



## Multiple Alleles Notes

**Multiple Alleles** - 3 or more alleles for a particular gene

**Antibodies** - Attach to cells and mark for destruction  
(proteins that float around body)

**Antigens** - Protein markers that serve as receptors of an antibody  
on surface of cells, viruses



Blood Type A	Blood Type B	Blood Type AB	Blood Type O
Picture	Picture	Picture	Picture
Antigen - A	Antigen - B	Antigen - A and B	Antigen - none
Antibodies - B (Anti-B)	Antibodies - A (Anti-A)	Antibodies - none	Antibodies - A and B (Anti-A + Anti-B)
Possible Genotypes - AA or A <sub>0</sub>	Possible Genotypes - BB or B <sub>0</sub>	Possible Genotypes - AB	Possible Genotypes - O <sub>0</sub>

Which of the following blood type(s) is **DOMINANT** - A and B

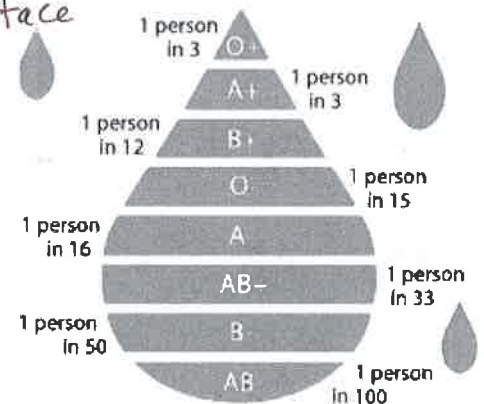
Which of the following blood type(s) is **RECESSIVE** - O

Which of the following blood type(s) is **CODOMINANT** - AB

**Rh Factor** - Another type of antigen found on the surface of red blood cells.

+ : Have the Rh antigen (dominant)

- : Do not have Rh antigen (recessive)



**Multiple Alleles:** Blood type is a trait that is determined by 3 different modes of inheritance: codominance, complete dominance and multiple alleles. The four possible phenotypes are of blood types A, AB, B and O. A and B alleles are codominant, while the O allele is recessive to both.

1. If A is codominant with B, what offspring would be possible from a cross between two AB blood individuals? (Include the probability with which they will occur)

	A	B
A	AA	AB
B	AB	BB

% Possible Genotypes:

50% AB, 25% AA, 25% BB

% Possible Phenotypes:

$\frac{25\%}{50\%}$  A       $\frac{25\%}{0\%}$  B  
 $\frac{50\%}{0\%}$  AB       $\frac{0\%}{0\%}$  O

2. A mother is Homozygous for type A and the father is Homozygous for type B. Which parent, if any can give their blood to their child in case

	A	A
B	AB	AB
B	AB	AB

% Possible Genotypes:

100% AB

% Possible Phenotypes:

$\frac{0\%}{100\%}$  A       $\frac{0\%}{0\%}$  B  
 $\frac{100\%}{0\%}$  AB       $\frac{0\%}{0\%}$  O

3. Both parents have blood type A, but 3/4 of their children have blood type A and 1/4 have blood type O. What are the complete genotypes of the parents? (Hint: Fill in the Punnett Square in reverse.)

	A	O
A	AA	AO
O	AO	OO

% Possible Genotypes:

25% AA, 50% AO, 25% OO

% Possible Phenotypes:

$\frac{75\%}{0\%}$  A       $\frac{0\%}{25\%}$  B  
 $\frac{0\%}{25\%}$  AB       $\frac{0\%}{0\%}$  O

4. Challenge! Show a cross between one parent who is homozygous for Type A- blood and another who is heterozygous for B+. (NOTE: blood type and the Rh factor are 2 different genes)

	A	A
B	AB	AB
O	AO	AO

	-	-
+	+ -	+ -
-	- -	- -

50% AB    50% + -  
 50% AO    50% - -

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$\frac{1}{2} AB \times \frac{1}{2} + - = \frac{1}{4} AB+$   
 $\frac{1}{2} AB \times \frac{1}{2} - - = \frac{1}{4} AB-$   
 $\frac{1}{2} AO \times \frac{1}{2} + - = \frac{1}{4} A+$   
 $\frac{1}{2} AO \times \frac{1}{2} - - = \frac{1}{4} A-$

Possible Genotypes	
$\frac{25\%}{25\%}$ A+	$\frac{25\%}{25\%}$ AB+
$\frac{25\%}{0}$ A-	$\frac{25\%}{0}$ AB-
$\frac{0}{0}$ B+	$\frac{0}{0}$ O+
$\frac{0}{0}$ B-	$\frac{0}{0}$ O-