

Blood Type Punnett Square Practice

There are four major blood groups determined by the presence or absence of two antigens (proteins) – A and B – on the surface of red blood cells:

Group A – has only the A antigen on red cells (and B antibody in the plasma)

Group B – has only the B antigen on red cells (and A antibody in the plasma)

Group AB – has both A and B antigens on red cells (but neither A nor B antibody in the plasma)

Group O – has neither A nor B antigens on red cells (but both A and B antibody are in the plasma)

Since foreign antigens can trigger a patient's immune system to attack the transfused blood with antibodies, safe blood transfusions depend on careful blood typing and cross-matching.

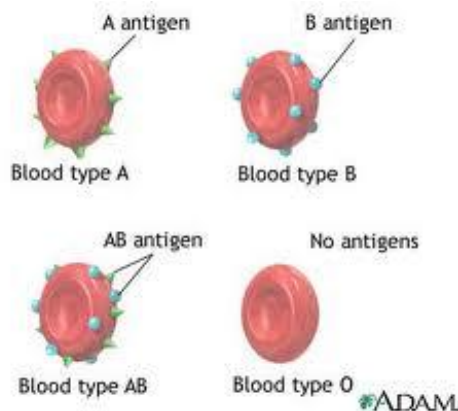
There are 3 alleles of the gene that controls blood type: I^A , I^B , i

The I stands for immunoglobulin, or the type of white blood cell that would be triggered to attack.

I^A and I^B are Co-Dominant genes, meaning when inherited together, they are both fully expressed, not blended, as in Incomplete Dominance. “ i ” is the recessive form of the allele.

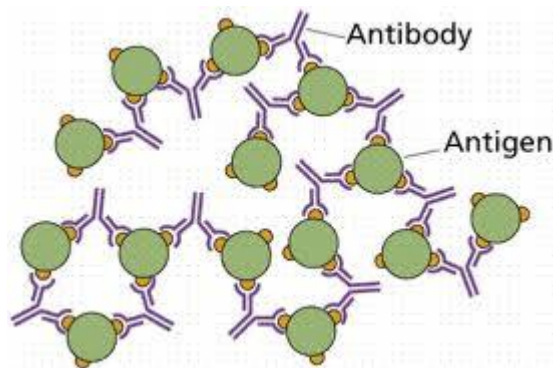
Possible genotypes are as follows:

Genotypes	Blood Type
$I^A I^A$ or $I^A i$	A
$I^B I^B$ or $I^B i$	B
$I^A I^B$	AB
ii	O



Blood Type	Antigen (RBC membrane)	Antibody (plasma)	Can receive blood from	Can donate blood to
A (40%)	A antigen	Anti-B antibodies 	A, O	A, AB
B (10%)	B antigen	Anti-A antibodies 	B, O	B, AB
AB (4%)	A antigen B antigen	No antibodies	A, B, AB, O	AB
O (46%)	No antigen	Both Anti-A and Anti-B antibodies 	O	O, A, B, AB

Agglutination



An additional complication in blood typing is that there is a third major antigen called the Rh factor. If you have the Rh antigen as well, we say you are Rh +. No Rh antigen, you are Rh - . Each of the four A, B, AB, O blood types can come with or without the Rh factor. We will not deal with the Rh factor in the following genetics problems.

Assignment:

Show the punnett square and phenotypic ratios for the following crosses:

1) Both the father and mother have type O blood.

_____ x _____

Phenotypic Ratio:

2) The father is type A homozygous, the mother is type B homozygous.

_____ x _____

Phenotypic Ratio:

3) The father is type A heterozygous, the mother is type B heterozygous.

_____ x _____

Phenotypic Ratio:

4) The father has type O blood, the mother has type AB blood.

_____ x _____

Phenotypic Ratio:

5) Both the father and mother have type AB blood.

_____ x _____

Phenotypic Ratio:

6) Alice has type A blood and her husband Mark has type B blood.

Their first child, Amanda, has type O blood.

Their second child, Alex, has type AB blood.

What is Alice's genotype? _____

What is Mark's genotype? _____

Show how you found the answer by completing the Punnett square(s) below:

7) Candace has type B blood. Her husband Dan has type AB blood.

Is it possible for Candace and Dan to have a child that has O blood? _____ Explain why or why not (use a Punnett square to help).

8) Ralph has type B blood and his wife Rachel has type A blood. They are very shocked to hear that their baby has type O blood, and think that a switch might have been made at the hospital. Can this baby be theirs? _____ Explain why or why not (use a Punnett square to help).
