

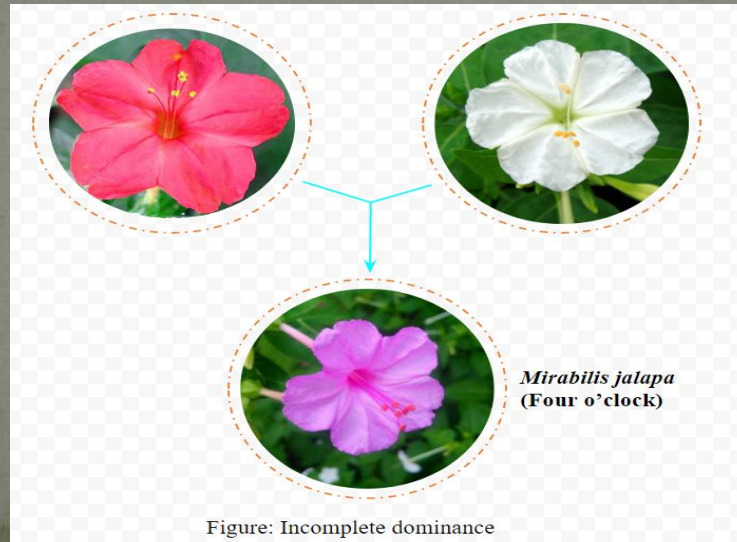
Exception to Mendel's laws

1. Incomplete dominance.
2. Multiple alleles.
3. Codominance.
4. Pleiotropy.
5. Lethal alleles.
6. Epistasis

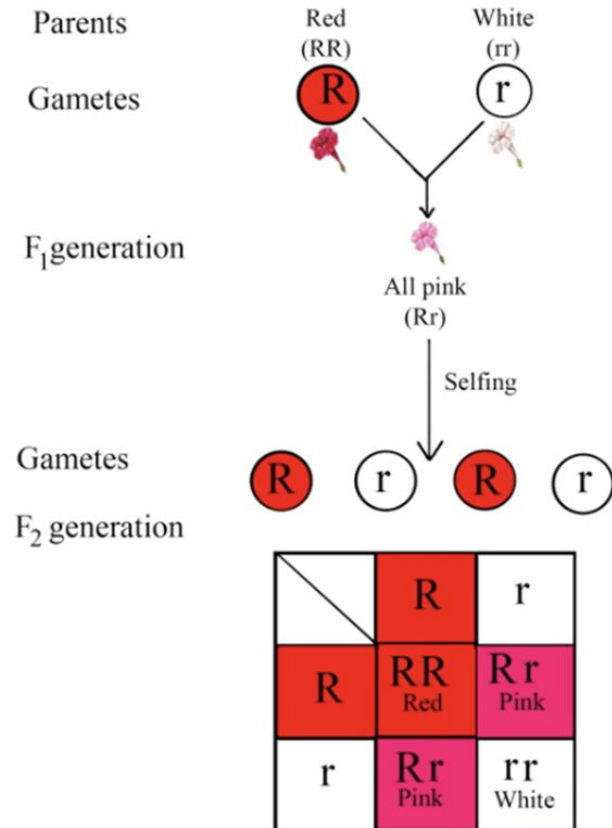


Incomplete dominance

- Incomplete dominance is a form of Gene interaction in which both alleles of a gene at a locus are partially expressed, often resulting in an intermediate or different phenotype.
- It is also known as **partial dominance**.
 - For eg., the pink color of flowers (such as snapdragons or four o'clock flowers),
 - the shape of hairs, hand sizes, voice pitch in humans.



Incomplete dominance in *Mirabilis Jalapa*



Phenotype ratio- 1:2:1 that denotes Red:Pink:White

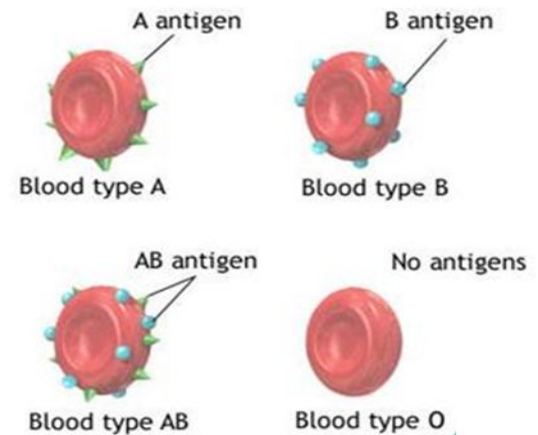
Genotypic Ratio- 1:2:1 that denotes RR:Rr:rr

Multiple alleles

- “More than two alleles of the same gene are present in the population”
- The **human ABO blood type** is a good example of multiple alleles.

- **More than two alleles can be inherited**
 - Example: Blood Types
 - Alleles= I^A , I^B , i

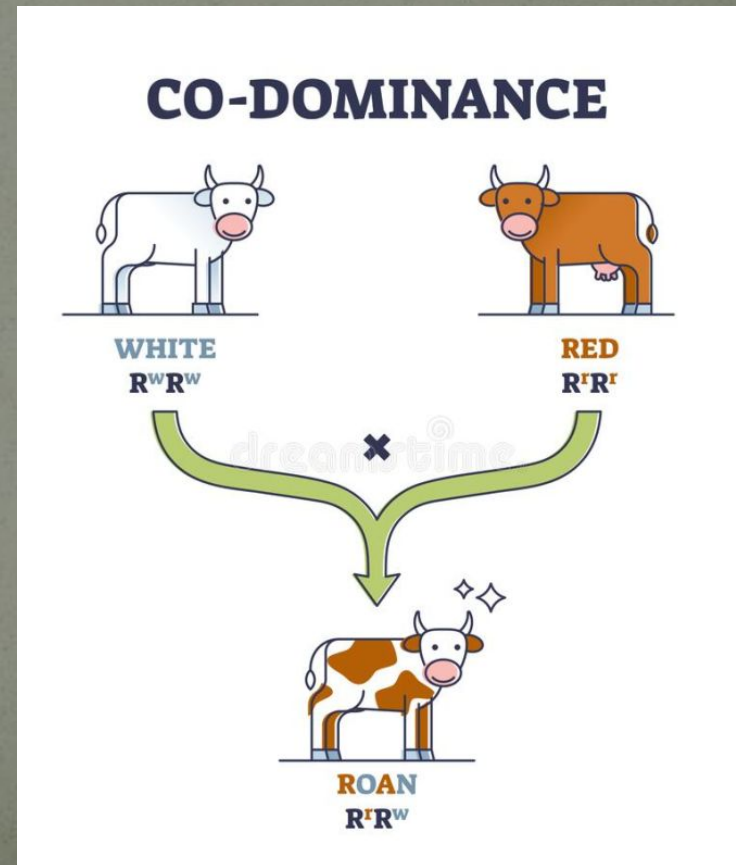
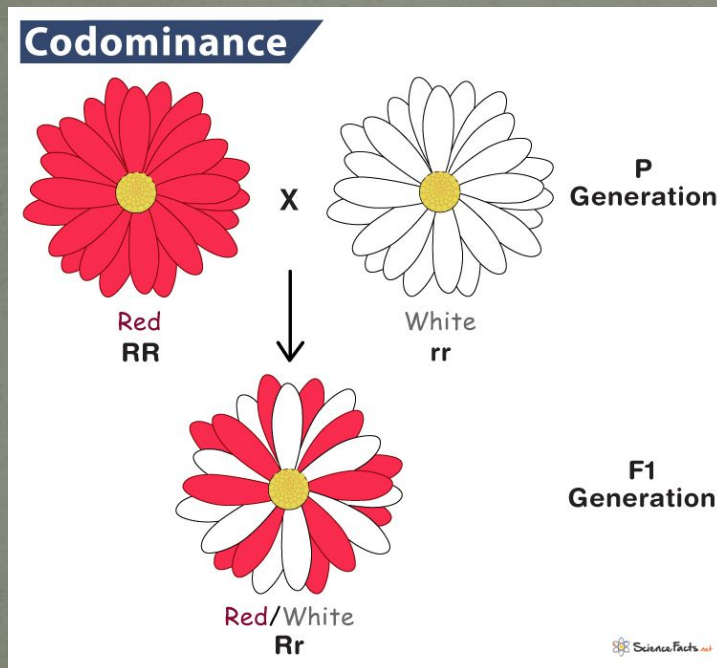
Blood Type (Phenotype)	Type of Antigen	Possible Genotypes
A	A	$I^A I^A$, $I^A i$
B	B	$I^B I^B$, $I^B i$
AB	AB	$I^A I^B$
O	None	ii



Codominance

Codominance : A condition in which both alleles of a gene pair in a heterozygote are fully expressed

- An example in humans would be the **ABO blood group**, where alleles A and alleles B are both expressed.



An example of **Multiple Alleles** and Codominance

Blood Types in Humans

Blood Types

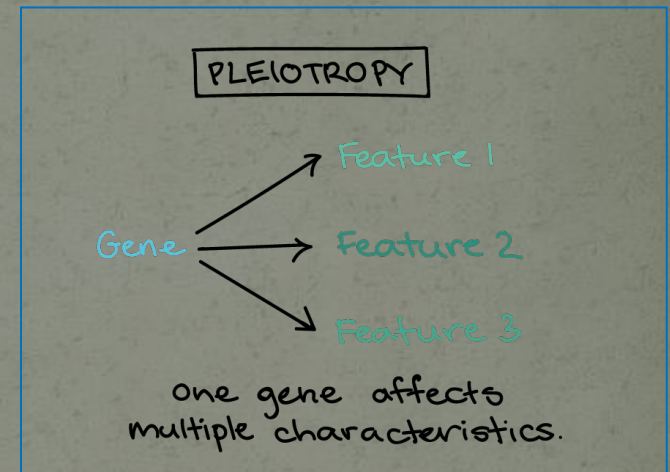
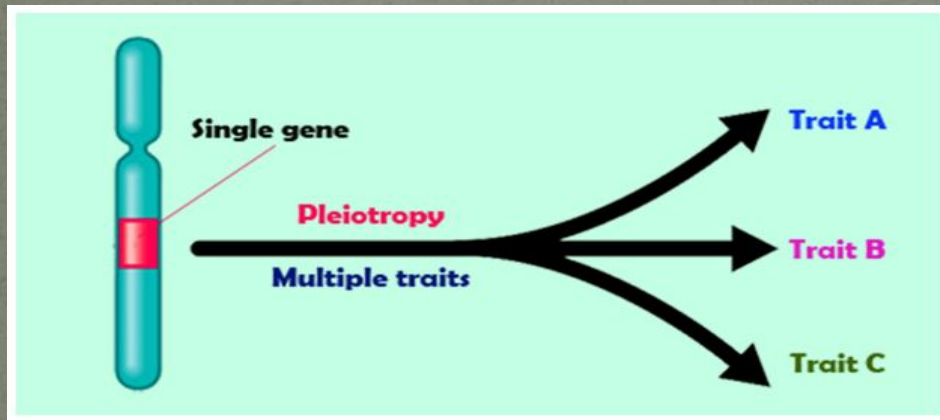
- Human blood type has 3 alleles
 - Dominant A allele
 - Dominant B allele
 - Recessive O allele
- A and B allele are equally codominant

Phenotype (blood type)	Genotype
A	AA or AO
B	BB or BO
AB	AB
O	OO

Pleiotropism

Pleiotropism is the condition in which a single gene controls more than one phenotypic effect, that is completely unrelated.

- **Pleiotropy** is a condition in which a single gene has multiple phenotypic expressions.



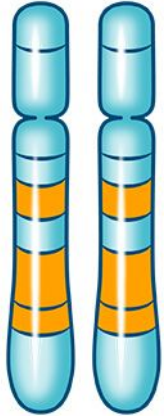
E.g.: **Phenylketonuria** It is an autosomal recessive disorder affecting chromosome number 12 and causes multiple effects such as mental retardation, hypopigmentation of hair and skin.

- **Sickle cell disease** is caused by a problem in the hemoglobin-beta gene found on chromosome 11. The defect forms abnormal hemoglobin.

Sickle cell disease is caused by a problem in the hemoglobin-beta gene found on chromosome 11. The defect forms abnormal hemoglobin.

What is Sickle Cell Disease (SCD)?

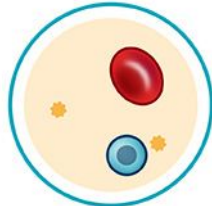
Chromosome 11



Two copies of a mutated Hemoglobin Subunit Beta (HBB) gene



Pain crises due to ischemia



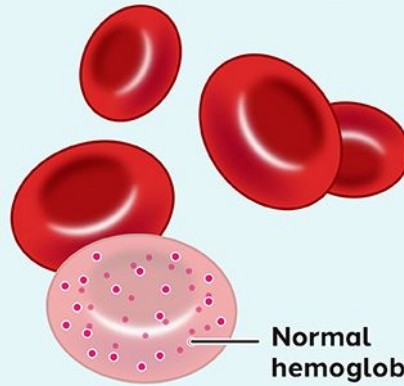
Anemia



Susceptibility to infections

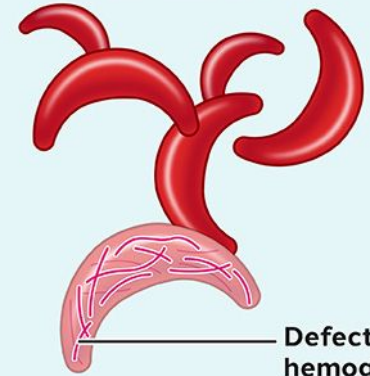


Normal red blood cells



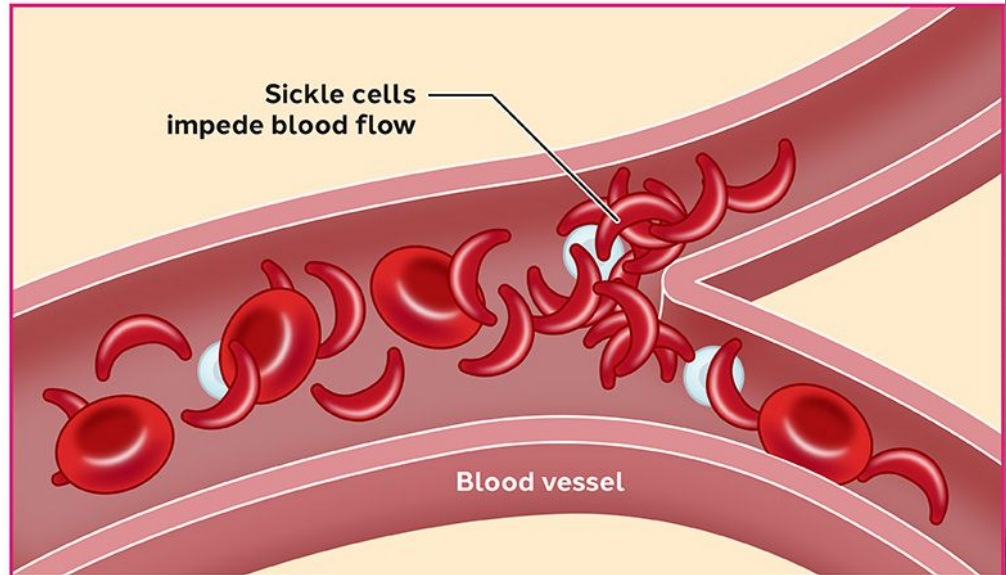
Normal hemoglobin

Sickle cells



Defective hemoglobin

Sickle cells impede blood flow



Blood vessel



CCT **GAG** GAG
 Pro Glu Glu
 5 6 7



CCT **GTG** GAG
 Pro Val Glu
 5 6 7



Normal



-O₂



Sickle

Lethal alleles

Lethal alleles (also referred to as lethal genes or lethals) are alleles that cause the **death of the organism** that carries them.

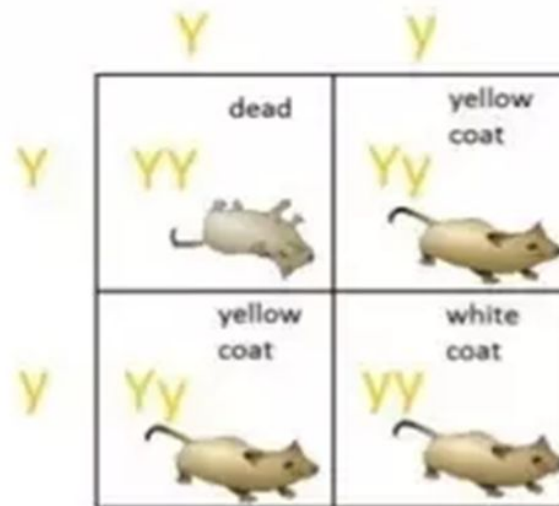
- They are usually a result of mutations in genes

❖ Alleles that cause an organism to die only when present in homozygous condition are called **lethal alleles**.

❖ Lethal alleles are often inherited as recessive mutants, recessive lethal alleles that kill only homozygotes.

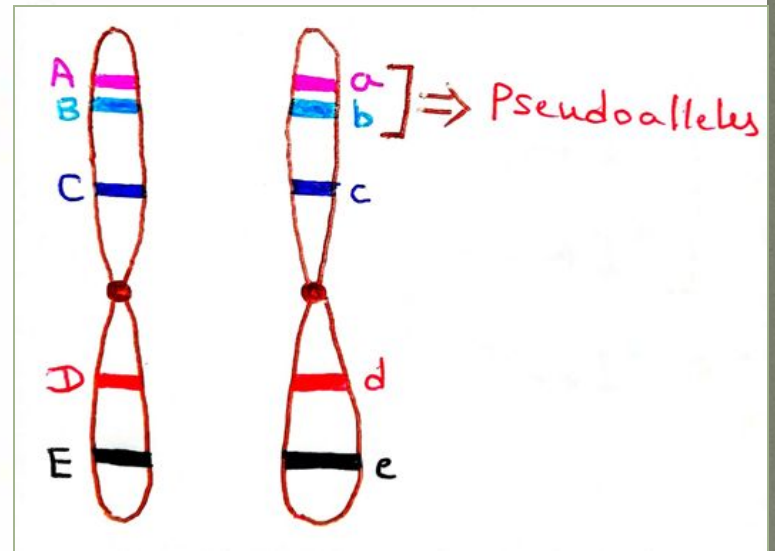
❖ **Example** coat colour gene in mice

❖ 3:1 (viable : dead)



Pseudoalleles

- ❑ Two genes with **similar functions** located so close to one another on a chromosome that they are genetically linked.
- ❑ Affect the **same character**.
- ❑ Given by Morgan(1928) and Lewis(1948).
- ❑ Pseudoallelic series or complex series.
- ❑ Eg: Affect pigmentation in **Drosophila**.



Drosophila melanogaster

Example: Red eye colour of Drosophila

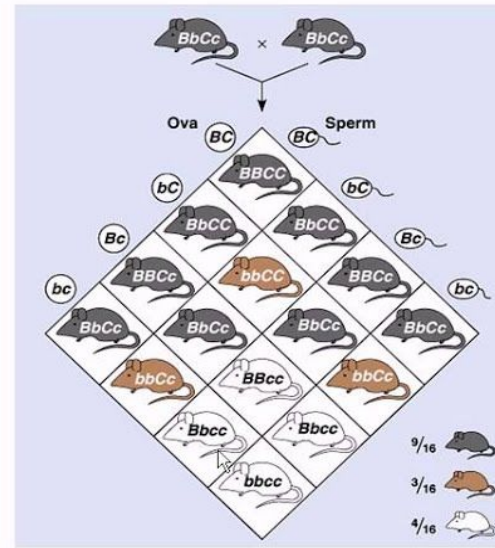
Epistasis

Epistasis occurs between genes where the expression of one gene is masked/inhibited /suppressed by the expression of one or more other genes.

Recessive epistasis ratio: 9:3:4

Dominant epistasis ratio: 12:3:1

- One gene completely masks another gene
 - coat color in mice = 2 separate genes
 - C,c: pigment (C) or no pigment (c)
 - B,b: more pigment (black=B) or less (brown=b)
 - cc = albino, no matter B allele



Test cross and Back cross

BACK CROSS

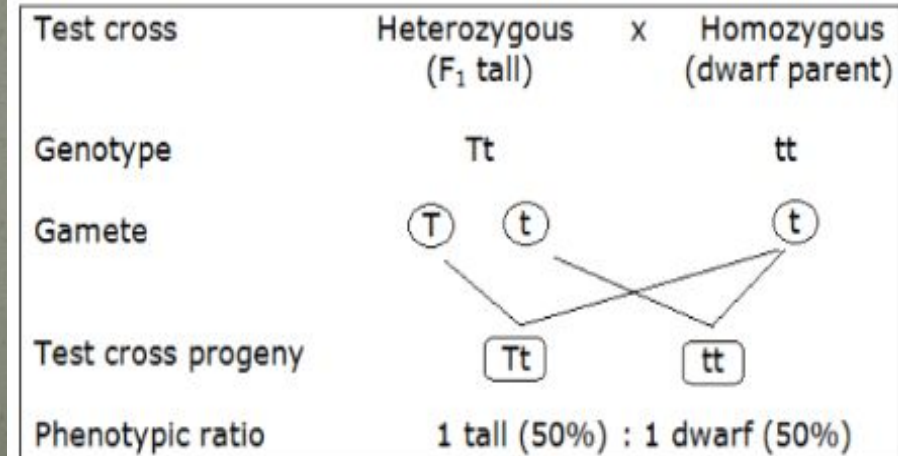
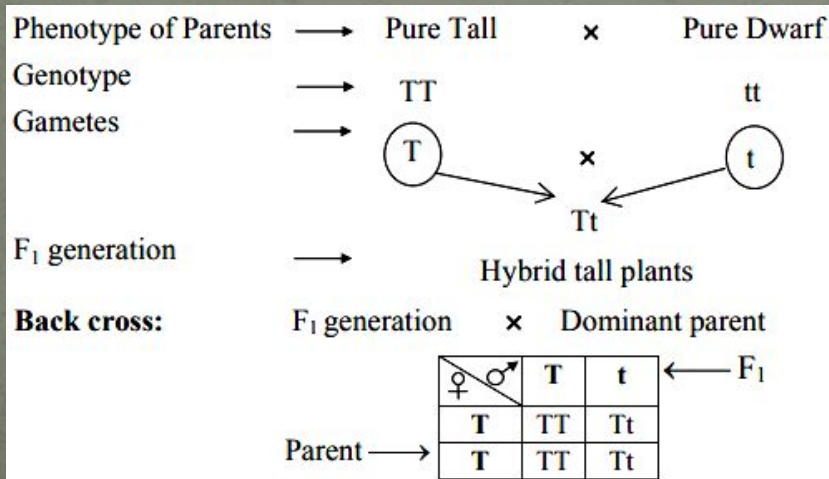
It is a cross involving F₁ progeny and either of the parents

It is used by scientists to improve a breed or variety of plant or animals

TEST CROSS

It is a cross involving F₁ individual and recessive parent

The phenotypes of F₁ progeny is examined to know the genotypes

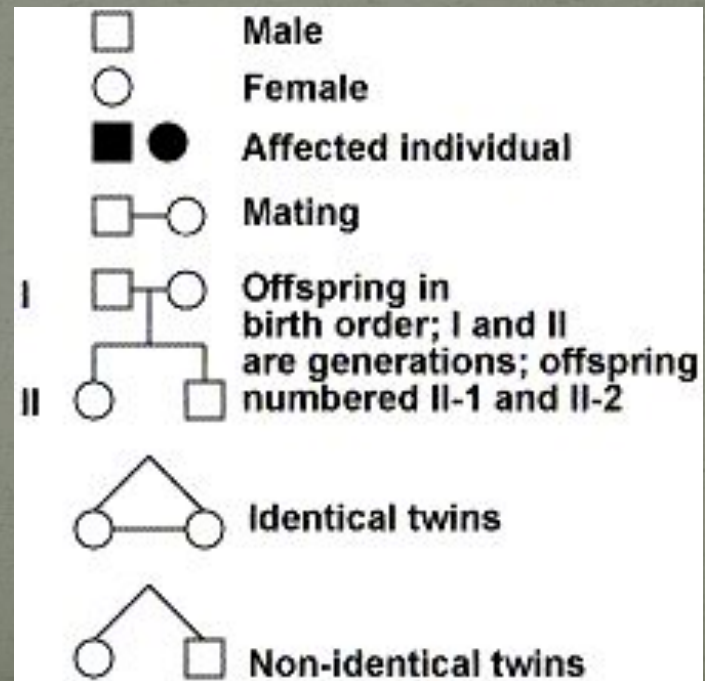


Pedigree Analysis

A **pedigree chart** is a series of symbols used to depict family members affected by a genetic trait in a family tree.

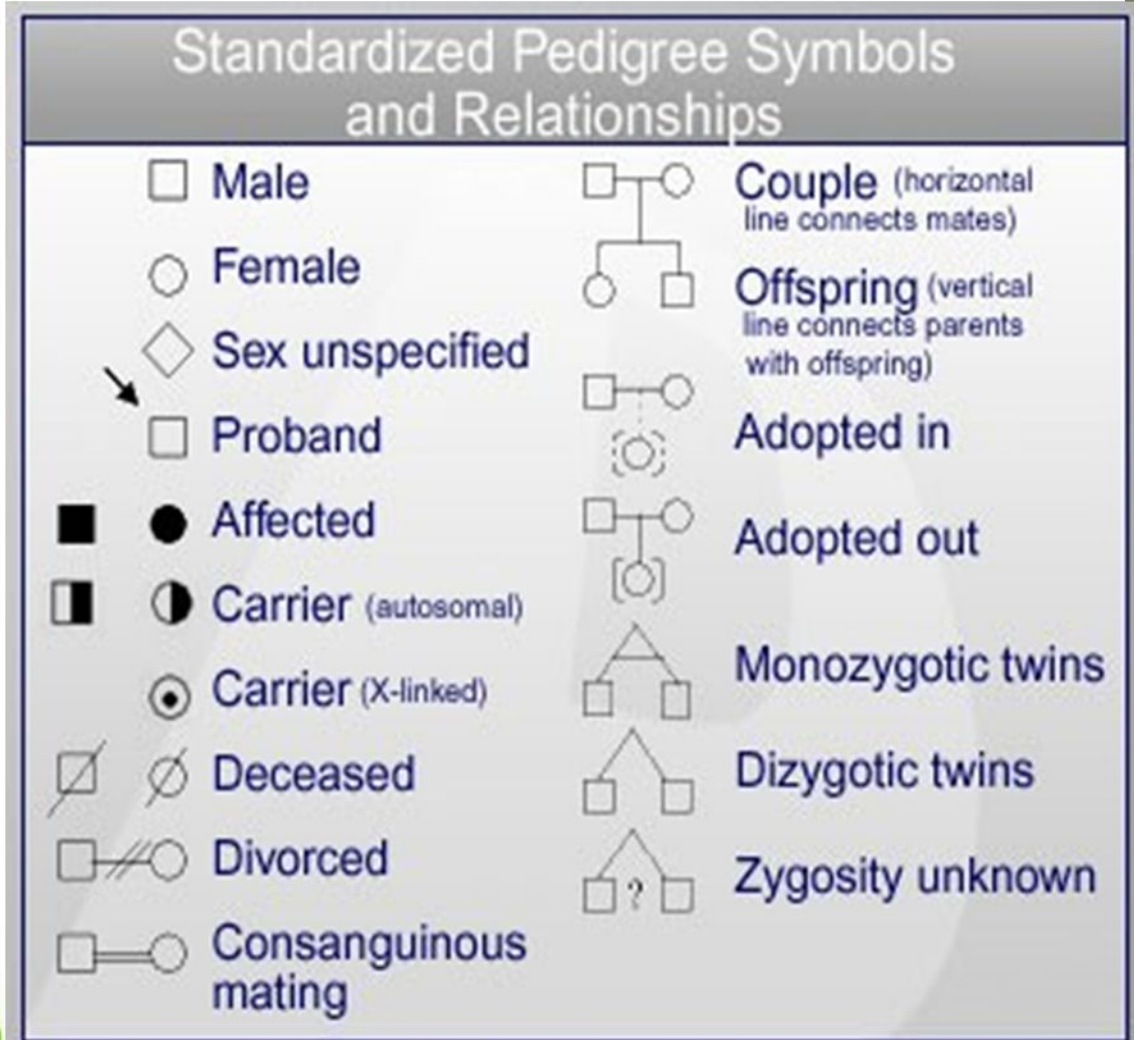
- **Circles** represent females and **squares** represent males in the chart below.
- **Colored shapes** represent individuals affected by a genetic trait
- The **roman numeral** stands for which generation the individuals belong to.
- The **digit** identifies the individual within each generation.

It was developed as a chart that can represent a family tree along with the family members and their genetic traits, respectively.



What is a pedigree?

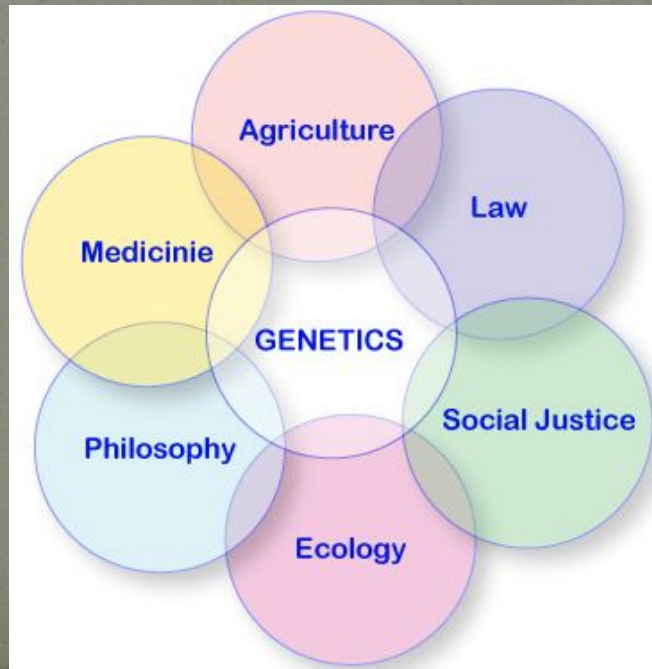
Pedigrees are a “family tree” that is used to show the inheritance of genetic traits/disorders



Significances of Genetic

Genes are the building blocks of life. They contain information for making specific molecules and proteins that allow human cells to function and that control how the body grows and operates.

- Heredity is vital to organisms' **evolution**.
- It describes how genes are passed from one generation to the next.



Identify

Incomplete Dominance or Codominance?



X



Incomplete Dominance



Codominance

MCQ

1. After cross-fertilization of true-breeding tall and dwarf plants, the F1 generation was self-fertilized. The resultant plants have genotype in the ratio

- (a) 1:2:1 (homozygous tall : heterozygous tall : dwarf)
- (b) 1:2:1 (heterozygous tall : homozygous tall : dwarf)
- (c) 3:1 (tall : dwarf)
- (d) 3:1 (dwarf : tall)

Answer: (a)

MCQ

If both genotype and phenotype shows the same ratios of 1:2:1 in the F₂ generation, it shows

- (a) incomplete dominance in monohybrid cross
- (b) complete dominance in monohybrid cross
- (c) dihybrid cross
- (d) co-dominance

Answer: (a)

MCQ

Lack of independent assortment of two genes is due to

- (a) recombination
- (b) crossing over
- (c) linkage
- (d) repulsion

Answer: (c)

MCQ

How many phenotypes can occur in the human blood group ABO with alleles I^A I^B i ?

- A. 2
- B. 3
- C. 4
- D. 1

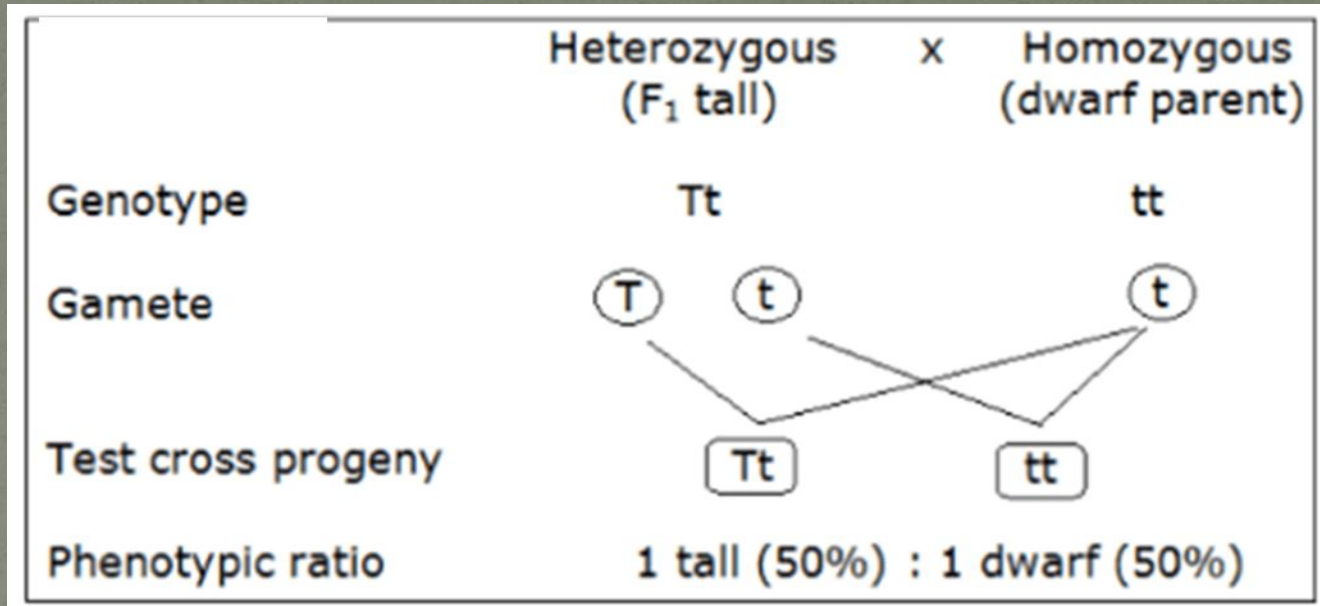
Ans C

MCQ

What is the basic unit of inheritance?

1. Cell
2. Mitochondria
3. Gene
4. Tissue

Answer: Gene



Which types of cross above

- 1) Back cross.
- 2) Test cross.
- 3) Recessive cross.
- 4) Dominant cross.

Test cross.

A cross between tall pea plant and its recessive parent is known as

- (1) Back cross
- (2) Test cross
- (3) Recessive cross
- (4) Dominant cross

Answer: 2



Thank you
