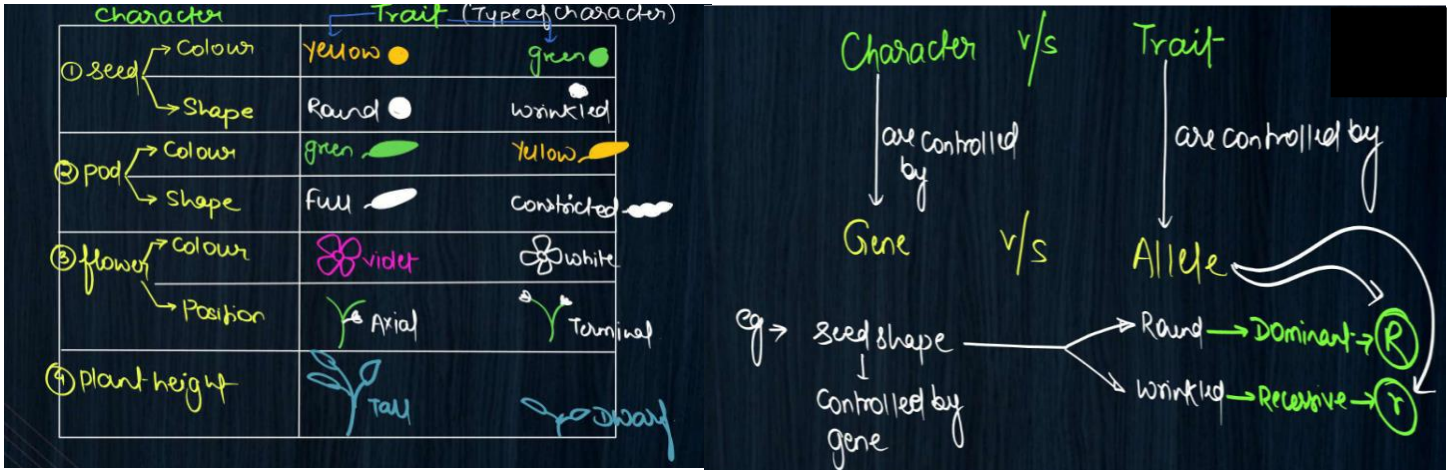
**Genetics** is the study of principles and mechanism of heredity and variation.

- Inheritance -Process by which characters are passed on from parent to progeny. It is the basis of heredity.
- Variation is the degree by which progeny differ from their parents. In terms of morphology, physiology, cytology and behaviouristic traits of individual belonging to same species. Variation arise due to:
  - Reshuffling of gene/chromosomes.
  - Crossing over or recombination
  - Mutation and effect of environment.

**Gregor Johann Mendel**- 'father of Genetics'.




Mendel conducted **Hybridization Experiments** on garden pea (*Pisum sativum*) for 7 years between 1856-1863 and proposed the law of inheritance in living organisms.

**Selection of pea plant:** The main reasons for adopting garden pea (Pisum sativum) for experiments by Mendel were –

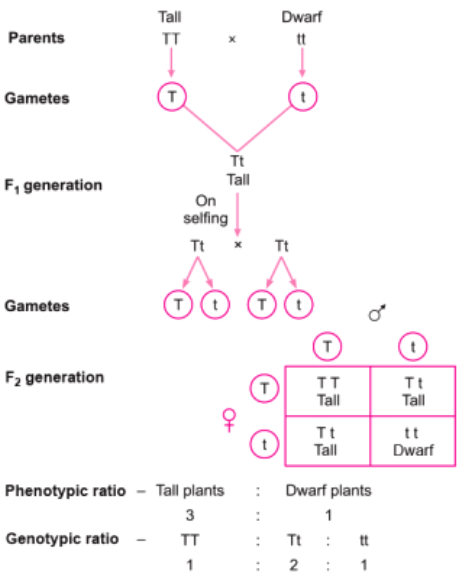
- Pea has many contrasting characters that are easily visible.
- Life span of pea plant is short (3-4 months).
- Flowers are Bisexual that could be easily self-pollinated or cross pollinated.
- Single mating could produce large no. of seeds.
- It is easy to artificially cross-pollinate & thus produce fertile hybrids.
- Easily obtain pure line or true breed (Homozygous TT/tt)

**Working method:**

- Choose 7- Contrasting Characters & studied only one character at a time.
- Used all available techniques to avoid cross-pollination by undesirable pollen grains.
- He applied mathematics and statistics approach.
- Conducted artificial hybridization/cross pollination using true breeding pea lines.
- Hybridization experiment includes emasculation (removal of anther), bagging and transfer of pollen (pollination).

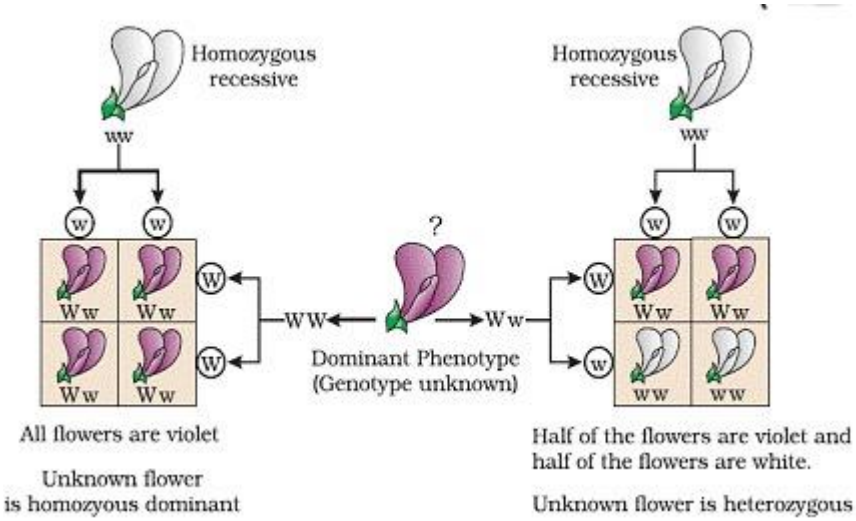
**Inheritance of one gene (Monohybrid cross)-** Cross for one Character

- **Factors** (Gene) discreet unit of inheritance that passes through gametes from one generation to next generation.
- Genes that code for a pair of contrasting traits are known as **alleles**.
- Same alphabetical symbols are used to represent one type of gene, capital letter (TT) for dominant and small letter (tt) for recessive.
- Mendel also proposed that in true breeding tall and dwarf variety allelic pair of genes for height is **homozygous** (TT or tt).
- TT, Tt or tt are called **genotype** and tall and dwarf are called **phenotype**.
- The hybrids which contain alleles which express contrasting traits are called **heterozygous** (Tt).
- F1 Generation- First Filial generation
- F2 Generation – Second Filial Generation.
- Mathematically condensable form of the binomial expression $(ax + by)^2$.




**Punnet Square**- Graphical representation to calculate the probability of all possible genotypes of offspring. It was developed by R. C. Punnet (British Geneticist).

**Test cross** is the cross between an individual with dominant trait and a recessive organism in order to know whether the dominant trait is homozygous or heterozygous.




**Principle or Law of Inheritance**

Based on observations of monohybrid cross, Mendel proposed two law of inheritance-

1. **Law of dominance**– states that –

**a.** Characters are controlled by discrete units called factors.

**b.** Factors always occur in pair.

**c.** In a dissimilar pair of factors one member of pair dominate the other.

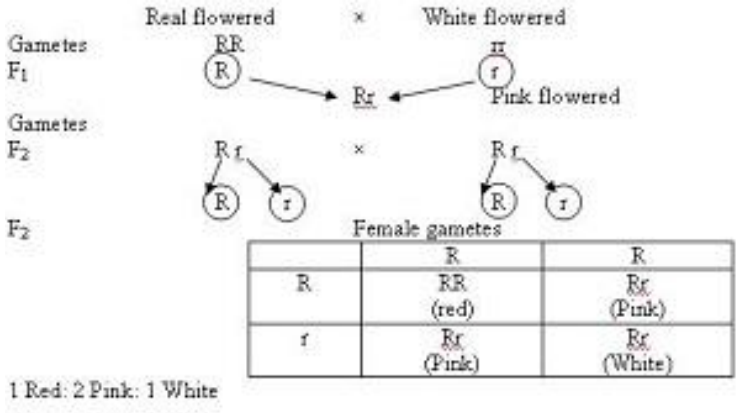
**d.** Dominant: The character which express itself in a dissimilar pair of factor (Tt) or heterozygous condition.

**e.** Recessive: The character which express itself in a dissimilar pair of factor. Express itself in homozygous condition only (eg- tt)

2. **Law of Segregation-** Alleles do not blends and both the characters are recovered during gametes formation as in F2 generation. During gametes formation traits segregate (separate) from each other and passes to different gametes. Homozygous- similar gametes. Heterozygous- different gametes.

**Incomplete dominance**

- It is a post Mendelian discovery.
- In heterozygous allelic condition one allele is not able to completely dominant over other result in hybrid expression.
- F1 generation do not resemble any of the parent.
- There is no blending of gene as in F2 generation the parental combinations are also obtained.
- In dog flower (snapdragon or Antirrhinum sp.) Two true breeds Red flowered and White flowered on crossing possess pink flowers in F1 generation. On selfing them, F2 generation has 1red: 2 pink: 1white.




- Another Ex4:'o'clock flower (Mirabilis Jalapa)

**Co-dominance**

- It is the phenomenon in which both the alleles express themselves.
- ABO blood group in human controlled by gene *I*. The gene has three alleles in which $I^A$, $I^B$ dominant over *i.*
- The plasma membrane of the RBC has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene.

- When $I^A$ and $I^B$ are present together, both express their own types of sugars because of co-dominance i.e. AB Blood group.

| Allele from Parent 1 | Allele from Parent 2 | Genotype of offspring | Blood types of offspring |
|---|---|---|---|
| $I^A$ | $I^A$ | $I^A I^A$ | A |
| $I^A$ | $I^B$ | $I^A I^B$ | AB |
| $I^A$ | $i$ | $I^A i$ | A |
| $I^B$ | $I^A$ | $I^A I^B$ | AB |
| $I^B$ | $I^B$ | $I^B I^B$ | B |
| $I^B$ | $i$ | $I^B i$ | B |
| $i$ | $i$ | $i\,i$ | O |