

History of Genetics

- ❖ Gregor Johann Mendel was a scientist who is recognized as the Father and Founder of genetics.
- ❖ Mendel conducted many experiments on the pea plant (*Pisum sativum*) between 1855 and 1866.
- ❖ He studied the results of the experiments and deduced many observations. Thus, laws of inheritance or Mendel's laws of inheritance came into existence.
- ❖ Before learning about Mendel's laws of inheritance, it is important to understand what the experiments performed by Mendel were.

Mendel's Experiments on Pea Plant

- ❖ Mendel after carefully study selected the pea plant for many reasons:
- ❖ The pea plants were easy to grow and maintain
- ❖ It has many clearly distinct and contrasting characters.
- ❖ The pea plant is an annual plant and so many generations of the plant can be studied in a short period of time.
- ❖ Peas are naturally self-pollinating but can also be cross-pollinated.
- ❖ Mendel made a list of contrasting characters which he studied:

	Flower Colour	Plant Height	Seed Color	Seed Shape	Pod Colour	Pod Shape	Flower Position
Dominant Trait	 Purple	 Tall	 Yellow	 Round	 Green	 Inflated (full)	 Axial
Recessive Trait	 White	 Short	 Green	 Wrinkled	 Yellow	 Constricted (flat)	 Terminal

Some Basic Terms

- ❖ **Genes** – section of a chromosome; control what traits any living thing will have and controls what traits a living thing can pass to its young.
- ❖ **Dominant Trait** – trait that hides another trait.
- ❖ **Recessive Trait** – trait that is hidden.
- ❖ **Pure Breeding or True Breeding** – when the traits of the offsprings are the same as the parent plant for several generations.
- ❖ **P Generation** – parent generation.

Some Basic Terms

- ❖ **Allele** - is one of two or more forms of a gene; groups of genes.
- ❖ **F1 Generation** – first filial generation, or the offsprings of P generation.
- ❖ **F2 Generation** – second filial generation, or the offsprings of F1 generation.
- ❖ **Genotype** – genetic makeup of the cell.
- ❖ **Phenotype** – organism's observable characteristics or traits; external appearance of an individual.

Some Basic Terms

- ❖ **Homozygous** – has 2 of the identical (same) alleles of a gene.
- ❖ **Heterozygous** – has 2 different alleles of a gene.
- ❖ **Punnett Square** – is a diagram that is used to predict an outcome of a particular cross or breeding experiment.
- ❖ **Heredity** – passing of traits to offspring.

Mendel Experiment

- ❖ Mendel structured his experiments in a way that he would observe one pair of contrasting characters at one time. He began his experiments using purebred lines for contrasting characters.
- ❖ He cross-pollinated two pure lines for contrasting characters and the resultant offsprings were called F1 generation(also called the first filial generation). The F1 generations were then self-pollinated which gave rise to the F2 generation of second filial generation.

Results of Mendel's Experiments

- ❖ Let us look at the results of Mendel's experiments on crossing a pure tall pea plant with a pure short pea plant.
- ❖ In the F1 generation, Mendel observed that all plants were tall. there were no dwarf plants.
- ❖ In the F2 generation, Mendel observed that 75% of the offsprings were tall whereas 25% were dwarf.
- ❖ Similar results were found when Mendel studied other characters.
- ❖ Mendel observed that in the F1 generation, the characters of only one parent appeared whereas, in the F2 generation, the characters of the other parent also appeared.
- ❖ The characters that appear in the F1 generation are called dominant traits and those that appear for the first time in the F2 generation are called recessive traits.

Conclusions

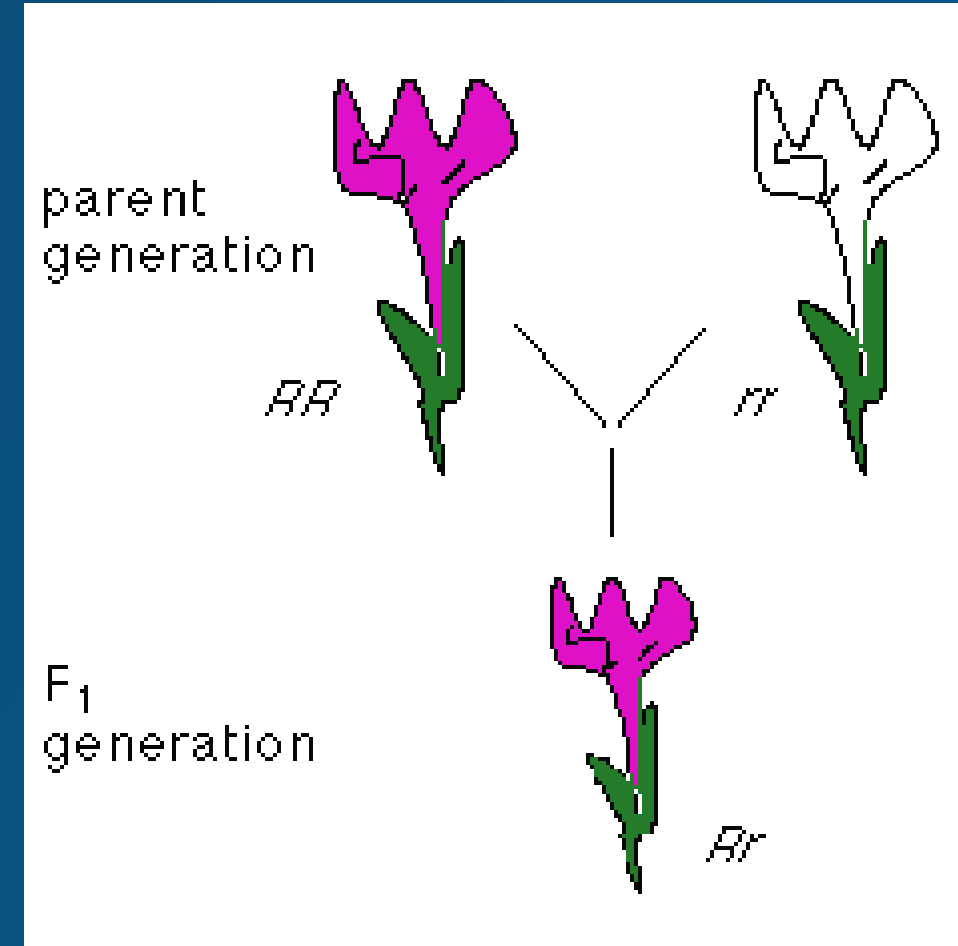
- ❖ The genes that are passed from the parents to the offsprings exist in pairs. These pairs are called **alleles**.
- ❖ When the two alleles are the same, they are called **homozygous**. When both the alleles are different, they are called as **heterozygous**.
- ❖ Dominant characters are described using capital letters and recessive using small letters. For example, the dominant genes for tallness in a pea plant are written as TT and recessive genes as tt. The heterozygous genes are written as Tt where the plant appears tall has the recessive gene which might express itself in the future generations.
- ❖ The appearance of the plant is known as the **phenotype** whereas the genetic makeup of the plant is called the **genotype**. So, a plant with Tt genes appears tall phenotypically but has a recessive gene.
- ❖ During gametogenesis, when the chromosomes become half in the gametes, there is a 50% chance of either of the alleles to fuse with that of the other parent to form a zygote.

Laws of Inheritance

- ❖ Based on these observations, Mendel proposed three laws.
- ❖ Law of Dominance
- ❖ The Law of Segregation
- ❖ Law of independent assortment

1. Law of Dominance

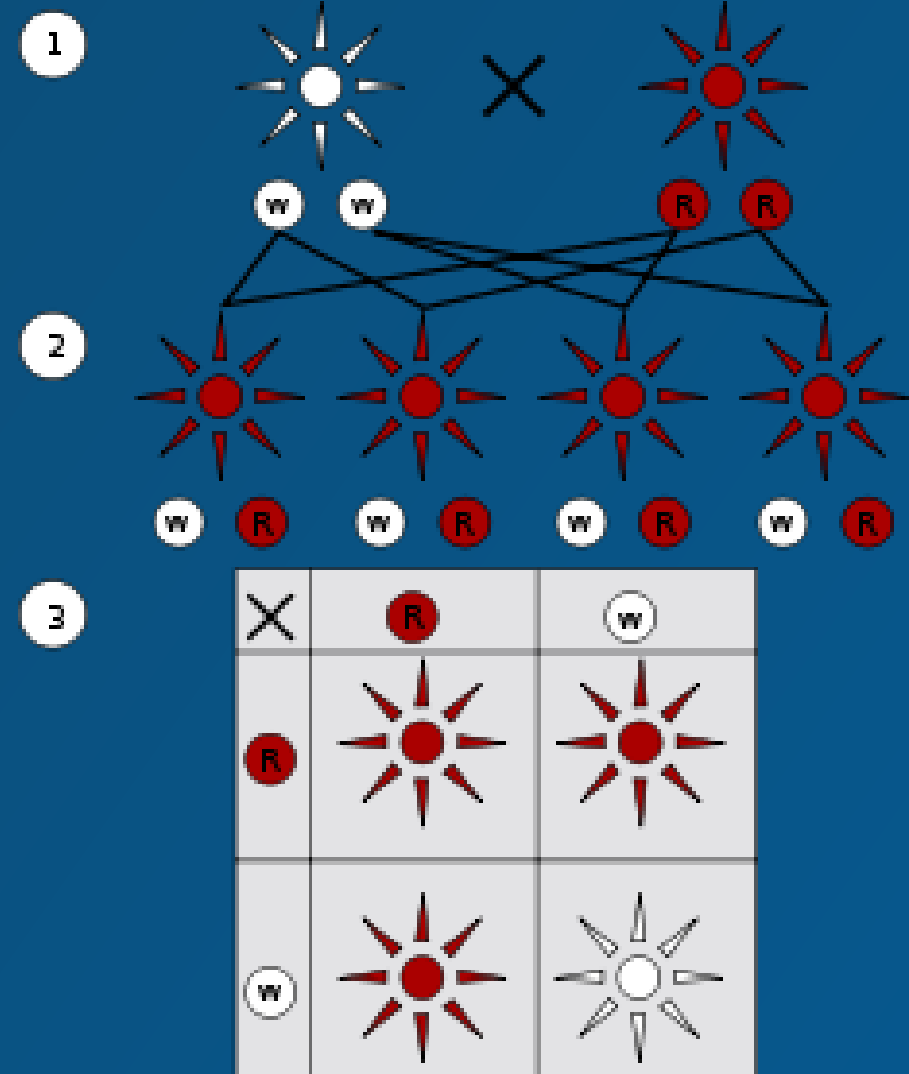
❖ This law states that in a heterozygous condition, the allele whose characters are expressed over the other allele is called the dominant allele and the characters of this dominant allele are called dominant characters. The characters that appear in the F₁ generation are called as dominant characters. The recessive characters appear in the F₂ generation.



2. Law of Segregation

❖ This law states that when two traits come together in one hybrid pair, the two characters do not mix with each other and are independent of each other. Each gamete receives one of the two alleles during meiosis of the chromosome.

❖ Mendel's law of segregations supports the phenotypic ratio of 3:1 i.e. the homozygous dominant and heterozygous offsprings show dominant traits while the homozygous recessive shows the recessive trait.



3. Law of Independent Assortment

- ❖ This means that at the time of gamete formation, the two genes segregate independently of each other as well as of other traits. Law of independent assortment emphasizes that there are separate genes for separate traits and characters and they influence and sort themselves independently of the other genes.
- ❖ This law also says that at the time of gamete and zygote formation, the genes are independently passed on from the parents to the offspring.

