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# Lecture – 6

## Multiple allele, Pleiotropism and Pseudoallele

by

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# MULTIPLE ALLELE

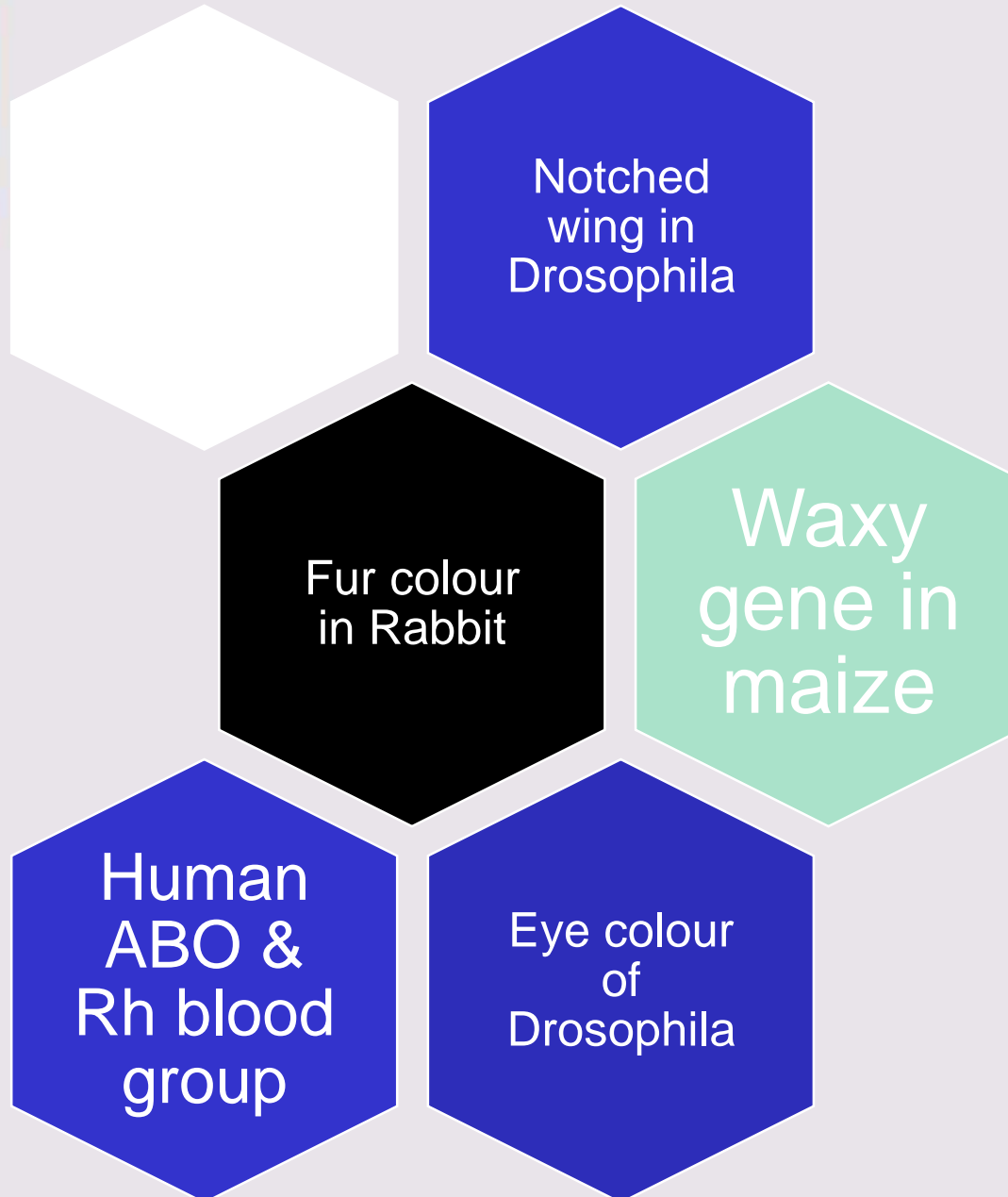
- An allele which consists of three or more alleles of the same gene
- However, individuals within the population are only able to hold two of them
- It can only be studied in populations

# + Examples of Multiple alleles



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# ABO Blood Group

Discovered by Karl Landsteiner in early 1900s

- An excellent example of multiple allele inheritance is human blood type. Blood type exists as four possible phenotypes: A, B, AB, & O.
- The human ABO gene is on chromosome 9.
- Everyone has two copies of chromosome 9 so you have two *ABO* genes.



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# ABO Blood Group

One copy is inherited from our mother, the other from our father.

There are 3 alleles (A, B and O) for the gene that determines blood type.

A person's blood type is determined by which allele he/she inherits from each parent.



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- The “A” allele is dominant and so is the “B” allele.
- Together though, the “A” and “B” alleles are **co-dominant**.
- The “O” allele is recessive.
- One combination of alleles in the ABO system exhibits a co dominant mode of inheritance which is blood type AB



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# Determining the Genotype

- Human blood type is controlled by three alleles :  $I^A$ ,  $I^B$  and  $i$ .
- Alleles  $I^A$  and  $I^B$  are dominant over  $i$
- $I^A$  and  $I^B$  are codominant

Phenotype (blood type)	Genotypes
A	$I^A I^A$ or $I^A i$
B	$I^B I^B$ or $I^B i$
AB	$I^A I^B$
O	$ii$



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# The ABO System

Genotype	Antigen	Phenotype
$I^A I^A$ $I^A I^O$	A A	A
$I^B I^B$ $I^B I^O$	B B	B
$I^A I^B$	A and B	AB
$I^O I^O$	Neither	O

## LEGEND

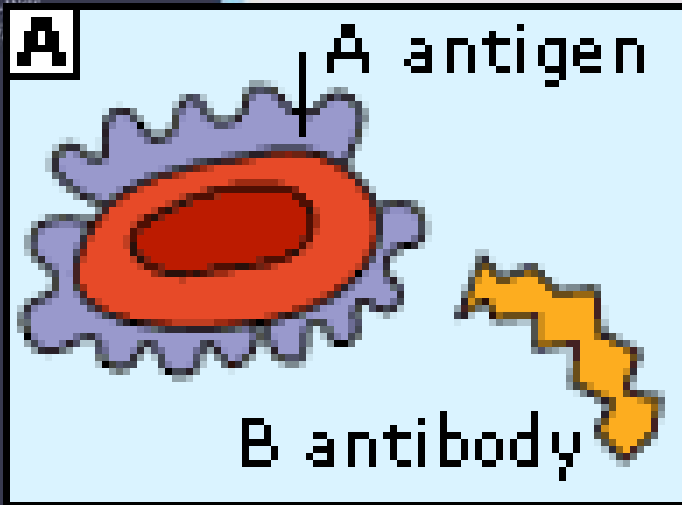
Allele	Codes
$I^A$	Type A
$I^O$	Type O
$I^B$	Type B



# ABO Blood Grouping System

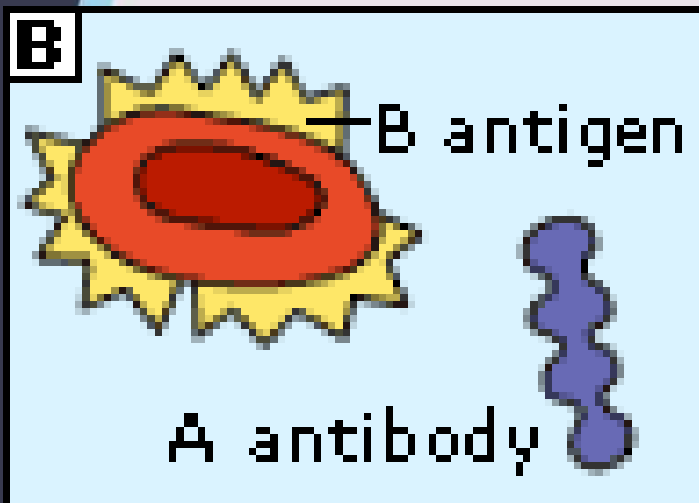


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## **Blood group A**

If you belong to the blood group A, you have A antigens on the surface of your RBCs and B antibodies in your blood plasma.



## **Blood group B**

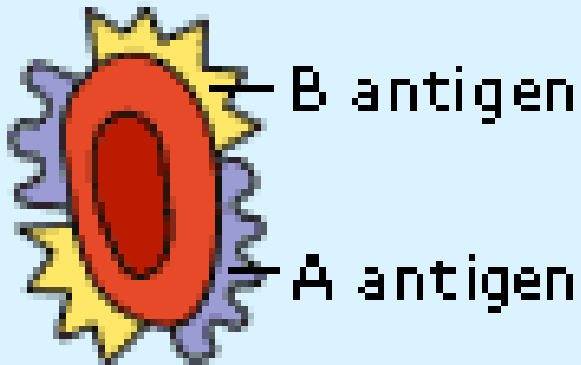
If you belong to the blood group B, you have B antigens on the surface of your RBCs and A antibodies in your blood plasma.



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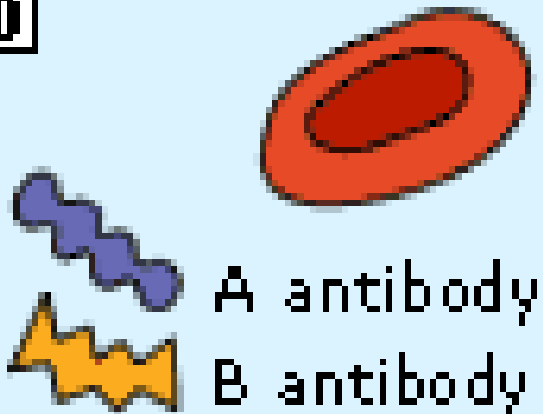
**AB**



## **Blood group AB**

If you belong to the blood group AB, you have both A and B antigens on the surface of your RBCs and no A or B antibodies at all in your blood plasma.

**O**



## **Blood group O**

If you belong to the blood group O (null), you have neither A or B antigens on the surface of your RBCs but you have both A and B antibodies in your blood plasma.



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# Blood Transfusions

- It is important to carefully match the donor and recipient blood types.
- If the donor's blood cells have antigen that are different from those of the recipient, antibodies in the recipient's blood recognize the donor blood as foreign.
- This triggers an immune response resulting in **blood clotting or agglutination.**



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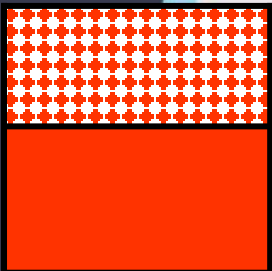
Donor

# Donor-recipient compatibility

		Recipient			
Type	A	B	AB	O	
A	Safe transfusion	Agglutination	Safe transfusion	Agglutination	
B	Agglutination	Safe transfusion	Safe transfusion	Agglutination	
AB	Agglutination	Agglutination	Safe transfusion	Agglutination	
O	Safe transfusion	Safe transfusion	Safe transfusion	Safe transfusion	

## Note:

- **Type O blood** may be transfused into all the other types = the **universal donor**.
- **Type AB blood** can receive blood from all the other blood types = the **universal receivers**.



= Agglutination

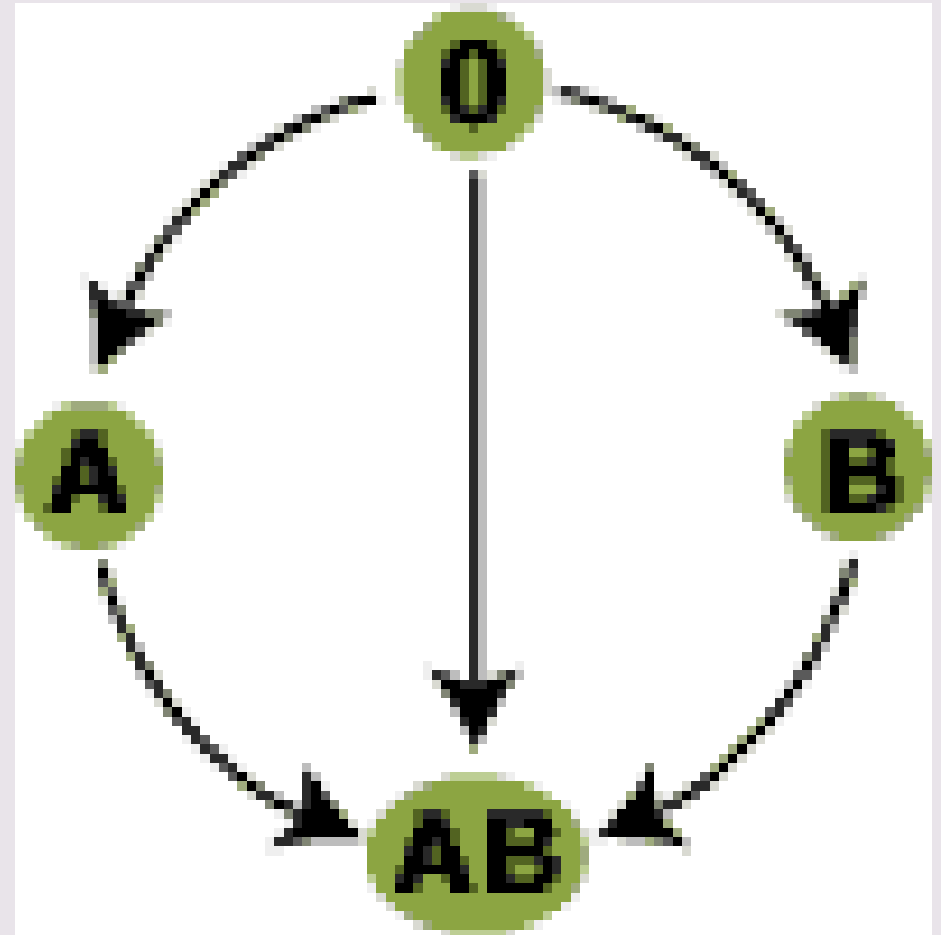
= Safe transfusion



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# Donor-recipient compatibility

- Blood group O is called "**universal donor**" because it has no antigens on RBC.
- Blood group AB are called "**universal receivers**" because it has no antibodies in the plasma.












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# Relative Abundance of Blood Types

<u><b>A</b></u>	<u><b>B</b></u>	<u><b>AB</b></u>	<u><b>O</b></u>
40-42%	10-12%	3-5%	43-45%



# The ABO Blood System

Blood Type (genotype)	Type A (AA, AO)	Type B (BB, BO)	Type AB (AB)	Type O (OO)
Red Blood Cell Surface Proteins (phenotype)	 <p>A agglutinogens only</p>	 <p>B agglutinogens only</p>	 <p>A and B agglutinogens</p>	 <p>No agglutinogens</p>
Plasma Antibodies (phenotype)	 <p>b agglutinin only</p>	 <p>a agglutinin only</p>	<p>NONE.</p> <p>No agglutinin</p>	 <p>a and b agglutinin</p>



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# Pleiotropism

- A gene having more than one phenotypic effect (manifold effects) is called pleiotropic gene and such phenomenon is referred to as **pleiotropy** or **pleiotropism**.
- A pleiotropic effect may be either due to a true pleiotropic gene or due to closely linked gene.
- If the side effects of a gene are beneficial, it helps in crop improvement.
- A gene governing awns in onas variety(Wheat) also enhance yield and





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# Pseudoallele

**Pseudo alleles:** Two alleles each of two or more tightly linked genes affecting the same function as a result of which, they appear as multiple alleles. (Or)

Alleles, which have two separate gene loci, but often inherit together due to close linkage and have very rare chance of crossing over are called pseudo alleles. Eg: Lozenge eye in *Drosophila*

**Iso allele:** An allele which is similar in its phenotypic expression to that of other independently occurring allele is called isoallele.



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