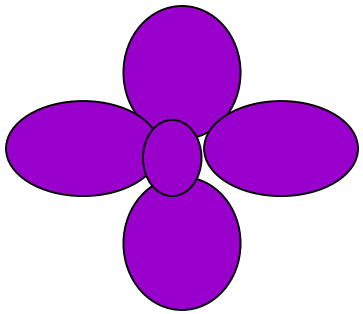
Non-Mendelian Genetics

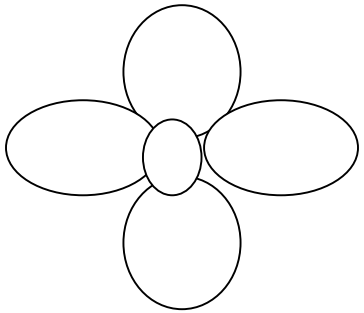
Mendelian Genetics: Dominant & Recessive Review

- One allele is DOMINANT over the other (because the dominant allele can "mask" the recessive allele)

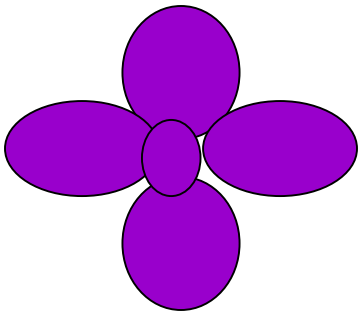
genotype: PP
phenotype: purple



genotype: pp
phenotype:



genotype: Pp
phenotype: purple



Soon after the rediscovery of Mendel's laws in 1900, there were reports of an inheritance pattern that differed from those established by Mendel. These variations were,

1. The degree of dominance differed and incomplete dominance was observed in certain cases.
2. Various genes were found to possess more than two alleles, or multiple allelic inheritance was observed.
3. It was found that a trait is governed by the interaction of two or more genes.

Such variations indicated that Mendel's laws do not apply universally to all sexually reproducing organisms.

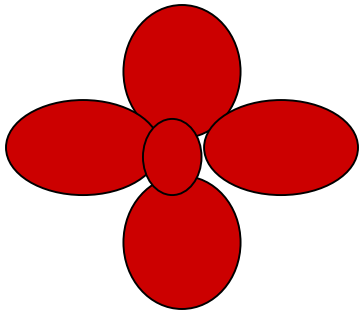
Incomplete Dominance

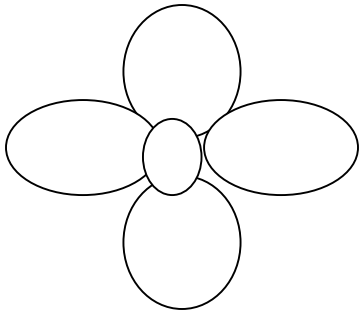
- Neither allele is completely dominant over the other allele.
- A heterozygous phenotype
  - A mixture or blending of the two

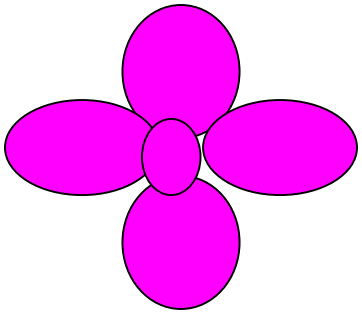
Incomplete Dominance

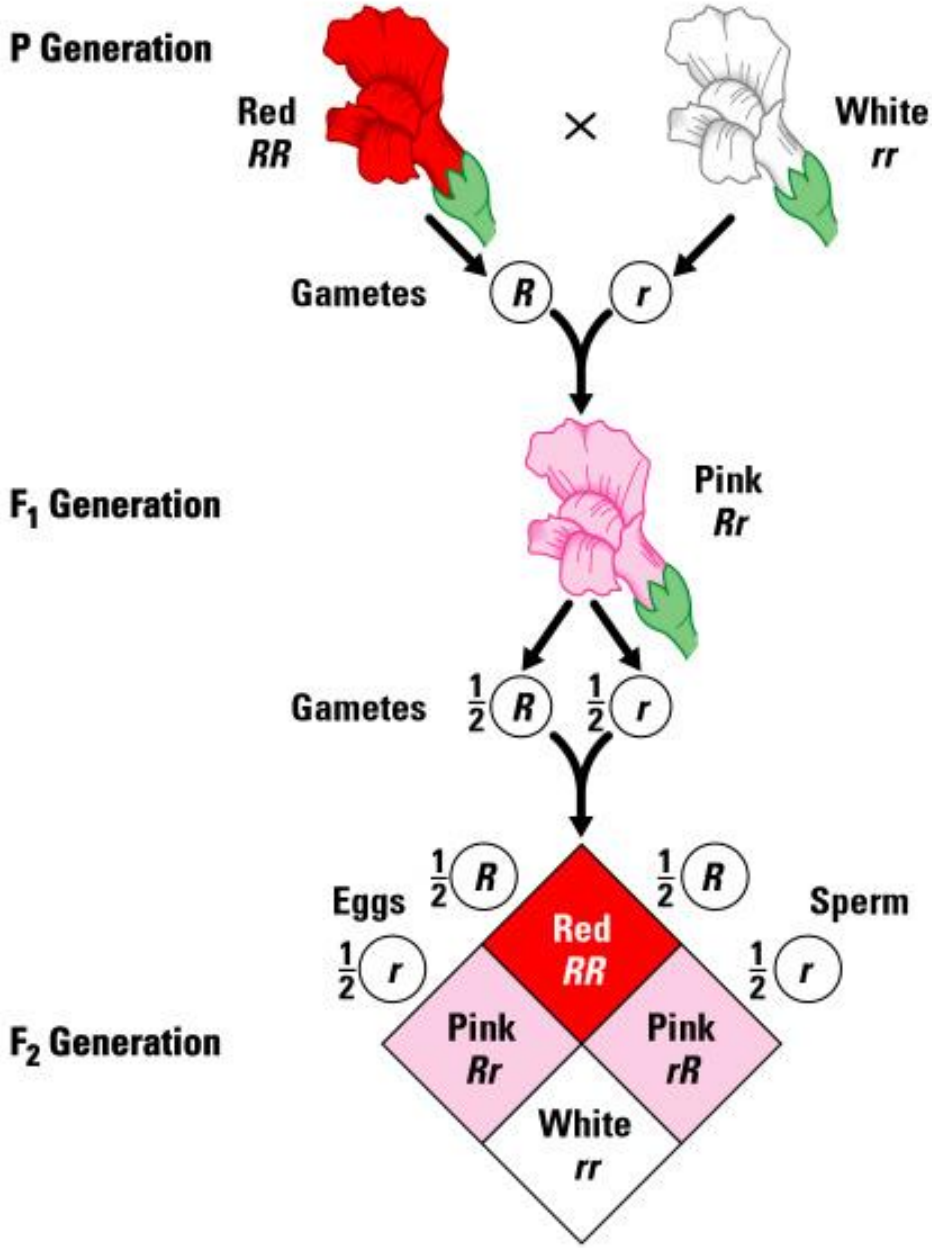
- a third (new) phenotype appears in the **heterozygous** condition as a **BLEND** of the dominant and recessive phenotypes. Ex - Dominant Red (R) + Recessive White (r) = Hybrid Pink (Rr)

RR = red **rr = white** **Rr = pink**









Problem:
Incomplete Dominance

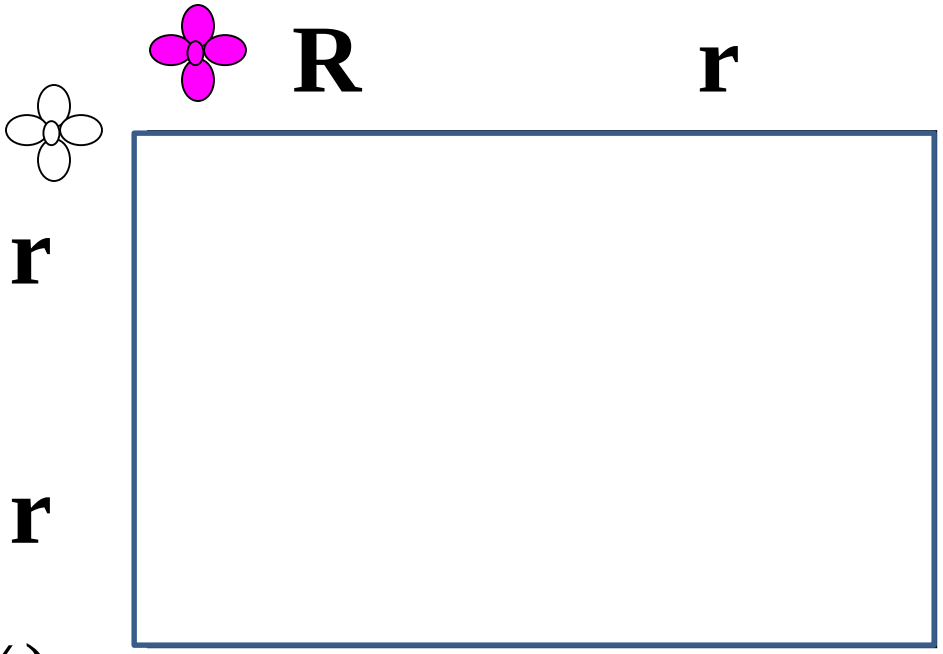
❖ Show the cross between a pink and a white flower.

<u>GENOTYPES:</u>

- RR (0%)
  Rr (50%)
  rr (50%)
- ratio 1:1

<u>PHENOTYPES:</u>

- pink (50%); white (50%)
- ratio 1:1



Codominance

- Two equally dominant alleles are expressed at the same time.

- Heterozygous phenotype will have both phenotypes visible

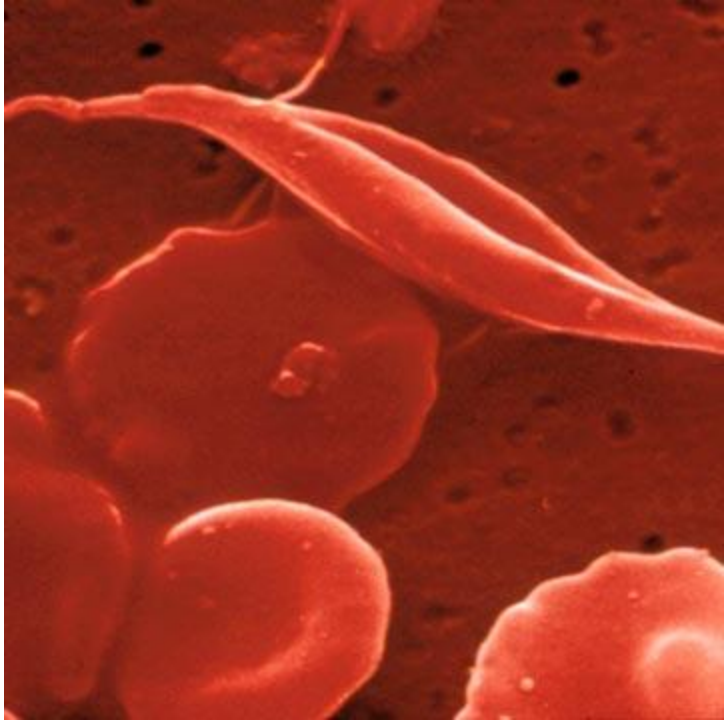
Codominance

- in the heterozygous condition, **both** alleles are expressed **equally** with NO blending! Represented by using two DIFFERENT capital letters.
- Example: Dominant Black (B) + Dominant White (W) = Speckled Black and White Phenotype (BW)

  - BB = black feathers
  - WW = white feathers
  - BW = black & white speckled feathers

- Notice –
  NO GRAY!
  NO BLEND!
  Each feather is either black or white

Sickle- Cell Anemia



- Co- dominance
- Caused by an abnormal

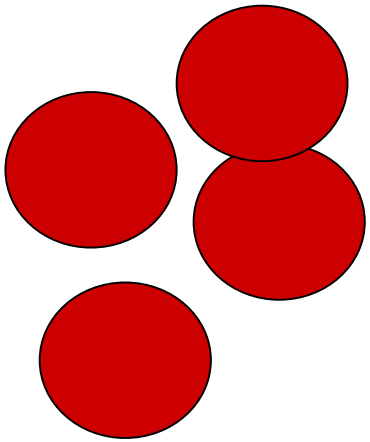
Hemoglobin, the protein that red blood cells use to carry oxygen

Normal hemoglobin is (RR)

Sickle Cell shaped blood cells (SS)

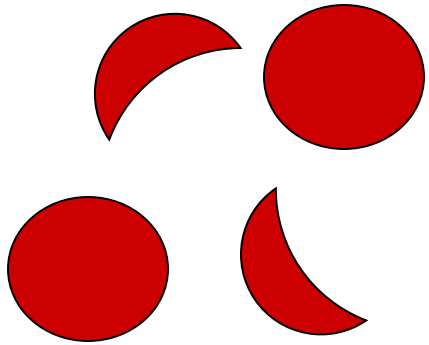
People who are carriers (heterozygous) for the disease there is a mixture of both normal and sickle cell (RS)

NN = normal cells



SS = sickle cells

NS = some of each



Problem: Codominance

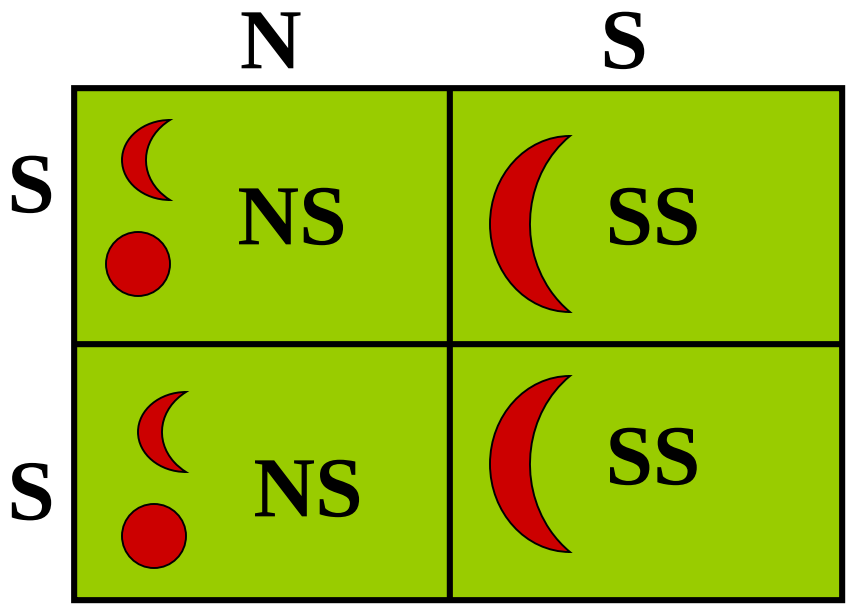
- Show the cross between an individual with sickle-cell anemia and another who is a carrier but not sick.

GENOTYPES:

- NS (2) SS (2)
- ratio 1:1

PHENOTYPES:

- carrier (2); sick (2)
- ratio 1:1



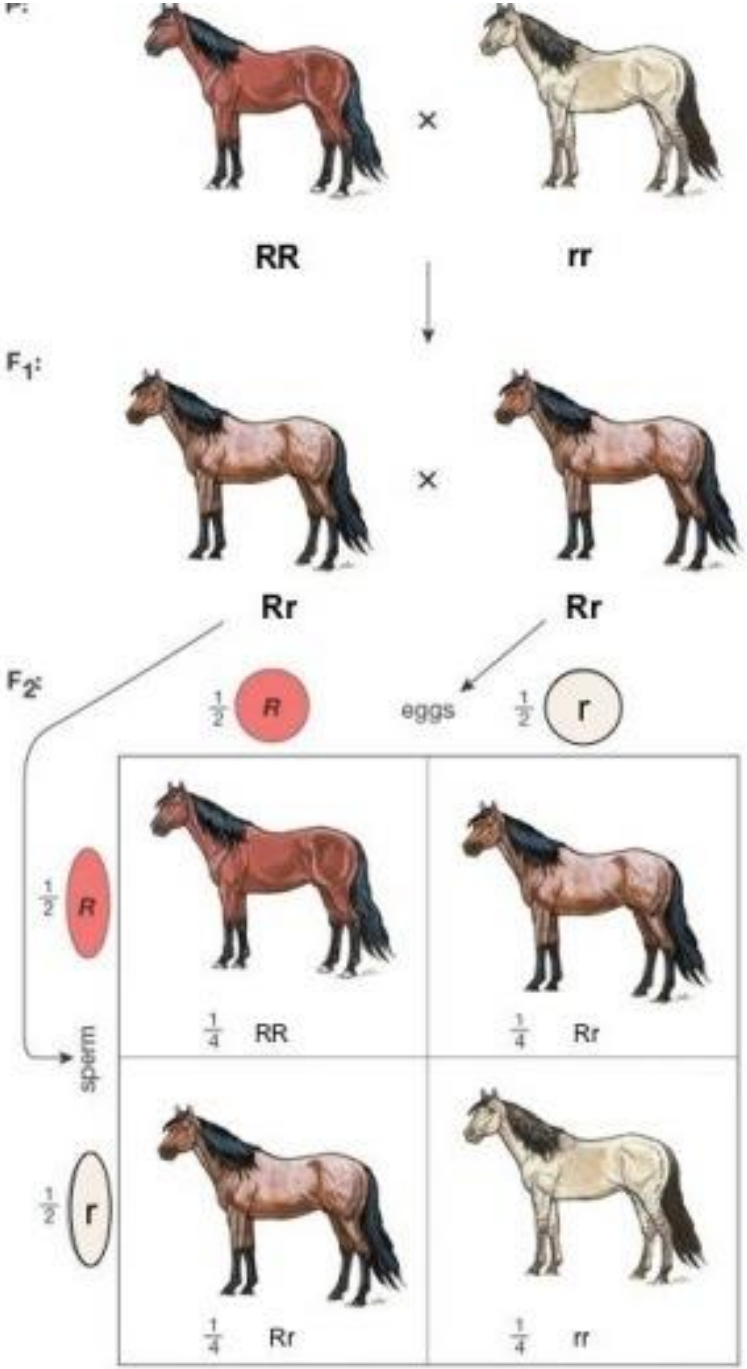
Codominance Example: Rhodedendron

- R = allele for red flowers
- W = allele for white flowers
- Cross a homozygous red flower with a homozygous white flower.

WW	R	R
W	RW	RW
W	RW	RW

Codominance Example: Roan cattle

- cattle can be
  - red
    - (RR – all red hairs)
  - (WW – all white hairs)
  - roan
    - (RW – red and white hairs **together**)



Roan Horse

http://search.vadlo.com/b/q?rel=2&keys=Dominance+Incomplete+Dominance+Codominance+PPT

Codominance Example: Appaloosa horses

- Gray horses (GG) are codominant to white horses (WW). The heterozygous horse (GW) is an Appaloosa (a white horse with gray spots).
- Cross a white horse with an appaloosa horse.

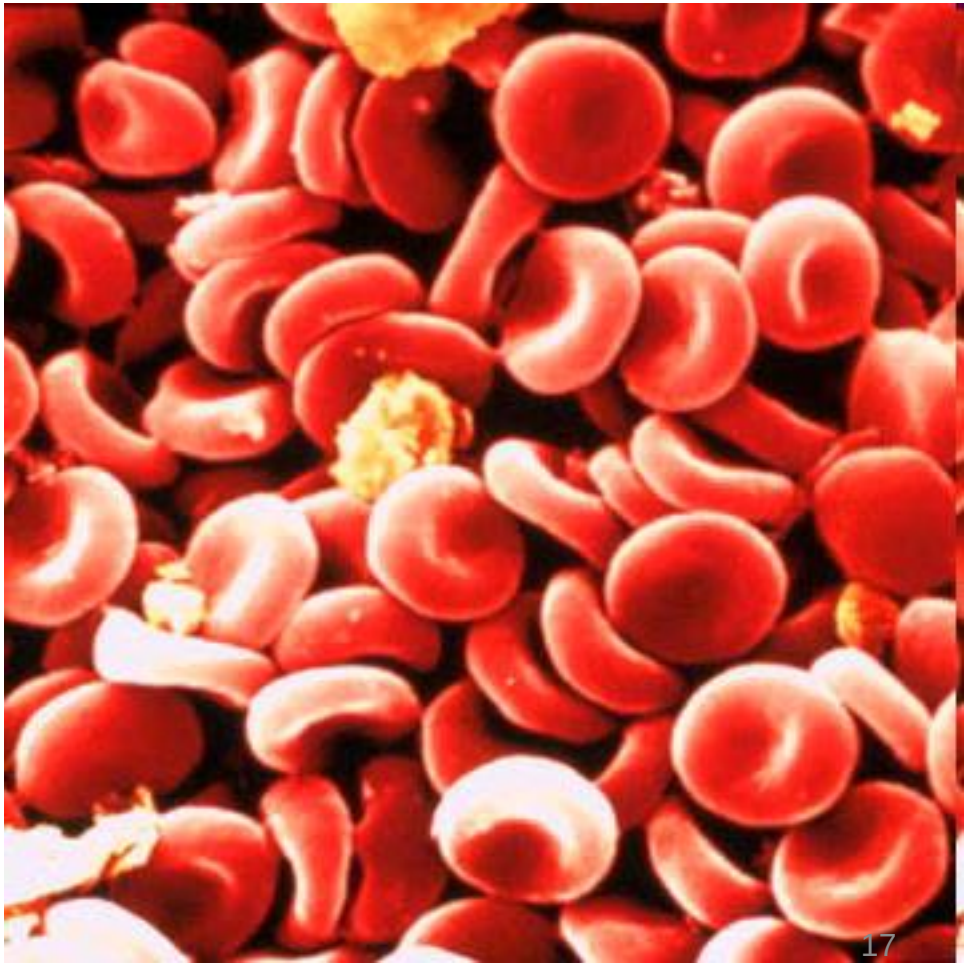
	W	W
G	GW	GW
W	WW	WW

Multiple Alleles

- There are **more than two alleles** for a gene.

Ex – blood type consists of two dominant and one recessive allele

options. Allele A and B are dominant over Allele O (i)



Multiple Alleles:

Blood Types (A, B, AB, O)

❖ Rules for Blood Types:

A and B are co-dominant *(Both show)*

AA or I^AI^A = type A

BB or I^BI^B = type B

AB or I^AI^B = type AB

A and B are dominant over O *(Regular dom/rec)*

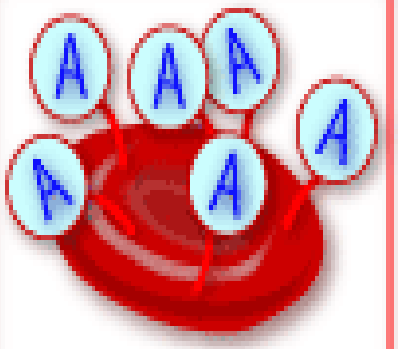
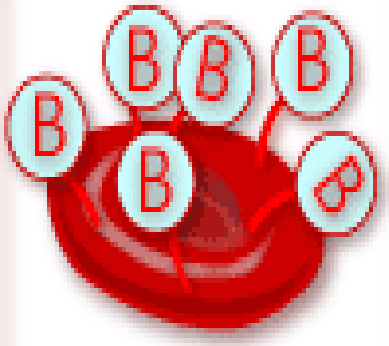
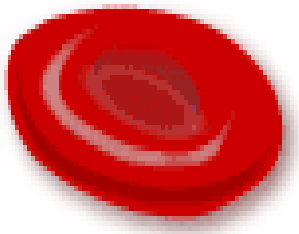
AO or I^Ai = type A

BO or I^Bi = type B

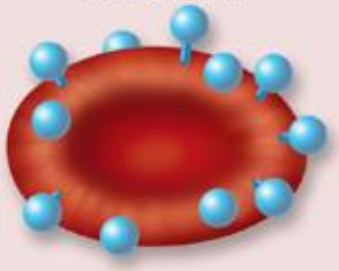
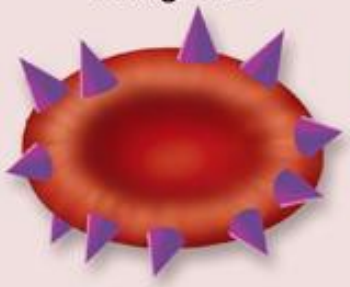
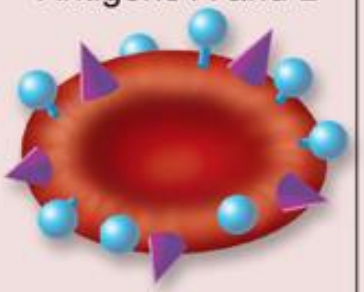
OO or ii = type O

Multiple Alleles:
Blood Types (A, B, AB, O)

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)	 A agglutinogens only	 B agglutinogens only	 A and B agglutinogens	 No agglutinogens

ABO Blood Types

	Antigen A	Antigen B	Antigens A and B	Neither antigen A nor B
Erythrocytes				
Plasma	Anti-B antibodies 	Anti-A antibodies 	Neither anti-A nor anti-B antibodies	Both anti-A and anti-B antibodies 
Blood type	**Type A** Erythrocytes with type A surface antigens and plasma with anti-B antibodies	**Type B** Erythrocytes with type B surface antigens and plasma with anti-A antibodies	**Type AB** Erythrocytes with both type A and type B surface antigens, and plasma with neither anti-A nor anti-B antibodies	**Type O** Erythrocytes with neither type A nor type B surface antigens, but plasma with both anti-A and anti-B antibodies

http://www.biologycorner.com/anatomy/blood/images/bloodtypes.jpg

Phenotype	Possible Genotype(s)	Allele (antigen) on RBC surface	Can Donate Blood To	Can Receive Blood From
A	I^Ai I^AI^A	A		
B	I^Bi I^BI^B	B		
AB	I^AI^B	AB		
O	ii	O		

Problem:
Multiple Alleles

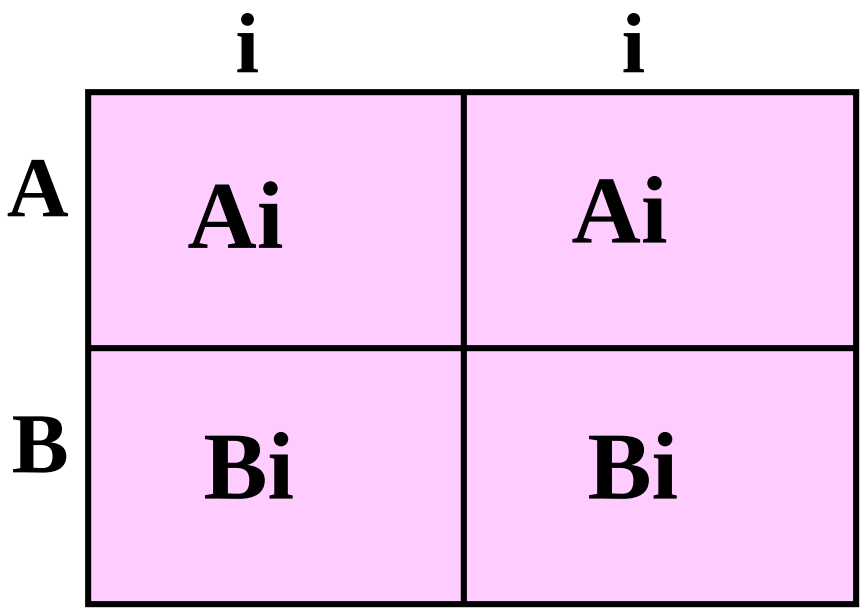
❖Show the cross between a mother who has type O blood and a father who has type AB blood.

GENOTYPES:

- Ai (50%)
  Bi (50%)
- ratio 1:1

PHENOTYPES:

- type A (50%)
  type B (50%)
- ratio 1:1



Problem:
Multiple Alleles

- Show the cross between a mother who is heterozygous for type B blood and a father who is heterozygous for type A blood.

GENOTYPES:

-AB (25%); Bi (25%);
Ai (25%); ii (25%)
- ratio 1:1:1:1

PHENOTYPES:

-type AB (25%); type B (25%)
type A (25%); type O (25%)
- ratio 1:1:1:1

	A	**i**
B	**AB**	**Bi**
i	**Ai**	**ii**