Hello students. I am Puja Sakhalkar, Assistant Professor at Carmel College of Arts, Science and Commerce for Women, Nuvem.

Today we are looking at a module 'Multiple alleles- blood groups in humans'. This module is from Unit 2 'Mendelian genetics and its extension'.

To give you a brief outline of what we are going to learn in this module, we will begin with the introduction of multiple allelism. We will look at blood groups in humans, multiple allelic inheritance, influence on blood types, blood type and genotype, scheme of blood group inheritance in progenies. This module will explain the concept of multiple allelism, it elaborates how multiple alleles influence blood groups in humans, it describes the inheritance of blood grouping alleles, and it applies the method to determine the possible phenotype in progenies.

Introduction. What are multiple alleles? Multiple alleles refer to a condition where there are three or more allelic forms available for a particular trait. Multiple alleles are formed as a result of mutation in the wild type allele to form several variants. Although each diploid individual will only have two alleles for a particular trait, there are several alleles available in the genepool. So, there is a choice between these various alleles, that's why it is called as multiple alleles.

Now let us look at human blood groups. Karl Landsteiner in 1901 first discovered that when blood is mixed from 2 individuals, it may or may not agglutinate. So why is it that in some cases it agglutinates and in some others, it does not agglutinate? Clumping occurs because of antigen-antibody reaction. He discovered two antigens, A and B on the surface of the red blood cells. He found that a person may contain either A or B or none of them. Based on this, he recognized three blood groups, that is, blood group A, blood group B and blood group O. Later in 1902, his students Von Decastelle and Sturli discovered the rare AB blood group.

The surface of the RBC's display antigens. For those individuals who don't have any particular antigen, the corresponding antibody will be produced in their plasma. As you can see in this image, a person with blood group A will have antigen A on their RBC's and they will have anti-B antibodies in their plasma. Similarly, a person with blood Group B will have antigen B on the surface of their RBC's and anti-A antibodies in their plasma. Blood group AB will have both the antigens, that is, A as well as B on the surface of their RBC's and they will have no antibodies in their plasma; no antibodies against these antigens. Next, people with blood group O, they will not have any antigens on the surface of their RBC's, but they will have anti-A and anti-B, both antibodies in their plasma.

Now, let us look at multiple allelic inheritance; how it influences the blood types. Bernstein in 1925 found that in humans the blood types A, B, AB and O are inherited by three allelomorphs. Gene controlling the blood type, he labelled as I and its allelomorphic forms as I^A, I^B and I^O. I^O is also commonly referred to as 'i'. Alleles I^A and I^B are codominant, while they are dominant over allele I^O. So, I^O is recessive.

Blood types and their genotypes. A person with blood group A can have genotype of I^AI^A or I^AI^O. This is homozygous condition, this is heterozygous condition. Similarly, a person with blood group B will have genotype I^BI^B if he is homozygous and if he is heterozygous, it will be I^BI^O. A person with blood group AB will have a genotype I^AI^B and, a person with blood group O will have a genotype I^OI^O. So that is how these alleles are determining the blood groups of humans. So, when parents belong to different blood groups, particularly when parents belong to blood group A & B and when both are heterozygous, their children can have any of the four blood groups.

As you can see here, one of the parent is belonging to A blood group, that is, heterozygous A and the other is belonging to heterozygous B. So, their children can have, if you look at the various combinations, they can have either heterozygous A blood group or heterozygous B blood group or AB or even O. Here, please note that I'm only talking about the blood groups and not the gender of the progenies.

Scheme of blood group inheritance in the progeny. From this table you can see that if the parents belong to different blood groups, what will be the possible blood groups of their progenies. If both the parents, belong to O blood group their children will have O blood group, whereas if two parents belong to AB blood group their children will have A or B or AB blood group. And if the two parents belong to, one belongs to A and one belongs to B, then, their children can have any of the four blood groups. Various other blood group combinations are also shown in this image. References for this module, you can go through these papers and these are the web links and this is for further reading. Thank you.