

**Human Physiology**  
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**Week - 02**  
**Lecture - 02**

Hello welcome everyone to another brand new class of human physiology. So, in last few classes we discussed about like human anatomy, cells, various ion transport pathway, different diseases related to cellular disorders. From now on in next few classes, we will discuss about blood, what are the different components of blood, how the blood clot happens, some diseases of the blood related to blood, blood transfusion, blood prototyping. So, I hope you will enjoy our classes of blood. So, what are the contents of today's blood class? So, we will discuss like different components of blood, then what are different components mostly like as you know like red blood cells or erythrocytes, we will discuss little bit about hemoglobin. And then we will discuss about the leukocytes mostly like the white blood cells, then we will discuss about the platelets ok.

So, mostly like these three component these are like cellular components of the blood, blood also has non cellular components. So, we will see like how everything is related to the blood. So, before we start what is hematology? Hematology is a branch of science that is concerned with the study of the blood or related to like blood forming tissue and related disorder. So, what are in general blood component? Blood is generally like the fluidic part of our body and as you know like what blood does, blood carries like oxygen, glucose, nutrients.

So, it is very important component because without the blood proper circulation, our cells, our all the organs, tissues, they will not receive all these important components and there will be a situation that our cells will be deprived of those material causing hypoxia or cell death. What is general pH of the blood? If you remember pH is roughly like in balance pH right around 7.35 to 7.45. So, it is neither acidic or like basic, it is mostly like neutral in nature.

Blood temperature is little bit like slightly higher than our body temperature, but there is not significant difference of course. So, what are composition of blood? As I said blood has both non-cellular component and cellular component. So, in the non-cellular component which is mostly like the fluidic part it is called as the plasma and 55 percent of the blood is made of this plasma and what are different component of plasma you can see like water, various important like ions right like electrolytic ions like sodium, chloride, potassium. It also can have some proteins to it. So, these are made of like about 55 percent of the blood which is called the plasma and this part does not have any cellular component and then the remaining 45 percent roughly actually like around 44 to like 45 percent of the blood contains like the cellular component and what are those cellular component we discussed right like RBC, erythrocytes, WBC, and around 1 percent of the blood is made of like platelet.

So, platelet number or volume is very low in compared to like plasma part or like the mainly the RBC part. So, we will see now one by one all their different components and their function. To start with we will discuss about the erythrocyte or the red blood cell. So, by the structure you can see this is like a bi-conclave kind of structure and for this cell this is I think one of the only cell this does not have any nucleus you see like there is no nucleus present this is a

nucleated cell. And that means, this type of RBC cell does not contain any genetic information of our body.

Is not it interesting? So, what is the main function of blood cell or the RBC? This basically RBC has like a protein component which is the hemoglobin right and hemoglobin gets bind to the oxygen, we know like how many oxygen one hemoglobin can bind with, almost like 4 oxygen and it basically delivers or supplies the oxygen in a direct transport procedure. And then this RBC cells are like quite high in number. So, you can see like almost per liter of blood 2.5 into 10 to the power 9, per liter of number of RBCs are present in our blood and compared to the white blood cells it out numbers the WBC almost like 1000 is to 1. So, WBCs are much like lesser in number.

Then the very important component of the RBC is the hemoglobin. So, this is basically a heme component of the protein and of course, it is bound with the iron molecule inside of that protein chain. And if you remember like each hemoglobin molecule can transport about 4 oxygen, right. So, in our respiration class we will discuss further in detail how the oxygen transport happens, but at this point if you can remember that hemoglobin has like 4 kind of pocket or the residue like 2 alpha, and then 2 beta residue and each of these residue can bind with one oxygen molecule. So, as a whole hemoglobin can bind to almost like 4 oxygen molecule and it can deliver 4 oxygen at a time.

So, how much hemoglobin is present in our body like in terms of men and female you can see like for men almost per like liter you can see around 13 like per milliliter you can see like 13.2 to about 16.6 gram. In cases of women you can see it is little bit less around 11.

6 to 15. So what happens in cases of anemia if you think in cases of anemia basically this RBC concentration or the hemoglobin concentration basically drops. both RBC and the hemoglobin concentration drops and this becomes more or less like almost like 6 to 8 gram per deciliter and in this cases because the hemoglobin and RBC concentration becomes lower they cannot carry ample of oxygen to the various tissues and cells and body becomes deprived of oxygen and we kind of experience like a shortness of breathing, we experience like lethargy, dizziness, right. So, anemia is a serious condition, we will further discuss in the disease class. So, what is basically in general function of the blood? Blood like does like the gas transport rate, it carries the oxygen to the cells and when after the cellular respiration cells removes the carbon dioxide, it also carries the carbon dioxide and it like kind of put the carbon dioxide near to the lung for the lung to again respire away. And then what are other type of functions blood also delivers like various nutritional substance, glucose.

Glucose is very important component because without the glucose our cells will not be able to do a glycolysis or the energy production. Blood also helps more like water balance because if our body contains more or less water it can cause lot of issue either dehydration or in cases of more water content it can also cause like edema type of condition. So, with blood our water regulation also happens apart from that in terms of heat balance like blood also helps to kind of take away the heat from one local area and it kind of distribute to other part. So, in cases of like overwork load through blood the heat gets dissipated and then slowly kind of it remove it gets removed from the body. So, blood has lot of important functions, but most importantly it plays active role in terms of like oxygen carry and like nutrient and glucose supply.

Apart from that blood also has like role of immunity we will discuss in later class. So, other functions like thermo regulation I already said right, osmotic function, detoxification,

regulation of acid base balance. So, lot of important function you can slowly go through one by one. If you have any further questions please let us know we will be happy to answer your question, but mostly try to remember this all the function. One important like thing you have to remember that fetal hemoglobin that means like whenever a baby forms or in the stages of formation of the fetus, the fetal hemoglobin which has the HbF type of protein molecule.

This has a higher affinity with oxygen compared to our adult hemoglobin which is HbA. So, what I am basically saying that the HbF that means, the hemoglobin that is present in fetus has higher oxygen binding affinity compared to what which hemoglobin which is present in the cases of our adulthood because fetus when in the growing stage of fetus in the early stages of fetus it needs lot of oxygen. Because it is a growing stage right, lot of additional like growth stages are happening at that time, lot of like small organs are forming, it needs lot of supplement of like nutrients and oxygen to grow and that is why the limited amount of hemoglobin that is present that needs to bind or have a higher affinity with the oxygen to reduce the work limit ok. So, this is very important information, please remember then what happens of this RBC cells or erythrocyte, right, they cannot survive like for long. Within like around 100 to 120 days after once the RBC does their function for almost 100 or 120 days, they basically gets damaged or destroyed.

And eventually the iron gets kind of salvaged out of those RBC for reuse purpose because our body doesn't want to kind of create a waste of the essential molecules or nutrients. So, basically the heme part of the protein part is degraded to become like the bilirubin. So, you remember like with our faeces and all the bilirubin generally comes out. So, by the function of this liver right this heme gets degraded to the yellow bilirubin, but the iron part it would get reuse further in our body. So, lost cells then are replaced by the division of the hemocytoblast.

Hemocytoblast is like a component of this RBC and whenever there is lost cells our red bone marrow cells where the red bone marrow cells present they are present in like our bones in the epiphysis area of the bone we will further discuss in the bone class. and also like all our ribcage, our spine, our fibula, our tumor, all these like long bones, they have the RBC cells that produces new RBC cells whenever there is like damages of the old RBC cell. This is a continuous process and basically this also goes by a negative type of feedback loop. Whenever there is a damage, it triggers the formation of new blood vessel or new blood cells. So, this is I am talking about the negative feedback loop.

So, whenever there is this damages of RBC or like after certain like time for example, like a lifespan of 100 or 120 days the old RBCs are destroyed. Now, what will happen once that old RBCs are destroyed. There will be a low number of RBCs in our blood and that will cause lower amount of supply of the oxygen because RBC number became low and whenever this lower amount of oxygen supply, there will be a situation called hypoxia. So, what will happen? basically lower RBC will cause lower oxygen supply that will cause a condition called hypoxia, right. And whenever there is a hypoxic type of situation, our kidney, an important organ, we will discuss about kidney later, but just try to remember whenever there is a hypoxic situation, our kidney will produce a very important hormone, which is called erythropoietin.

And what is the role of this hormone erythropoietin? The erythropoietin will trigger the formation of the new RBC cells from where? From the bone marrow. So, basically when the erythropoietin forms it will get circulated, it will activate the bone marrow and they will form more and more number of RBC to reduce this condition of hypoxia. So, that again the new RBCs can supplement the delivery of the oxygen in a proper manner. So, this is a negative

feedback loop try to remember this is also like a this is the way our human body maintains the homeostasis. You remember in our last class we discussed about the homeostasis that is whenever our body is balanced a certain balance gets hampered.

certain conditions, certain hormones, certain cells they will try to activate and try to mitigate that situation ok. So, basically this is a negative feedback loop is refer our last class if you have any confusion ok. What are different type of leukocytes present in our blood? If you remember that we have different like five type of leukocytes. So, mostly they are categorized into two type. One is granulocytes and another is the agranulocytes.

So, what are these granulocytes? If you see like this three tribe, there are small small granules are present right, you can see like small small granules. So, if the WBCs have granules into it, they are called granulocytes. And what are the three different granulocytes? Neutrophil which are the most number in the in terms of WBC almost 50 to 70 percent. Then eosinophils they are almost about 2 to 4 percent and then basophils which are about 1 percent. And then another two type you can see this lymphocyte and the monocyte right.

They do not have any granules into it. The lymphocytes are about around 25 to 45 percent and monocytes are about 3 to 8 percent. And in general, in terms of per microliter, we have about like 4000 to 11000 cells per microliter. So, you can see the number like compared to the RBC, the number of WBCs are very low. Okay, so this is the way how the blood cells form.

We'll not go into too much of detail, but try to remember the chart, the process how the blood cell form is called hemopoiesis. It can be like RBC, it can be platelet, it can be like all these WBCs which are immune cells, right. So, how it starts basically all cell like kind of division initially it starts with a stem cell which is like kind of a originator cell of our body. There are different type of stem cells also, but let us not go into too much of detail you can consider that this pluripotent stem cell is one of the original cell starting cell in our body. and from this pluripotent stem cell then there is like certain stages of differentiation happens and it becomes like myelized stem cell or lymphoid stem cell from there again stages of like formation and differentiation that cause like formation of proerythroblast, megakaryoblast, right, eosinophilic like myoblast, monoblast.

So, different stages right differentiation mostly like here this type of like differentiation happens differentiation right. And once this once this cell form these are like committed cell. So, these are like committed cell committed stem cell you can also call these are like committed stem cells because initially when the pure protein stem cells are there they are non committed they do not know that which exact cells they have to develop. So, basically they are kind of non-committed and with the steps they become like more committed in nature and you can see once they become committed like the proerythroblast form like the RBC, the megakaryoblast form the platelet and so on. So, this is like the state how the new like blood cell formation happens in cases of all like RBC, WBC which is called the hemopoiesis.

It is very important and many of these states happen simultaneously like in our bones. There are certain enzymes also maybe from the liver or other spleen area can participate into this is a complex procedure of course, more research is going on in this area. The information is enough, but still like there are plenty of research needed to understand exact like molecular biology of this type of pathways ok. So, hopefully like you will read more about this and if you have any question please kind of ask us in the live sessions and in the like the website. So, there are different growth factors also they are very important.

So, basically like for the granulocyte monocyte macrophage like growth factor type of they have an important role for like the differentiation and growth and the activation step. So, you can see like all these growth factor I am not kind of repeating all this and they have the important role of formation of all these kind of cells. Finally platelet, platelets are very low in volume and number, right. You remember almost only like 1%, even sometimes less than 1% of total volume of bloods are the platelet, right. So, these platelets are also very small in size and they kind of circulates with the blood.

They are called like thrombocytes. What is their role basically? Platelets has a very important role for blood clotting and blood coagulation. In our next class, we will thoroughly discuss about the platelet, how the blood clotting happens, how the platelets get activated, how they generally stay in activated condition, but after injury the platelet activation happens and the clotting happens. So, everything we will thoroughly discuss. So, main role of the platelet is the blood clotting. So, function of platelet is the role in hemostasis, role in the clot formation and eventually clot retraction and the injury repair.

So, all these role we will thoroughly discuss in the next class. So, yeah again also platelets may have some certain like role in the phagocytosis also, but mostly the main role of the platelets is in the blood coagulation pathway ok. So, I hope you enjoyed our blood class. We have discussed like different component of blood like RBC, WBC, platelet. RBC what it does? It carries oxygen, nutrients.

Overall blood carries also like other like heat and other thing also it does. WBC mainly like these are immune cells it maintains the body's immunity. We will have a completely separate class about body's immunity and we will see like how the neutrophil, basophil, eosinophil all these different WBC cells plays an important role about our maintaining our body's immunity. platelet role of the platelet is maintaining the doing the blood clot and in cases of an injury it coagulates the blood and also kind of like activates the repair mechanism. So, can you tell that after the whole class that which blood cell, which type of blood cell has an important role maintaining our body's immunity? This is your task and we will thoroughly discuss each of those.

So, about the RBC, how hemoglobin carries oxygen, it would be again referred and thoroughly discussed in the lung and respiration class about the WBC and the immune system we will thoroughly discuss it in the immunity class right. There we will cover each of the immune cells WBC cells and we will see their role in maintaining the immunity and for the platelets we will thoroughly discuss about the platelet and their role in the blood coagulation in our next class for the blood coagulation and hemostasis. Hopefully, you enjoyed. Thank you again for attending another new classes of the human physiology. Let us meet in the next class with another exciting topic. Thank you very much.