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)

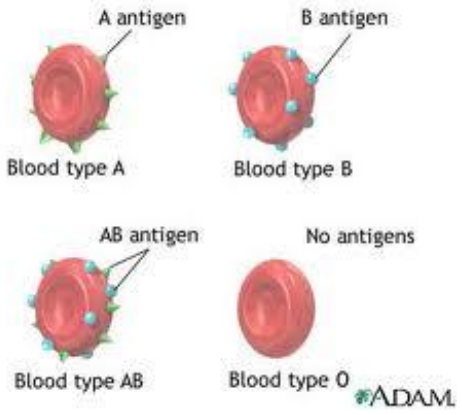
Since foreign antigens can trigger a patient's immune system to attack the transfused blood with antibodies, safe blood transfusions depend on careful blood typing and cross-matching.

There are 3 alleles of the gene that controls blood type: **I^A, I^B, i**
The I stands for immunoglobin, 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.

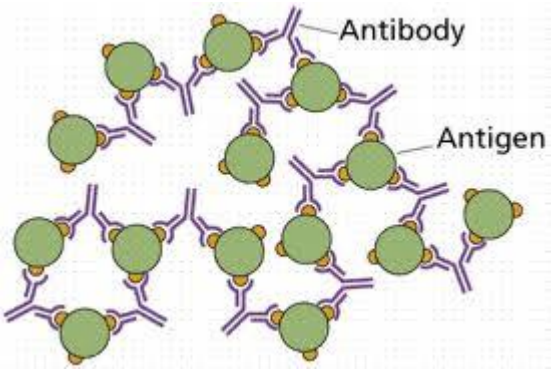
Possible genotypes are as follows:

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.

ii x ii

Phenotypic Ratio:

	i	i
i	ii	ii
i	ii	ii

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

$I^A I^A$ x $I^B I^B$

Phenotypic Ratio:

A : B : AB : O

0 : 0 : 4 : 0

	I^B	I^B
I^A	$I^A I^B$	$I^A I^B$
I^A	$I^A I^B$	$I^A I^A$

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

$I^A i$ x $I^B i$

Phenotypic Ratio:

A : B : AB : O

1 : 1 : 1 : 1

	I^B	i
I^A	$I^A I^B$	$I^A i$
i	$I^B i$	i i

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

ii x $I^A I^B$

Phenotypic Ratio:

A : B : AB : O

2 : 2 : 0 : 0

	I^A	I^B
i	$I^A i$	$I^B i$
i	$I^A i$	$I^B i$

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

$I^A I^B$ x $I^A I^B$

Phenotypic Ratio:

	I^A	I^B
I^A	$I^A I^A$	$I^A I^B$
I^B	$I^A I^B$	$I^B I^B$

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? $I^A i$
What is Mark's genotype? $I^B i$

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

	I^B	i
I^A	$I^A I^B$	$I^A i$
i	$I^B i$	$i\ i$

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? NO Explain why or why not (use a Punnett square to help).

$I^B I^B$ or $I^B i$

possible phenotypes: A, B or AB

	I^A	I^B
I^B	$I^A I^B$	$I^B I^B$
i	$I^A i$	$I^B i$

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? YES Explain why or why not (use a Punnett square to help).

possible phenotypes: A, B, AB or O

	I^A	i
I^B	$I^A I^B$	$I^B i$
i	$I^A i$	$i\ i$