

Human Physiology
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Week - 01
Lecture - 01

Hello everyone, I Dr. Sudip Mukherjee from School of Biomedical Engineering, IIT, BHU. I welcome all of you to the new course Human Physiology. So, this would be an exciting journey with all of you. Next 12 weeks, we will go through different topics and chapters of human physiology, and we will know how our human body works, what various types of diseases are, and what different types of drugs can work for our body. Overall I think it would be really exciting for all of you to know about our body.

So, to start with what is physiology? It is a study of normal functions in a living system. So, as a body, We explore a branch of biology that deals with the functions and activities of life or living matter such as like organs, tissues and cells and of physical and chemical phenomena involved. What are the aim of this? To understand basic mechanisms and processes behind the functions of living system. and how the cells, organs, organ systems work and how it is integrated at the organism level.

So, before we go in detail we must know what is the history of physiology right, because currently in case of modern physiology we know like about various diseases and drugs, but how about our ancient time. What were the pioneers of the physiology who discovered certain observations or therapies? Let us deep into it. So, as you can see that at 400 BCE Hippocrates the father of medicines who proposed the humoral theory of health. It is mostly with like knowing about the body fluids and by use of the body fluids to predict certain disease or our human conditions. Then, in the second century CE, Galen's influence theory came.

Galen is a Greek physician, he conducted animal dissections and described various bodily functions influencing medical thought for long duration. After that slowly around like in 17th century during the Renaissance William Hervey discovered blood circulation and the role of heart revolutionizing the understanding of the cardiovascular system. Following which around 19th century the Claudio Bernard introduced the concept of homeostasis. This is a very important component, we will discuss in detail in second or third class. So, homeostasis is very important that in our body always we try to maintain a balance.

Homeostasis is nothing, but like maintaining a balance and then around 20th to 21st century modern physiological concept came. The discovery of DNA, discovery of RNA and all other genetic materials, neurotransmitters, molecular biology advancement everything was slowly discovered. 1497 to 1558, a French physician who first introduced the term physiology from ancient Greek meaning which is study of nature origins. So, basically we discussed about Worldwide the discoveries of physiology, but we should not forget about our Indian ancient history, right because India was very rich in terms of like development in the field of physiology. We all know about our Ayurveda's right.

So, around 1500 BC to 1600 BC as you can see the first time the culture of Ayurveda came in practice and you can find lot of text. Like of course, these are ancient text, maybe not everything was properly documented, but whatever we can found you can see like in Charaka, Samhita and Sushruta in which lot of bodily functions and doshas like Vata, Pitta, Kapha these were

described. Then Sushruta who is often called like a father of surgery. He has performed some innovative surgery that back that days. It was like almost difficult to imagine now like how he has done those surgery, but he is one of the pioneer and call rightly called as like father of surgery.

Also apart from that he discovered the role of blood circulations and nerves. Following which around 8th to 12th century Unani medicines came that is mostly influenced by the Greek and Indian traditions. It integrated like physiological concepts of Ayurveda and Islamic medicine. Slowly once the colonial era started western influence came to our physiological concept also and the pioneer institutions like Calcutta Medical College and others started to work with the traditional knowledge in blend with like the western modern medicine. And currently there are lot of government organizations like ICMR and hospitals like AIIMs and all the IITs, NIPERS, IISERS, in the scientist level, in the doctor level, many people are contributing in various aspect of physiology, modern medicine and trying to explore to discover drugs that can cure different daily diseases like cancer, diabetes, neurodegenerative disorders, genetic disorders.

So, it has been a vast long journey. So let's start to explore about our body, right? Why physiology is so important? Why human physiology is so important? Till 20th century mostly we'll see there are a lot of scientific developments in the other domain like physics, chemistry, electronics, engineering. But somehow our human body related studies like biology, physiology, these are long neglected. But with growing concerns like environmental pollutions, increase in the rate of lot of diseases, our food and other habits like lot of different diseases are like causing a mayhem. So, we need to really understand about our human body, how every part function.

If we can know about those, then only we will be able to understand about various diseases. And if we can understand about various diseases, it would be easier for the scientists, for the medical students to discover life-changing therapies. So, let us see what are different components of our body. I promise you we will not leave any component of our body because it is all about us. So, starting from brain to like all our bones everything we will try to cover in this next 12 weeks.

So, as you can see that some of the very important component let us start for example, with our, brain is a very important component why because here you can find like the nervous system and nervous system as you know like it controls our emotions and also it kind of helps us in various other kind of stimulations and activity. Nervous system is so, so important. I always say like the most important organ of our body is brain and then you can see here, We will also discuss about heart and in general the cardiovascular system because heart plays a very important role for the blood circulation process and as you all know like blood carries oxygen, blood carries like various sort of nutrients. So, it is very crucial for our whole body that blood circulation happen in a right time. Then you can see we will discuss about lymphatic circulation or lymphatic system.

Lymphatic system along with blood plays a very important role about our body's immunity. So, as you know like kidney is very important organ for our body and it removes like all the toxic waste like creatinine, urea, ammonia because if the toxic waste builds up in our body, it will cause lot of damage. So, kidney is very important. And then we will also discuss about skeletal system right about like bones joints because it gives us like a structural framework a structural safety. And also we'll discuss about endocrine glands.

These are very important because a lot of important hormones that get secreted like for example, insulin which controls like the glucose regulation in our body gets secreted from pancreas. So, we'll discuss in thorough about endocrine glands. We'll discuss about respiratory system because as you know like without having the breathing will not stay alive. So, we have to continuously like breathe and oxygen will get consumed and after the cellular respiration carbon dioxide would be released and that also needs to be removed out from our body by help of by help of like respiratory systems controlled by the lung. We will discuss about Digestive systems is also very important because we consume food, it breaks down through our digestive system, the nutrients gets circulated to our cells and eventually it helps to produce like the ATP inside of mitochondria and the energy that requires to function all of our body and for that digestive system is so, so important.

One very important chapter we have to thoroughly discuss that is the reproductive system and of course, as you know like there would be differences of male and female. So, let us one by one little bit in detail we can see. So, first one as you can see is the respiratory system, which is mostly consisting of nose, trachea and lungs. Lung is the most important component. So, we will thoroughly discuss about lung and its functions, how the gas transport happens between the lungs and tissues that will be thoroughly discussed in the respiratory system classes.

Also, we will thoroughly discuss about mechanism of respiration and related disease and conditions that is very important to discuss. Further we will see how the system brings in oxygen and expels carbon dioxide and water. So, these all will be discussed in the respiratory system class. Then circulatory system as we said like blood is a very important component because it carries like all our oxygen, nutrients everything. And inside of the circulatory systems heart is the pivotal component.

So, we will discuss thoroughly about heart, heart anatomy, how it functions everything. Then we will discuss about various components of blood and functions. So, this is very crucial right, we will discuss about RBC, WBC right, we will discuss about various immune cells also like T cells, B cells. So, many component we will discuss about blood and also platelet. Platelet is very important for blood coagulation.

So, this would be covered and apart from that different diseases also will be covered related to the circulatory system. Then as I said like endocrine system is a very important component. the study of endocrine hormones that carry signals throughout the organism helping it in respond in concert. So, hormones are the very important component of our body because many of the human body functions are controlled by hormone. So, what are some common endocrine glands in our body like pituitary which is called like mother of all endocrine glands, then thyroid, adrenals, pancreas, pancreas this is very important right for insulin.

What insulin does? It regulates the glucose in our body. So, that is why insulin is very important, right. So, we will discuss later about parathyroid, gonads. So, all type of hormonal endocrine glands that play very important role in our body. We will discuss about their structure, their functions and their diseases also.

So, some of the glands for example, like pancreas, we will discuss about diabetes. Different classification of those diseases like type 1 diabetes, type 2 diabetes, the remedies, what are the modern medicines to tackle those diseases. So, everything would be in detail covered in the endocrine system chapter is very important component in our body and we will hope that you will enjoy that chapter particularly. Then digestive system is another important component as

we said like it helps in terms of movement of solids from the mouth to secretory organs, excretory organs and eventually the concept and conversion of the food to fuel like after consumption the food how the end product of energy happens. So, the whole thing would be thoroughly discussed during the digestive system.

It includes like lot of component in our body like pancreas, liver and then how we will discuss about like how the digestion of fats, protein and carbohydrate happens and different digestive diseases also. So, we will cover, we hope like the digestive system will give you a detail idea about it. And then immune system, immune system is a very important component right like along with our lymphatic system and blood circulation system our human immunity depends very much. So, as you know like the body's natural defense system is maintained by our by the WBCs, white blood cells, thymus and lymphatic system. So, everything will be thoroughly covered in the immune system chapters.

A complex array of receptor and molecule combine to protect the host from attacks of pathogen. Because our body is open to the environmental system as you know like there are several types of bacteria, virus always lingering around in with our body. So, if our body does not have the immune cells, it will break down very quickly, It will get affected by bacteria and virus attack and other type of microbes also. So, immune system is very important component. Our body has different type of immune cells like T cells, B cells, NK cells will come slowly in those chapter how these cells play important role to maintain the innate immunity, to maintain the adaptive immunity.

So, these are very important component and these are also part of modern discovery of physiology. So, slowly slowly from natural human anatomy to like modern discoveries will thoroughly cover. And as I said next chapter will discuss about urinary systems where the mostly excretion of toxic waste happen from our body which includes like kidneys, bladder, urethra, What is the role of urinary system, right? Basically, it removes anything which is toxic to our system or which is excess to our body. Like anything can be toxic depending on their dose, right? So, if we consume too much of water, that can cause lot of damage to our body. So, our body does not require any excess water.

So, as a whole the urinary system will remove the water from the blood the excess water in terms of like urine production which will further carry different type of waste. What are very common type of waste we know like ammonia. So, these are some common waste then creatinine this type of waste will be removed by the urinary system. We will discuss about physiology of urine formation also further we will discuss which is very important right about hemodialysis in case there are like some urinary disease where our kidney fails and it is important to kind of point out that we have two different kidneys right in both sides of our body. There might be a situation that both of our kidney will fail.

If only one get damaged, it may still be worked out to some extent of course, although like it would be compromised the overall general functions, but still we can live with one functional kidney. But if there is a significant damage to both of our kidneys, then we need the help of hemodialysis to purify our blood. so that all these toxic waste what has been mentioned can be removed. So, urinary systems will be very important component. The nervous system as I said that brain spinal cord brain is our most important organ in our body according to me.

So, we will thoroughly discuss about brain and spinal cord, peripheral nervous system, autonomic nervous system, and then we will see how like the senses, memory, emotions,

movement and thoughts are controlled. We will discuss in detail about the structure and functions of brain, spinal cord and neuron. Neurotransmission and neuromodulation this type of processes will be thoroughly covered. We will discuss about blood brain barrier, it is very important for our body to discuss about blood brain barrier because it controls movement of no unwanted molecules, it controls the diffusion of unwanted molecules. So, blood brain barrier if it wants it will only allow certain molecules to pass towards our brain, otherwise it will prevent the access of those molecule.

Then we will have to also discuss about neuronal injury, right. As we know like in case of significant neuronal injury, it is very difficult to cure. So, we have to see like what happens when neuronal injury happens and what are the situations when there is a chances of repair. Not all the cases can be repaired. So, we will discuss in detail that when it can be repaired, when it cannot be repaired.

We will discuss about neurohumoral transmission, reflex actions. We will discuss about astrocytes and various neurodegenerative disease like Alzheimer, and few genetic disorders also like amyotrophic lateral sclerosis. So everything would be thoroughly covered in the nervous system chapter. Then next is a skeletal system. You can see skeletal system consists of bones right bones are important component in muscles tendons ligaments cartilage various type of muscles and finally, like bone related diseases.

So, everything would be thoroughly covered during the skeletal system. Then these two are so important, right, like for a living entity, if our reproduction system do not work well, the natural way of living entity will not exist. So, we should very well know about our male reproduction system, female reproduction system. Under the female reproduction system, we will thoroughly discuss about the reproduction Then ovarian cycle, menstruation cycle, we will discuss about how the fertilization works, we will discuss about the pregnancy and contraception procedures. Finally, we should also discuss about various in terms of the reproductive health and other diseases and their cure.

In the male reproductive system, we will discuss about the male reproductive organs. We shall deep dive to know about spermatogenesis process and also discuss about reproductive health and diseases. So, as a whole in general reproductive system is very crucial and we will know in coming weeks how it works. So, I hope I could give you like a fair bit of idea about how the physiology works. and what are different component of physiological system in our body.

In next few classes, next 12 weeks, we will thoroughly discuss about each of those organ, we will thoroughly discuss about how everything functions, what are different type of diseases related to those organs and what can be probable therapies, right. our class today, there are some fun facts, like let's discuss some fun facts about physiology. This you may know, you may not know, but it would be interesting to know few of them, right. So, it is very important to kind of say that every human alive today started from a single cell, right.

That's so interesting. The next is like the brain itself cannot feel pain because it lacks a pain receptor. So, why our body can feel pains but our brain cannot because it doesn't have any pain receptor. It's important to know that laughter is beneficial for our heart because it release lot of end of endorphins and it improves our cardiovascular health. So, we should laugh all the time. try to remove our stress because our cardiovascular health is so important.

Then the masseter muscle which is used during the biting is one of the strongest muscle in the human body based on their size and weight. We have lot of strong muscles, muscles are very important, but masseter muscles are one of the very important strongest muscle in our body. Last few thing like our average human heart weights about 0.3 kg while you can compare the adult elephant heart it is almost it weighs like 30 kg. So, you can see the differences like elephant heart it weights almost like 100 times more than a human heart and then for a blue whale the heart weight is about like 180 kg.

So, you can understand the difference of course, like there is a weight difference between all those mentioned organism and then another important fun fact like in every year our heart pumps nearly almost like you can see like 26 lakhs liter of blood which is equivalent to an like Olympic size of swimming pool. So, you can understand like how much hard our heart had to do had to perform on a regular basis because unless it can pump out the blood in proper time it will not be able to give us the oxygen and nutrient supplement in right time. Then the last one is like many of you know like the skin is like the largest organ in our body right. It almost like accounts for like 15% of the total body weight. So, skin is very important because skin is the first barrier or the first protector in our body.

It prevents our body from getting immediate exposure from the dust, from various type of microbes. So, skin is very important component and it is the largest organ. and skin also helps to remove like various toxic waste like water, carbon dioxide and also it helps in the dissipation of the heat. So, I think you liked different type of fun facts. You can go through much more and hopefully like you will enjoy the physiology course in the next 12 weeks.

I really hope like you will be able to connect with my course and enjoy finally very important that you should refer. So, whatever my courses will give you the study materials and other slides. You should still go through different textbook if you have the access will mostly follow This one the first one which is the Guyton and Hall's textbooks of medial physiology 11th edition. If you have one or two older editions also it will work, but apart from that there are many other references you can follow.

I will also share some video links with you. You can go through read some those content and I will probably provide you all the references with my slides. So, nothing to worry you will be also given with all the study material. even after all the classes if you have some questions, we will do live sessions and you can also contact me by my email. So, I again welcome you to my course.

Thank you for registering to the course. I really hope that you will enjoy my course and next 12 weeks will be an exciting journey with all of you for this exciting part of the life system which is human physiology. Thank you.