to study the living organisms.

So, living organism could vary very, from a very tiny particles like viruses or it could be a very large organisms such as the dinosaurs. So, whether it is virus particles or whether the dinosaurs, both of these living organisms actually share some of the similar properties or also they have some of their exclusive properties as well.

So, as you can see that many the Corona virus is simply a virus which is actually causing the disease and it is also similar to the some of the previously known viruses and its mode of transmission is also the same that it goes from one person to another person through the coughing and other kinds of mode and, but, there are exclusive properties, there are exclusive properties, so that these viruses are actually causing the pathology within the humans and that pathology is causing the death of the individuals.

But scientists are trying to understand the biology of this particular virus and how they are doing it? They are actually doing the different types of experiments, then, they are collecting the data and then these datas are going to be interpreted and then they are trying to draw the conclusions from these experiments and that is how they are coming up with new and new hypothesis as well as the theories so that you can be able to overcome the pathological outcome of this particular viruses.

So, as you can see, that the understanding the living organisms and how a particular living organism is exhibiting its different biological activity is an easy task considering that you will actually going to plan a systematic study, you are going to do the systematic experiments, you are going to analyse those experiments and based on those conclusions, you can be able to draw, you could be able to design the new experiments.

So, purpose of this particular course is that we are trying to give you a glimpse of what is living organisms, what are different properties of living organisms and how this living

organism you know, how you can be able to study a particular living organisms utilizing the different types of tools and different types of ideas, what is available in the, in this particular stream of science. So, the first question, which I would like to ask, you is, so, what is science and what is its objectives?

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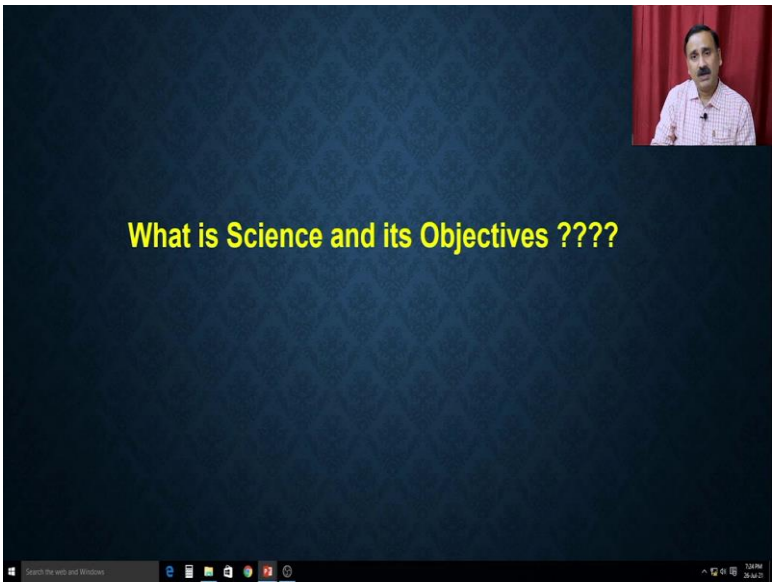

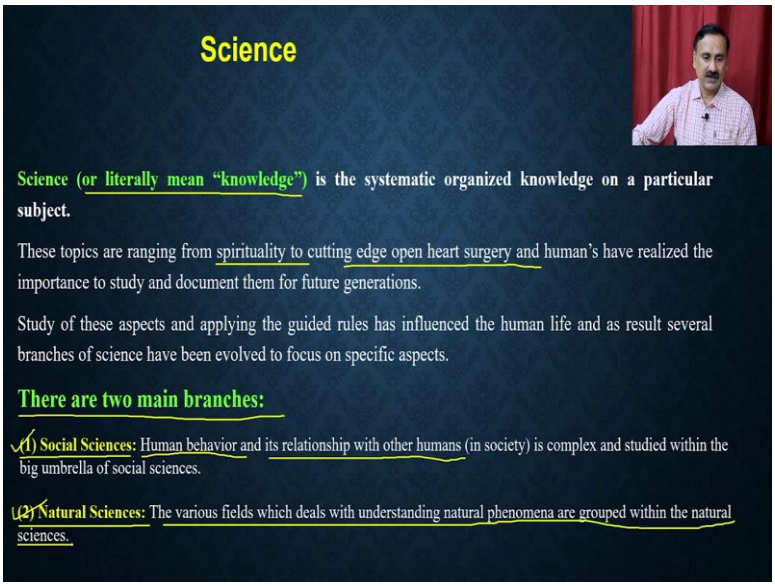

So, we start our lecture today with these particular questions that what is science and what is its objectives? So, science or is literally means, that you have the knowledge. So, science literally means that you are actually having a systematic arrangement of the knowledge and that knowledge can be interpreted that knowledge can be utilized for the human welfares or trying to understand the biology of that particular organisms.

So, these topics, which are being part of the under the big umbrella of science are ranging from the specialties to very cutting-edge open-heart surgeries, and all these comes not by a single day, but it comes by a systematic over progression, systematic analysis of the different types of experiments and the results.

So, because of that the humans have the, humans have decided that they will go with this kind of particular type of study and that is how they are actually trying to understand the different aspects whether it is something which is related to physiology or whether it is related to something else. So, because of that the science is further being divided into the two different main branches, these main branches are the social sciences and as well as the natural sciences.

You know that every living organism is actually remained in the within a society whether it is a jungle or whether it is a city like Guwahati, the living organisms are actually are under the continuous interaction with their neighbours, their environments and all other kinds of things. And so, because of that, the science is further being divided into two main branches.

One is called as a social sciences, so social sciences is actually the science which is actually going to deal with the human behaviours and its relationship with the other humans in a society and it is very complex in terms of the many aspects what we have been covered within the social sciences, and that is actually a very, very big field of science, where you can be able to study the many aspects related to the relationship of the humans with the other humans and as well as the relationship of the humans with the other non-biological factors, what is present within the society.

Apart from that, you have the natural sciences. So, within the natural sciences, you have the various fields, which deals with the understanding the natural phenomena and that are grouped within the natural sciences.

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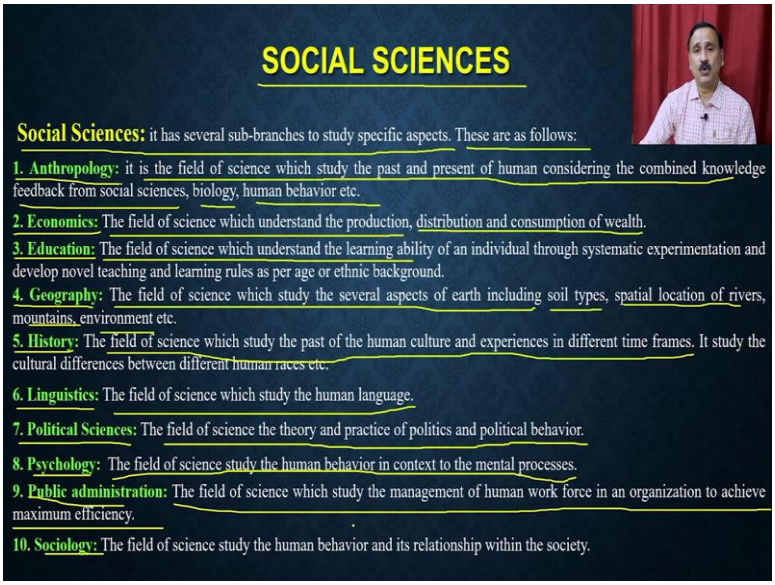

What you see here is that the social sciences, so, within the social sciences, you have the many sub branches which are being developed as the human were progressing within the society and how they are being utilized, because as you grow and as you in, generate more and more knowledge, you are actually developing the, you are trying to bifurcate so that you will be able to be able to focus on a particular topic and that is how the, that is how social sciences or the natural sciences are further being subdivided into the different fields to study a specific aspects of the particular branch of the science.

So, the social sciences, which are further been divided into the specific sub branches, these are as follows. So, you have the Anthropology, you have the Economics, you have Educations, you have Geography, you have History, and you have Linguistics, then you have Political Science, Psychology, Public administration and the Sociology.

So, these are not extensive exhaustive list of the fields or the sub branches that are being covered within the social sciences, it is possible that you may have some additional sub branches which are not being listed here, this is just to give you an idea that these are the different types of fields which are being evolved from a single science field, and then it is further divided into social sciences and natural sciences.

And within the social sciences, you have the these many different sub branches, for example, the Anthropology, it is the field of science, which study the past and the present of human considering that combined knowledge, feedback from the social sciences, the biology and the human behaviour. So, anthropology is actually going to discuss about the human behaviour

within the society and how the different types of knowledge feedback from the social sciences.

Then you have the Economics, this field of the science which actually understand the production, distribution and consumption of the wealth. Then you have the Education. So, these field of science is actually understanding the latest tools and techniques and it actually is going to develop the different fields, different tools, so that the learning experiences from a human could be better.

For example, we are conducting the MOOCs course. So, this MOOC courses, idea of the MOOC courses came from the people who were doing the study or research within the education field, and that is how they realized that it would be possible to go with the high-end knowledge to 1000s and millions and billions of students simply by if you go with the online courses.

Similarly, you have the geography. So, this field of the science which actually studied the several aspects of earth, including the soil type, special location of the rivers, mountain and environment. So, geography is actually going to help you in terms of the how the location of the different types of rivers are available. So, it actually going to help with the natural resources, how you can be able to exploit the natural resources and so on.

Then you have the History, the field of science, which actually studied the past of the human culture and experience in different frames. So, the history is very important for the social development of a human being, because the history actually tells us that what mistake you have made in the past and what experiences you have gained by doing this particular.

So, if you study if you listen the ancient stories and then if you understand that okay they have made this mistake, by doing, by following this particular thing, then why not we should not do that, because otherwise, we will also going to commit the similar kinds of mistakes. So, that kind of new information you get by studying the history.

Similarly, you have the Linguistics a field of science, which actually studied the human language. Then you have the Political Science, the Political Science is the field of science which the theory and practice of politics and political behaviour. So, that is a political science. Then you have the Psychology, the field of study, which studies human behaviour in context to the mental processes.

So, psychology is also a very, very important field where the physicians or doctors are trying to understand what kind of changes are happening within the mental illness or within your brain or the thinking process, and because of that, you are trying to develop different types of diseases.

You can even imagine that the people are going with the depressions and all other kinds of mental problems, and they are only, they so, they will be getting cured simply by changing their mood and changing the understanding the what is happening with the thinking process, and that is how they are being diagnosed with a particular disease and that is how they are at being cured by the doctors.

Then you have the public administrations. So, this field of science, which study the management of the human workforce in an organization to achieve the maximum efficiency and then you have the social, sociology and that field of science which actually study the human behaviour and its relation within the society. So, apart from the social sciences, you also have the natural sciences.

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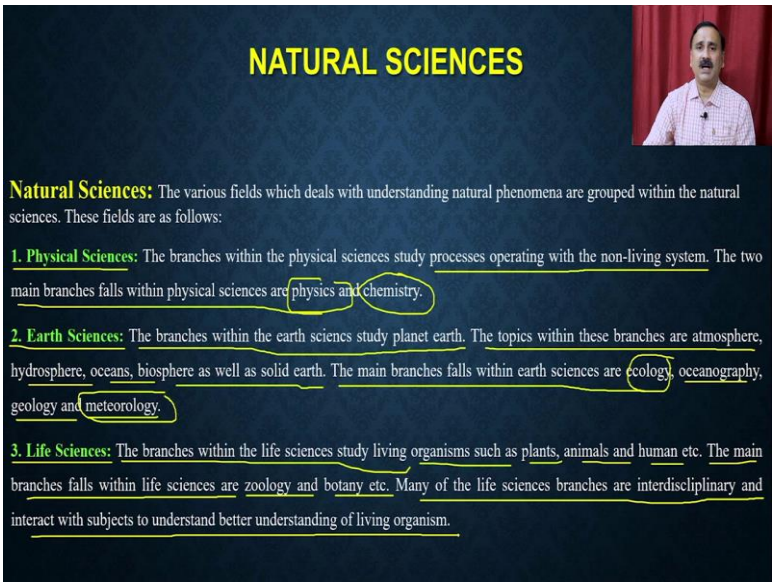

These natural sciences are as like just like as we discussed for the social sciences, the natural sciences are also being subdivided into the sub branches. These are the physical sciences, then you have the earth sciences, and then you have the life sciences. The branch within the physical sciences are actually studying the processes or which are operating within the non-living system. The two main branches fall within the physical sciences are the physics and the chemistry.

Now, the earth sciences the earth, the branch within the earth sciences study the planet earth. The topics within these branches are the atmosphere, hydrosphere, oceans, biosphere, as well as the solid earth. The main branches fall within the earth sciences are the ecology, then oceanography and geology and the meteorology.

Meteorology is the field of science, it is actually going to tell you what will be the weather tomorrow, whether there will be a thunderstorm, where there will be raining, whether they will be some hails are going to fall and how the weather is going to be for next one month or a couple of weeks. So, that you can be able to plan your different work or other kinds of things.

Similarly, you have the life sciences, the branch within the life sciences you study the living organisms, such as the plant, animals and humans. The main branches fall within the life sciences are the Geology and the Botany. Many of the life sciences branches are interdisciplinary and interact with the subject to understand the better understanding of the living organism.

So, the life sciences is a field of science, which actually study the living organisms. This which includes the plants, animals, and humans, viruses, bacteria, algae, fungi and all other kinds of living organisms, whether they you can be able to see them through the naked eye or not, or whether you can be able to utilize some tools to study them.

So, they are mainly been fall into two different categories, the Geology and Botany. So, the life sciences are actually dealing with the living organisms and life sciences are also been called as the Biology.

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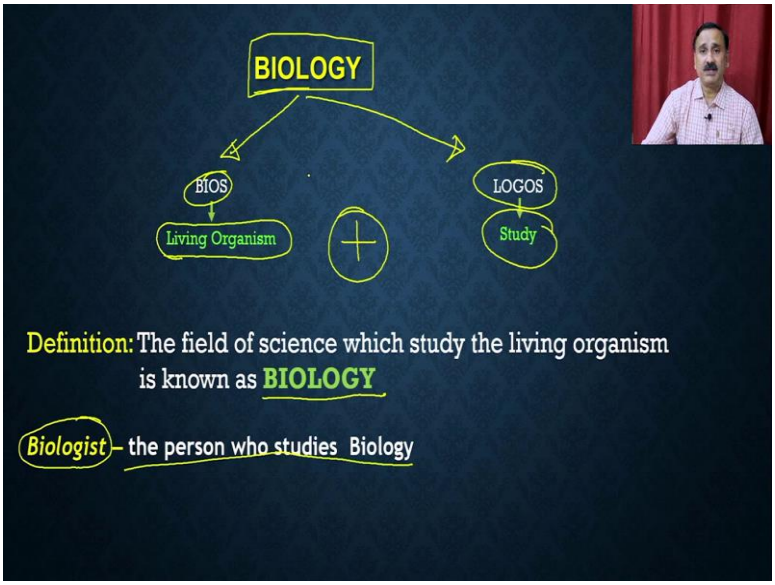

So, what is mean by the biology? Biology is the field of science which are being formed and so, if you see the biology, the biology is a term which is been made by the two names the 'BIOS' and the 'LOGOS'. So, what is mean by the BIOS? BIOS is called as the living organisms, which means and LOGOS means the study. So, biology is a field of science, which is actually going to study the living organism.

So, as the definition concern, the field of science which actually study the living organism is known as the biology and the person who study the biology if called as the biologist. So, before we getting into the detail of the biology and the different aspects, what are going to be we are going to cover in this particular course, let us understand some and introduce you to some of the biologists who have actually done the remarkable work.

And because of them, we could be able to reach to this stage where we can be able to do the gene manipulations, where we can be able to do the many types of molecular biology related experiments, cell Biology related experiments, where we could be able to generate the test tube babies, we could be able to even generate the artificial things and all that.

So, let us study the, let us realize the contribution of the some of the eminent biologists. This is not the exhaustive list, I have just taken few examples to give you an idea that how the eminent biologists have actually, paved the way so that you can be able to understand the different aspects of the biology.

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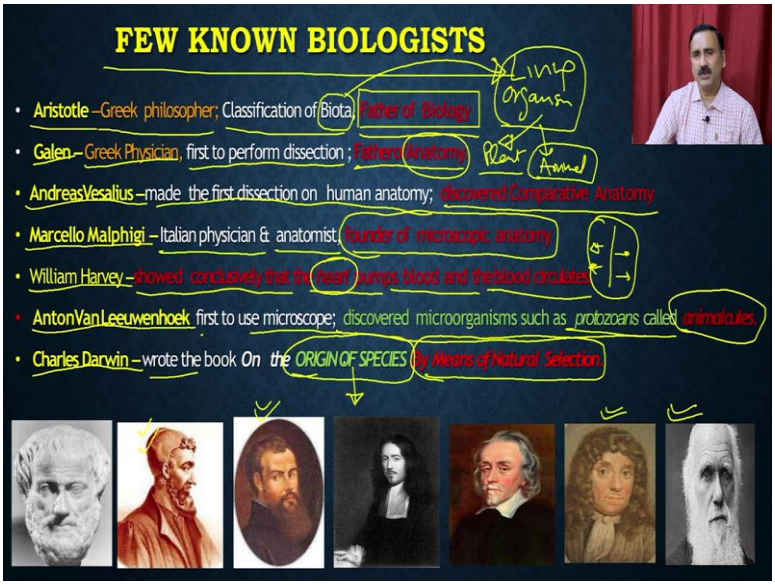

So, the biology started with a, so these are the few unknown, few known biologists where you have the Aristotle, Gallon and AndreasVesalius, then you have the Marcello Malphigi. Then you have William Harvey, then you have the AntonVanLeeuwenhoek, and the lastly, what we have is the Charles Darwin.

So, what you see here is the Aristotle. The Aristotle is also been called as the Father of Biology, because Aristotle was the first person or even or in general in we will say that he was the first scientist or the biologist who realized that there are many different types of living organisms present and that is how he has actually attempted the first time how we can be able to classify these living organisms.

So, he, so Aristotle was the Greek philosophers, and he actually put the first attempt, how you can be able to classify the biota. What is mean by the biota is the living organisms. Biota includes the living organisms of the that particular living organism, whether this that includes the plants or the animals. So, he has actually utilized that information and that is how he could be able to called as the Father of the Biology.

Then we have the Galen, so this is the picture of the Galen, and he was the Greek physicians, and he was the first to perform the dissection. So, he could be able to utilize, he would be able to, he has developed the tools and because of utilizing that tools, he could be able to perform the dissections, which means he could be able to cut the body of a particular animal, and he has shown the different types of organs, what are present in that particular animals and that so, he was called as the Father of Anatomy.

So, Anatomy is the field of science, which actually study the internal structures of the particular organisms, which means, it is actually going to say what are the different organs are present for example, in a human, we have the heart, the liver, the lungs, the pancreas, the all-different types of organs and these different types of organs have the different contribution in terms of the different aspects of the physiology.

Then we have the AndreasVesalius, so, this is the AndreasVesalius and he made the first dissection on the human anatomy, which means, he has actually done the anatomy of the human beings and that is how he could understand the what are different organs are present in the humans. And he discovered the comparative anatomy, which means, he actually discovered what are the different types of organs are present in humans compared to the other animals.

Then we have the Marcello Malphigi. So, it was, he was the Italian physicians and the anatomist. And he was actually the founder of microscopic and atomic which means he could be able to do the dissections visualizing the microscopic tools.

Then we have the William Harvey. So, William Harvey is also being considered as the Father of Cardiology, and he showed that conclusively that the heart actually is the organ which actually pumps the blood and the blood actually circulates within the human body and he has done the similar type of several types of experiments utilizing the tools and techniques whatever available at that point and then that is how he actually concluded that the heart is the main organ which is responsible for pumping the blood within the human body and this is the blood which actually circulates within the human body.

Then we have AntonVanLeeuwenhoek he is famous, because he has discovered the microscopes and utilizing its microscope, which was very crude and the very simple microscope, he could be able to discover the micro-organism. So, which was also he termed as the animalcules, which means animal like creatures, but they are very, very small, because in the, remember that in the ancient times, the people were (dis) understanding that the animal means a big, which was cat is a animal, but the lower organisms are not animals, like algae is not an animal or those kinds of things.

So, those things are being broken down, that kind of theory was broken down by the AntonVan Leeuwenhoek, because he utilizing the microscope, he could be able to see the micro-organism under the microscope and that is how he has discovered the protozoans and

these animals are, these particles whatever they were living organisms, moving living, tiny living organisms are being considered as animalcules.

Then we have finally we have the Charles Darwin. So, Charles Darwin is actually famous. So, this is the Charles Darwin. And this is the AntonVan Leeuwenhoek. So, the Charles Darwin actually did the several types of experiments with the very extensive expeditions to the around the world actually.

And that is how he actually drawn the conclusion that the evolution of the particular organism is happening because of the selection by the natural means, which means he was a big advocated or he was a big philosopher or he was actually favouring the idea that the whatever is modifications are happening within a particular living organism, that is because the living organism is being forced for going through those kinds of modifications, because he want to adjust themselves towards the change to natural conditions.

And here you, he has utilized the different types of models, he has taken the pigeons from the different parts of the world, he compared them that how the pigeons are, what are their feeding habits and all that and all these results are being presented into a book which is called as the original species.

So, when the Charles Darwin has written the book like original species, that year and the following years the original species was the best seller books, even the number of copies what are being sold by the, of the original species are more than the number of copies of the Bible on that particular year.

So, people were buying more and trying and they were very curious about understanding the evolutions, how the humans are being evolved, or how the other organisms are being evolved, what is the theory behind that and so on. And that is how the Charles Darwin was a very, very, very, influential person, trying to govern the evolution theories and so on.

So, this is all about the contribution of the few of the known biologist, I have as I said, these are not the extensive list, this is a just a simple example of showing you the different scientists and their contributions.

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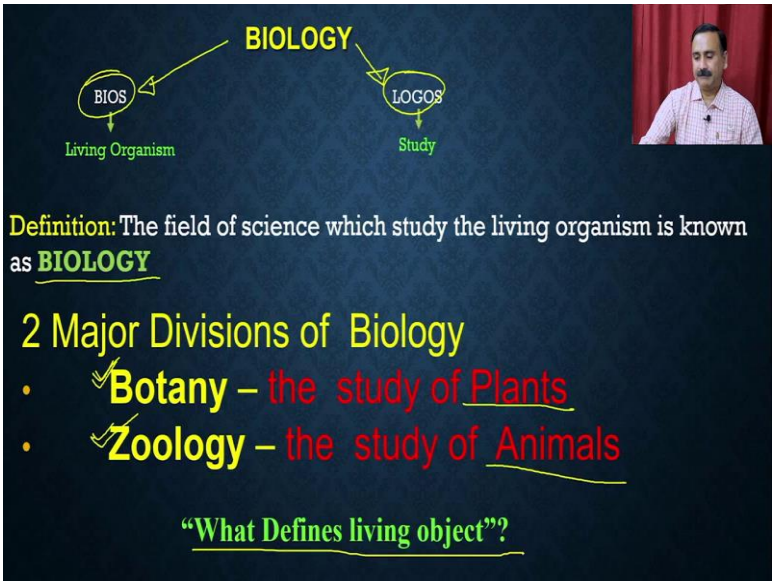

So, as the name suggests, the biology is a field of science, which actually study the two aspects of the biology. One is the BIOS, the other one is LOGOS. So, as the name suggests, the definition of the biology is that it is actually going to study the living organisms. So, if you want to study a living organism, a living organism could fall under the two categories, either it could be the study of the plants, or it could be the study of the animals.

So, if you fall under the plants, then you are actually going to use the subdivision which is called as the Botany or if it is under the animals, then you can actually be able to utilize that Geology. Now, before we get into these particular fields and try to understand the property of these particular living organisms, we have to ask the questions, what is mean by the living? What you, what defines a particular object as a living organisms?

Because until you do not define that, you, how you can be able to say that or how you can be able to study that particular living organism, can we say virus is a living organism? Can we say we know mobile is a living organism, can we say something like that, so, what parameters we should use to define that okay, this is a living organism and this is not a living organism.

Let us understand that by comparing the two models; one where we have taken a model of the diesel engine, and I have compared the properties of a diesel engine with a living organism such as the flowering plants.

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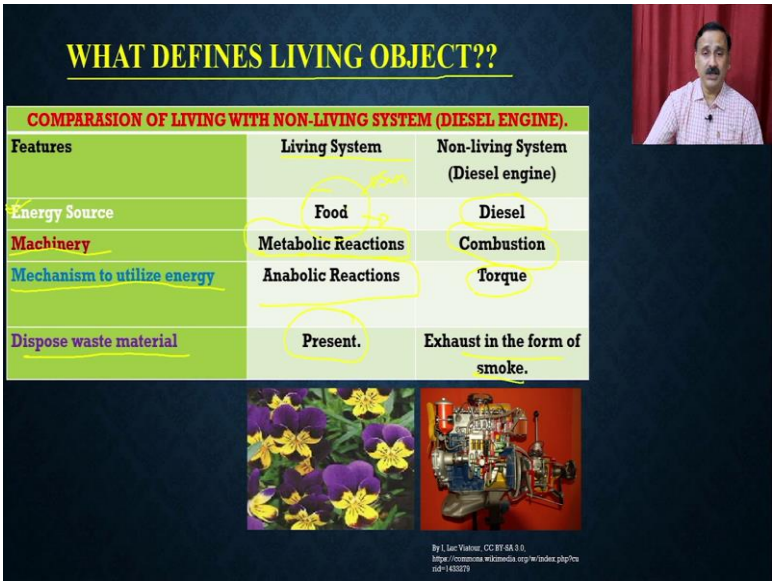

So, what defines the living organisms? So, you have I have given you a comparison of the different properties so, if it is a living organism, so, these are the different features what we can actually be able to use. So, in here you have a living system, so, we know that the plants have living system and then we have taken a non-living system. So, we know that the diesel engine is a non-living system. So, I have taken a diesel engine.

So, what will be the source of energy in terms of as far as the source of energy is concerned, the living systems are actually going to be defined on to the food. So, for example, in the case of plants, they are actually going to use the food from the sun, whereas, in the case of the other organisms, they are actually going to use the, they are going to use the plant as a food or as a source of energy.

Whereas, in the case of the diesel engine, it is actually going to use the diesel engine as the diesel as the energy source. Then you have the machinery for what kind of machinery is present. So, machinery is made up of the different types of metabolic reactions. If you do not understand any of these terminologies, you will be able to follow you once you follow this course, you will be able to understand these terminologies.

So, metabolic reactions, so, it actually going to utilize that particular food, then it will put it into the different types of metabolic reactions, these metabolic reactions are actually going to generate the energy and that energy is going to be utilized by that particular organism whereas, in the case of diesel engine, it is actually going to be the combustion which means the diesel is going to go into the engine and that is actually go through a process of combustion.

So, combustion is a process which actually is going to burn the diesel and that is how you are actually going to generate the energy. What will be the mechanism of utilizing the energy? So, utilization of the produced energy what you are going to generate within these metabolic reactions are going to be the anabolic reactions, which means, this energy is going to utilize for most of for the anabolic reactions, so, that you can be able to utilize that for driving the biological activities.

Whereas, in this case it is actually going to be a talk which is going to be generated by the combustions. What will be the disposal-based materials? So, because when you do the anabolic reactions, you are actually or the catabolic reactions, you are actually going to generate the metal waste material.

So, in both the cases it is actually going to generate the waste material. So, if the waste material is going to be present in the case of biological system, it is going to be a biodegradable waste material, whereas, in the case of the diesel engine, it is actually going to exhaust in the form of smoke.

So, you see, I have compared the two system; one is living system the other is a non-living system and as far as the features are concerned, both of these systems have the similar system or similar features. So, our question still remained the same what defines a living object? So, considering the properties of a living organisms, people have come up with different features which are definitely should be present in a living organism. Let us see, what are these features.

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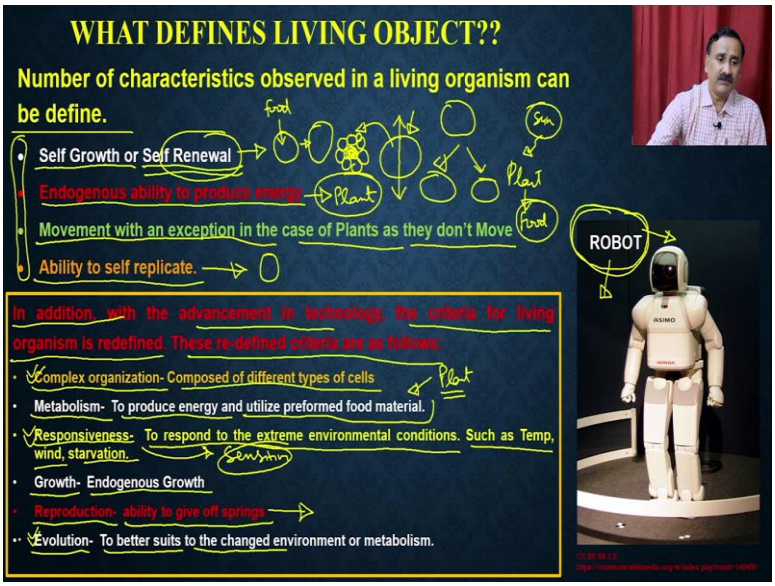

The number of characteristics is being observed in a living organism and it can be defined as, so one of the first system what is also should be very, very important is that the living organism is should have the self-growth and it should also have the self-renewal. What is mean by the self-growth is that you should, it should be a intrinsic growth rather than the extrinsic growth.

For example, if you take the dust particles, if you take a small dust particle, it may still, it may also grow, it may grow by taking another dust particle, and that is how it will actually grow all over the place, and that is how initially you are taken this dust particle, but now it becomes this big dust particle. But this is an extensive growth, you are actually adding the dust from outside.

Whereas in the case of living organisms, you are only giving, you are only going to provide the food and that food is actually going to, get converted into the energy, and that is how this living organism will actually grow in terms of the size, in terms of the other kinds of parameters.

Similarly, you have to have a self-renewal, which means, the living organism should be able to produce the replica of their same copies, which means the living organism, if you start with the one living organism, it should be able to get broken into and it will give you the two-living organism. This is going to be the again as I said, it is going to be an intrinsic it will be coming out of this particular thing.

Whereas in the case of the non-living systems, you finally have to provide some kind of external forces, because of that the dust particle might be get broken down, it may give you the multiple copies, but that will not be going to self-renewal, it will require the additional forces from outside, you might have to use a hammer, and then you might have to broke, bigger stone particle and that is how it is actually going to give you the tiny stone particles. But that is not considered to be a self-renewal, it is considered to be that you are providing a force from outside.

Then it should also have the endogenous ability to produce the energy, which means it should have its own self-sufficient machinery so that it could be able to produce the energy on its own, which means if you say, for example, if you take a plant, you just have to do what you have to do. If you have plant, what you have to do is you have to just provide the sunlight. And that is how the plant is actually able to going to produce the food.

So that is called as the endogenous ability to produce the energy, you cannot have the non-living organism to be performing these tasks because they require the exogenous energy force, for example, just we compared the, the living organism versus the diesel engine, and it is shown, that a diesel engine required a diesel from outside. So, you have to pour the diesel, whereas in this case, it is actually going to keep running the metabolic reactions, and that is how it is actually going to be able to produce the force.

Then, the living organism could also be having the moments, it could be able to move from one place to another place, definitely we have the exceptions. So, for example, we have an exception in the case of plants, because they do not move, there are plants, which also moves along the water streams, but the majority of the plants actually are stick to a particular place in the soil, and so they do not move.

But that does not mean that the plants are not living organism. Plants are definitely a living organism, because they actually follow some of these properties. And then they also should have the ability to self-replicate, which means the living organism should be able to produce the more copies of the similar kind.

Now, if you see that these properties or these parameters, so these parameters were actually been considered when the people have not discovered some of the, because there was no technological development. So, because of that, people have not discovered a non-living system such as the robot. So, you might have seen the robot and you might have seen the robots in the movies also.

So, robot is very much possible and very much could be able to perform some of these tasks. And because of that, the people have started rethinking and redefining their parameters and their criteria how we can be able to define the living organism. For example, the robots. Robots are, could be able to utilize and reassemble, reassemble the new robots and that is how they can be able to have the ability to not the self-replicate from the endogenous, but if you provide them the raw material, they could be able to produce more robots.

Similarly, they can be able to produce the energy because if you put the solar panels into the robots, they could be able to generate their own energy and they do not be dependent on the externally provided energy, which means they do not require any kind of diesel or electrical energies.

Similarly, the robots they can actually, so, so, that is because the people have started developing some of these complicated non-living organisms or non-living systems, the people have come up with another additional criteria, what will be defined the living organisms.

So, in addition, with the advancement in the technology, the criteria for the living organism are redefined. These redefine criteria are as follows. What is the redefine criteria? First criteria is that the living organism should have the complex organizations which means it should be composed of the different types of cells, which is not possible in the robot. Robots that only made up of the different types of electronic components.

So, complex organization, which means the living organism should be composed of the different types of cells, so you can have the cells for the heart cells, you can have the liver cell, you can have the lung cells, you can have spleen cells like that.

Then it should be having a metabolism, which means, it should be able to have to produce energy and utilize and perform which, it should be able to provide the energy and utilize the preformed food material, which means, it should have the metabolic reaction so, that you can be able to produce the energy and it can be able to utilize the preformed food material, which means, if it provides the food material from the plant, it can be able to utilize that.

It should be responsive, so, it should be able to respond to the extreme environmental conditions such as the temperature, wind and starvation. So, this is very, very important, which means the, it should be sensitive for the external factors it should be sensitive. See, you will see the robots, robots are not sensitive, even if you send the robot to the moon, where the temperature is going to be extremely cold, they do not, it does not matter to them, because they will be still able to work, they will be able to perform their tasks whereas, the humans are actually going to be susceptible for these kinds of (())(37:13) or even if you send a robots to a very, very hot conditions, then also it is going to work.

So, that is how, the responsiveness is a very, very important criteria for a living organism. You might have seen if you have the, you might have seen the movie ants in the in your home. As soon as you touch with the hands, they actually change their direction and they just move away. Similarly, you might have seen the many other things.

Then you also have another criteria, which is called as the growth. So, growth should be endogenous growth, it should not be the exogenous growth. I have given you an example of

the dust particle versus the other living organism. So, dust particles are actually going to have the exogenous growth. It should, it will capture the more dust particle, but then it is actually going to grow because of the exogenous growth. Whereas in the living organism, you are going to have the endogenous growth.

Similarly, it should have the reproduction. So, it should have the ability to give off the spring. So, this is a very, very important criteria for a living organism, it should be able to reproduce, it should be able to pass on its genetic material to the off springs and that is how it can be able to continue with the, within the world.

And then it should also have the ability to evolve, which means it should have to have the ability to better and better to keep it updated within the system. You might have seen that or you might have heard that the humans are being evolved from the monkey. And you might have seen the monkeys, they are very, very different from the humans. So, in a million years, people have started changing their food habits, their ability to learn and that is how they are actually being very, very diverged from the monkeys.

So, that is a very, very important thing that if you change environmental conditions, if you change some kind of hurdles, you will be actually able to change accordingly so that you will be able to overcome these problems and that is very, very important for a living organism because you can imagine that if you could not be able to change the because of the changing environmental conditions, then it will, you will not be able to succeed, then you will be get dead.

Because if suppose there will be a scarcity of water. And if there is a plant, which cannot adopt to this particular type of low water condition, then that plant is going to die and that is how it is actually will not be able to propagate, it will not be able to give the off springs and that is how that particular species is going to be vanished. So, the adaptation to the new change or the adaptation to the new environmental condition is very, very important phenomena of the living organisms.

So, these are the things what defines the living objects, and these are the things which we are going to study within this particular type of course actually. So, let us understand some of these properties.

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So, diversity and complexity in the biological system. So, diversity and the complexity in the biological system is a very, very important thing, which actually is very, very, which makes the biology very interesting. You might have you see, these are the different types of flowers, these are the different types of flowers are present in the northeast part of the India, like Assam, Meghalaya, Manipur and all those states.

So, these and you see that, so, much variety of the flowers are present and that is how there is a diversity and the complexity in the biological system. The complexity and the diversity are in terms of the different types of organisms, different types of organisms and different shapes. So, let us see, what are the different types of complexity is present in the biological system, so that you will understand that studying this particular type of organism is not an easy task.

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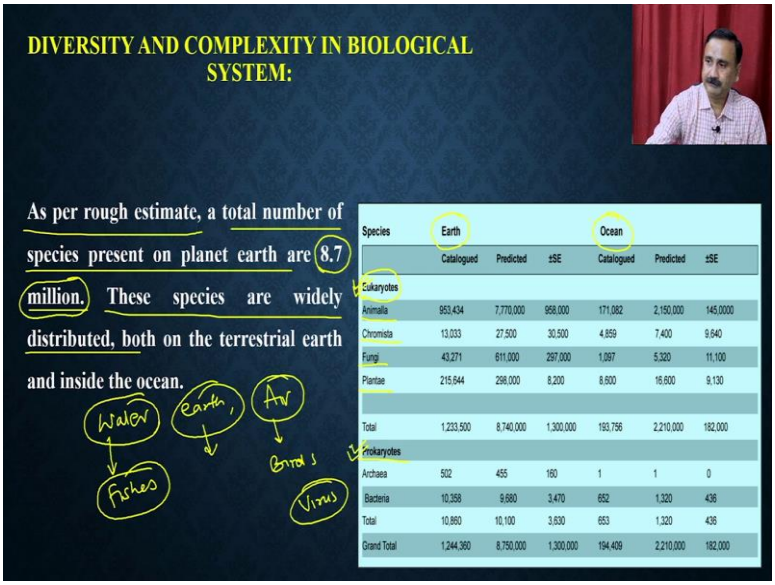

So, complexity in terms of so, as per the rough estimate, a total of a total species present on the planet earth are 8.7 million. These species are widely distributed both on the terrestrial earth and inside the oceans. So, you see the number of species what are present on the planet earth is 8.7 million and these are distributed on the all the three parts like they will be present in the water, so, they will present in the oceans, they will be present on the earth, and they are also present in the air.

So, within the air, you have the birds, within the earth you have all the terrestrial animals like dog, cat, buffalos, elephants and within the water you are actually going to have the fishes. So, you have the different types of fishes, and so on. So, you see here is the total number of earth so you have majorly you have the two different categories you have the eukaryotes and prokaryotes.

Do not worry about these terminologies because this is just an introductory class. So, I am just giving you the so, we are going to define all these terminologies in the subsequent lectures. So, eukaryotes, within the eukaryotes, you can have the animals, you can have the chromistas, you can have the fungi you can have the plantae. So, you will see the different types of species what present onto the surface or what is present within the oceans.

And you see the distributions in the animals, chromista, fungi or plantea they are distributed thoroughly from, on the both the locations. Similarly, you have the prokaryotes. So, prokaryotes are the lower organisms and they are also been the thoroughly distributed within the terrestrial animals or the oceans. What I have not considered is the viruses because or

even other organisms, smaller organisms. So, what I have taken is only the eukaryotes and prokaryotes.

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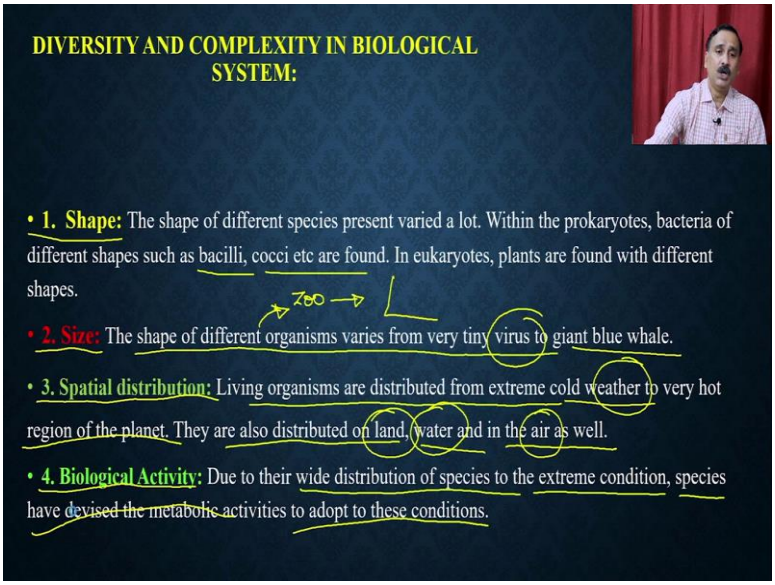

Now, what is the diversity? Diversity is in terms of shapes. The shape of the different organism present varied the lot. Within the prokaryotes bacteria of different shapes such as the bacilli, cocci, etcetera. In eukaryotes, the plants are found with different shapes. You might have seen the plants which are of very tiny like few millimetre plants or you can have you might have seen the trees very big trees.

Then you have the shape; the shape of the different organism varies from very tiny virus particles to a giant blue whale. If you go to any, this is very important. So, if you go to any zoo within India, you will see that zoo is actually having a museum where you are actually going to see that they are actually going to put all these living organisms on a display with a with a scale and if you see the scale, you will see that how the blue whale is almost like 30 to 35 times bigger than humans.

So, there if you see you will understand and then you will be able to appreciate that how the, how the different biological organisms are being actually varied in terms of size. Then you have the special distributions. So, living organisms are distributed from the extreme cold weather, you might have seen that polar bears which are present in a very very extreme cold conditions to very hot region of the planet, they are also distributed on land, water and in the air.

So, we have already discussed on the land you have the lions, you have the buffalo, you have the dog and cat. In the water, you have the different types of fishes like shark, dolphins and ornamental fishes and in the air, you may have the different types of birds. Then that apart from that the complexity also comes when they are talking about the biological activity.

But due to the wide distribution of the species to the extreme conditions, the species have devised the metabolic reactions to adopt these conditions and because of that, the biological activities are also going to be different. For example, the polar bear if it has to survive in those extreme cold conditions, it has to run its metabolic reaction in such a way so that it should actually be able to keep its body warm.

Similarly, you might have seen the fishes which are also been present in the lake but if the lake is completely frozen? You might have seen the, year I think we show me when the winter people show the video of the Dal Jheel. And that is very, you know, famous in every year I think the news reporters are actually showing the news of the Dal Jheel got frozen, that does not mean that the organism what are present in that particular lake is going to be died.

Because if there is a frozen thing, so what they do is they have adopted, they are actually going through the different types of biological, they have adopted the biological activity in such a way that they could be able to survive even in those extreme cold conditions or even the frozen conditions.

So, this is all where the you know, you have to appreciate and understand that the biology or the living organisms are very, very complex, they are actually complex in terms of the diversity and in their also complex in terms of their diversity. And because of that, it is easy to understand them if you understand the relationship between the different organisms, but it will also difficult in terms of that you cannot understand some of the unknown factors which might be governing that particular type of phenomena.

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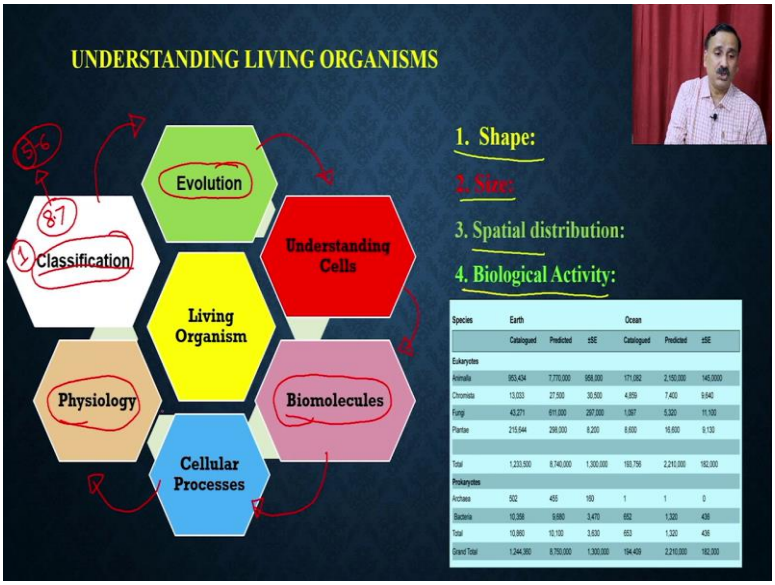

So, in this particular course, we are actually going to understand the living organisms. So, if you want to understand the living organisms, you have to understand the many aspects of the living organisms. As I said, the living organisms are very complex in terms of the shape, in terms of the size, in terms of the spatial distribution or in terms of the biological activity.

And that is how because they are so much diversified, it is impossible for a particular scientist to study all these you know, 8.7 million species organisms to be studied individually, and that is how you might have to categorize these animals. So, because of that, you might have to use the different types of organisms or different types of criteria. For example, first thing what you have to do is you have to classify these organisms, so that you can be able to understand the relationship between the different organisms.

So, if you classify them, the 8.7 million could actually be can categorized into 5 to 6 different bigger groups. So, if you study one group, you can be able to study the for example, 1 million animals or species. So, if you can classify them and if you group them, then you can just pick up one organism from that each group and you can just study that in detail and that is actually going to be a representative animal.

For example, if I want to study the, for example, the fishes. So, I can just take the one fish and I can just study all the different properties of that particular fish and that is actually more or less going to group for all the fishes what are present in that particular water. Once you study that, you can also study the evolution, because evolution is actually going to give you the relationship between these 8.7 million species of the living organisms.

Once you understand the evolutions then you can actually understand the different types of cells. As I said, the living organisms are complex in nature. So, they are actually be able to made up off of different types of cells. So, if you understand the cells, if you understand different types of cells, then you can be able to understand how this particular organism is made up of and you know that the cells are made up of the bio molecules.

You are, the cells are made up of the different types of bio molecules and these bio molecules, you can if you study the bio molecules, you can be able to understand how these cells are made up of what are the different types of metabolic reactions are happening, how the how these bio molecules are being utilized in the different types of metabolic reactions, and how the, these bio molecules are playing crucial roles.

Similarly, to that the biomolecules if you can also study, once you understand the properties of these biomolecules, you can be able to understand the cellular processes. And once you understand the cellular processes, you can be able to summarize these cellular processes and then you that is actually going to tell you about the physiology of that particular organism.

Because ultimately you want to understand the physiology of that particular organisms and what are, because for example, how we move, how we you know run from one place to another place or how the plants are actually synthesizing the food, these things if you want to understand you have to first understand the cells where the plants are actually performing these reactions.

Then, you have to understand mineral bio molecules like enzymes and all other kinds of proteins, lipids, which are participating in these reactions, and then you have to understand the cellular processes and when you integrate these all these information, you can be able to understand the physiology, you can be able to understand how the stomatas are opening within the plants and that is how they are actually taking the oxygen.

How we are breathing? So, if you say that breathing is a process, that breathing process, you cannot understand, until you understand the morphology of the lungs, until you understand the morphology of the ribs, until you understand the many such thing, until you do not understand the whole passage of the breathing process.

So, with this, I would like to conclude our lecture here. In a subsequent lecture, we are going to discuss each of these aspects individually and with this, we would like to integrate the whole stories or whole picture so that you will be able to understand the living organism in a

better way. We are also going to discuss what will be the advantage of understanding the living organisms, because what will be the advantage that also we are going to take. So, with this I would like to conclude my lecture here. Thank you.