CO-DOMINANCE AND MULTIPLE ALLELES
(AN EXAMPLE OF ABO BLOOD TYPES)

- Co-Dominance occurs when both genes/alleles in the genotype are equally dominant.
- Multiple Alleles occurs when more than 2 genes/alleles determine a characteristic, such as in ABO blood groups.

- Example of ABO Blood Types

There are 4 different blood types – A, B, AB and O.

BLOOD TYPE OR PHENOTYPE	GENOTYPE	ANTIGEN PRESENT	ANTIBODY PRODUCED
A	AA or AO	A	Anti-B
B	BB or BO	B	Anti-A
AB	AB	A and B	none
O	OO	none	Anti-A and Anti-B

- Example 1 – Blood Types

Mum has blood type AB and Dad has blood type O. The possible blood types of the children are ...

	A	B
O	AO	BO
O	AO	BO

Possible genotypes = 1 AO : 1 BO
Possible phenotypes = 1 A : 1 B
½ the children will be A blood type, and the other 1/2 will be B blood type.

- Example 2 – Blood Types

Mum has A blood type and Dad has AB blood type. The possible children's blood types are ...

First Possibility

	A	A
A	AA	AA
B	AB	AB

Possible genotypes = 1 AA : 1 AB
Possible phenotypes = 1 A : 1 AB
½ the children will have blood type A, and the other ½ will have blood type AB.

Second Possibility

	A	O
A	AA	AO
B	AB	BO

Possible genotypes =1AA:1AO:1AB:1BO
Possible phenotypes = 2 A : 1 AB: 1 B
½ will have blood type A, ¼ will have blood type AB, and ¼ will have blood type B.

ANTIGENS AND ANTIBODIES IN ABO BLOOD TYPES

- The blood type is so-called because the blood contains particular antigens – A, B, both A and B, or neither A nor B.
- The body produces antibodies to neutralise any particle (e.g. bacteria, dust, foreign blood in transfusions) that it recognises as foreign. For example, if blood type A contains Antigen A, then it will produce antibodies against B blood type (Anti-B Antibody), because B antigens are foreign. Similarly, if blood type O contains neither antigens A nor B, then a person with blood type O would produce anti-A and anti-B antibodies.
- Agglutination or 'Clumping' – If antigen-A came in contact with the antibody against it (Anti-A), then the blood would clump or clot. This could occur in an incorrect blood transfusion.
- Universal Recipient – This is a person with blood type AB who can receive a blood transfusion from any of the other blood types.
- Universal Donor - This is a person with blood type O who can donate blood to any other blood type.

COMPLETE DOMINANCE OR DOMINANT-RECESSIVE INHERITANCE (AN EXAMPLE OF RHESUS FACTOR IN ABO BLOOD TYPES)

- The ABO blood types are sub-divided into positive and negative types also, depending on whether that blood type does or does not contain the Rhesus Factor.
- If the Rhesus Factor is present, the genotype contains one or two R genes/alleles. If the Rhesus Factor is absent, the genotype is rr.

Blood Type	ABO Antigens Present	Rhesus Antigens Present	ABO Genotype	Rhesus Genotype
A+	A	yes	Aa or AO	RR or Rr
A-	A	no	AA or AO	rr
B+	B	yes	BB or BO	RR or Rr
B-	B	no	BB or BO	rr
AB+	A and B	yes	AB	RR or Rr
AB-	A and B	no	AB	rr
O+	none	yes	OO	RR or Rr
O-	none	no	OO	rr