AUG
Faculty of Computer and Information Sciences
Ain Shams University

Session 3

Heredity

◆ Introduction

- Mendelian inheritance is a set of primary tenets relating to the transmission of hereditary characteristics ***from parent organisms to their children***; it underlies much of genetics.
- The tenets were initially derived from the work of **Gregor Mendel** published in 1865 and 1866, which was "re-discovered" in 1900; they were initially very controversial, but they soon became the core of classical genetics.
- The laws of inheritance were derived by **Gregor Mendel**, in the 19th century conducting **hybridization experiments** in **garden peas**.
- He spent 7 years, between 1856 and 1863, growing and testing about 28,000 **Pea plants**.
- From these experiments, he deduced two **generalizations** that later became known as ***Mendel's Laws of Heredity*** or Mendelian inheritance. He described these laws in a two part paper, "Experiments on Plant Hybridization", which was published in 1866.

◆ Mendel's Theory

- Why did he select a pea plant for his experiments?
    - The pea plant can be easily grown and maintained.
    - They are naturally self-pollinating but can also be cross-pollinated.
    - It is an annual plant, therefore, many generations can be studied within a short period of time.
    - It has several contrasting characters.

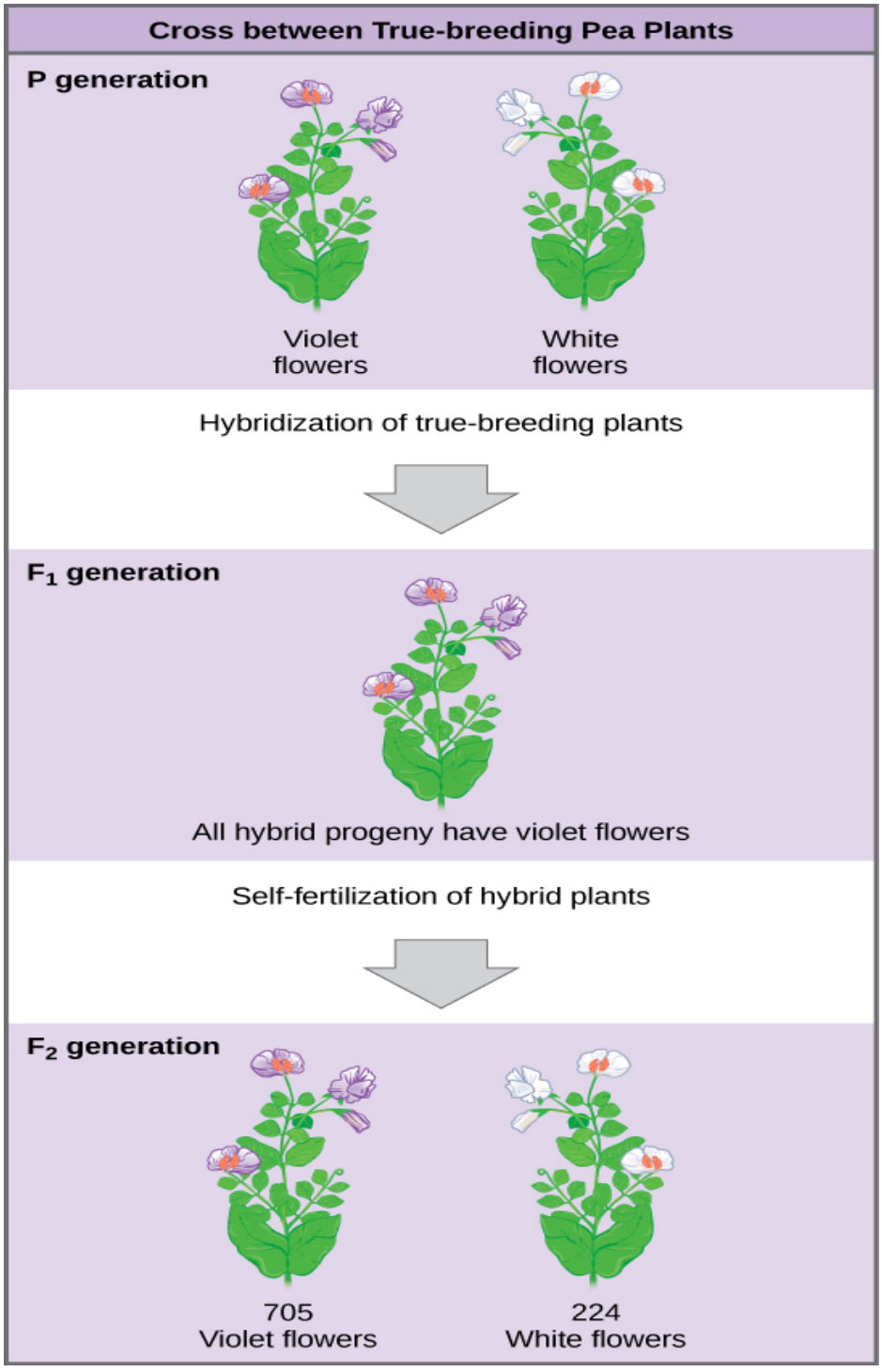
- Mendel conducted 2 main experiments to determine the laws of inheritance. These experiments were: Monohybrid & Dihybrid Cross Experiment

- While experimenting, Mendel found that certain factors were always being transferred down to the *offspring* in a stable way. Those factors are called genes.

- He experimented and *Considered* *7 main contrasting traits* *in the plants*. Then, conducted both the experiments to determine laws of inheritance.

	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

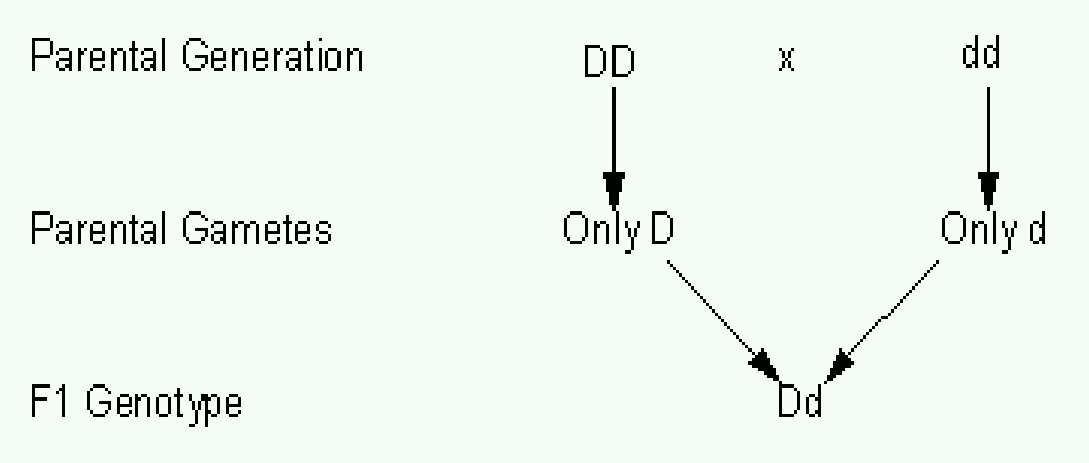
◆ Mendel's Laws

- Mendel discovered that by crossing:
  true breeding ***white flower*** and true breeding ***purple flower*** plants
- The result was a hybrid offspring, rather than being a mix of the two colors,
  the offspring was purple flowered ----------> (F1)
- 

- # Mendel's Conclusions
  - Conceived the idea of heredity units, which he called "**factors**"
  - Characteristics are **Dominant - سائد** & **Recessive - متنحى**.
  - "factors", later called "**Genes**".
  - Each parent has a gene pair in each cell for each trait studied.
  - The **F1** from a cross of two pure lines contains ***one allele for the dominant phenotype and one for the recessive phenotype***, These two alleles comprise the gene pair.
  - ***One member of the gene pair segregates into a gamete***
  - ***Each gamete only carries one member of the gene pair.***
  - ***Gametes unite at random and irrespective of the other gene pairs***.

- **Genetics Definitions**
  - **Allele**: one alternative form of a given allelic pair; tall and dwarf are the alleles for the height of a pea plant; more than two alleles can exist for any specific gene, ***but only two of them will be found within any individual.***

  - **Allelic pair**: the combination of two alleles which comprise the gene pair.



- **<u>Homozygote</u>**: an individual which contains only one allele at the allelic pair; for example ***DD*** is homozygous dominant and ***dd*** is homozygous recessive; pure lines are homozygous for the gene of interest.
- **<u>Heterozygote</u>**: an individual which contains one of each member of the gene pair; for example the ***Dd*** *heterozygote*.
- **<u>Genotype:</u>** the ***specific allelic combination*** for a certain gene.

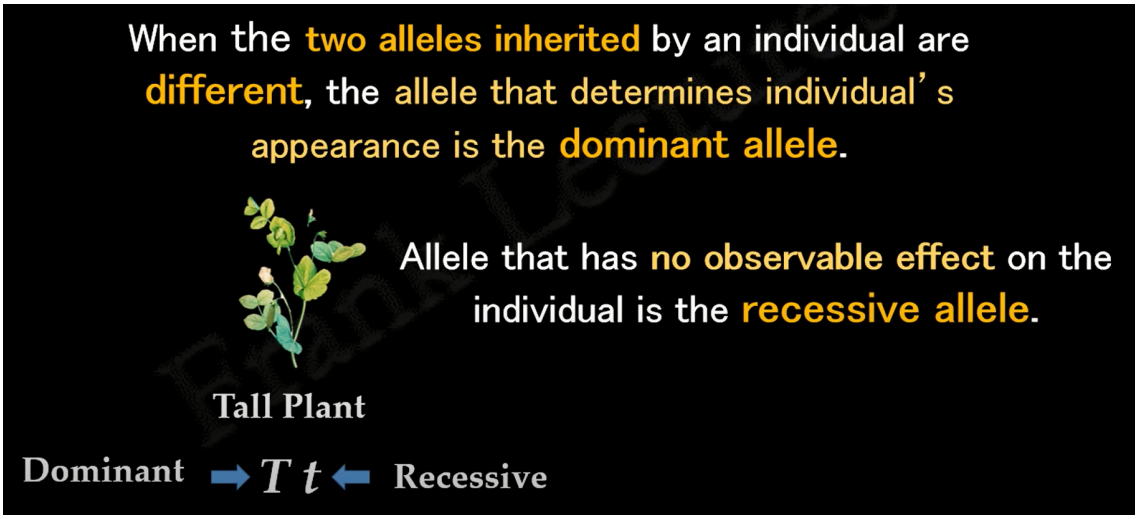
- **Mendel's Laws of Inheritance**

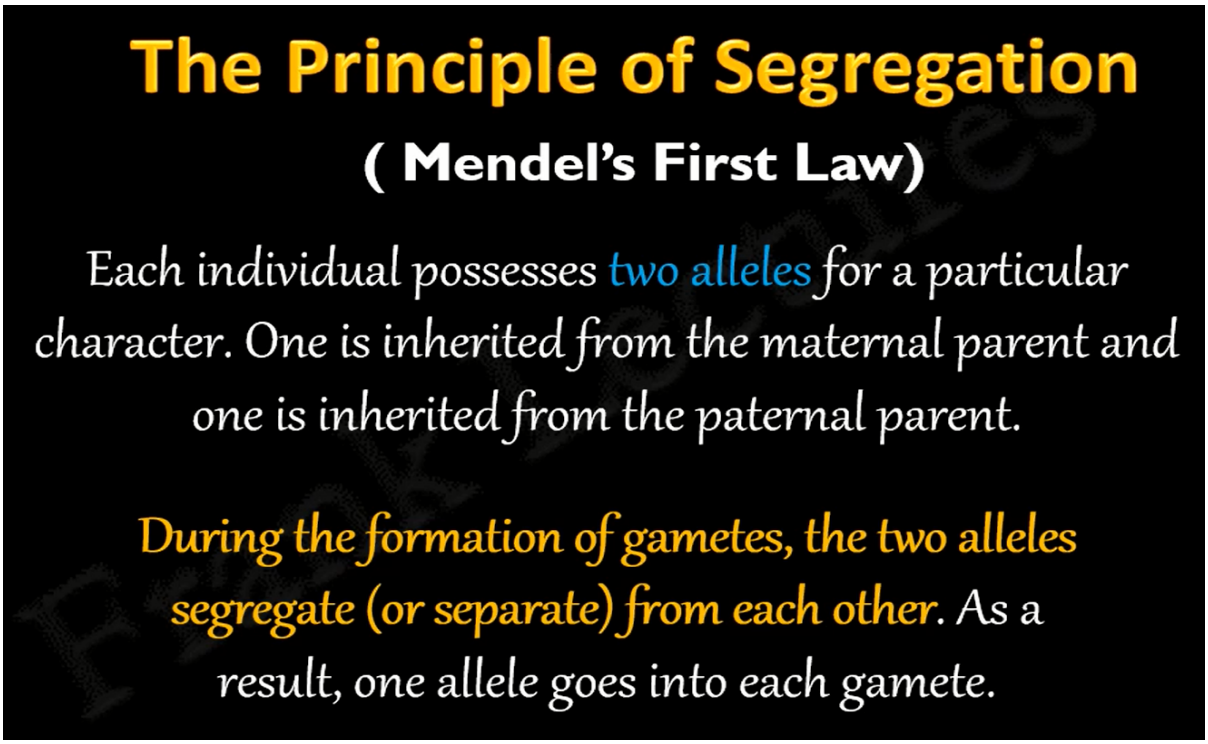
  1) Mendel's 1st Law (segregation)

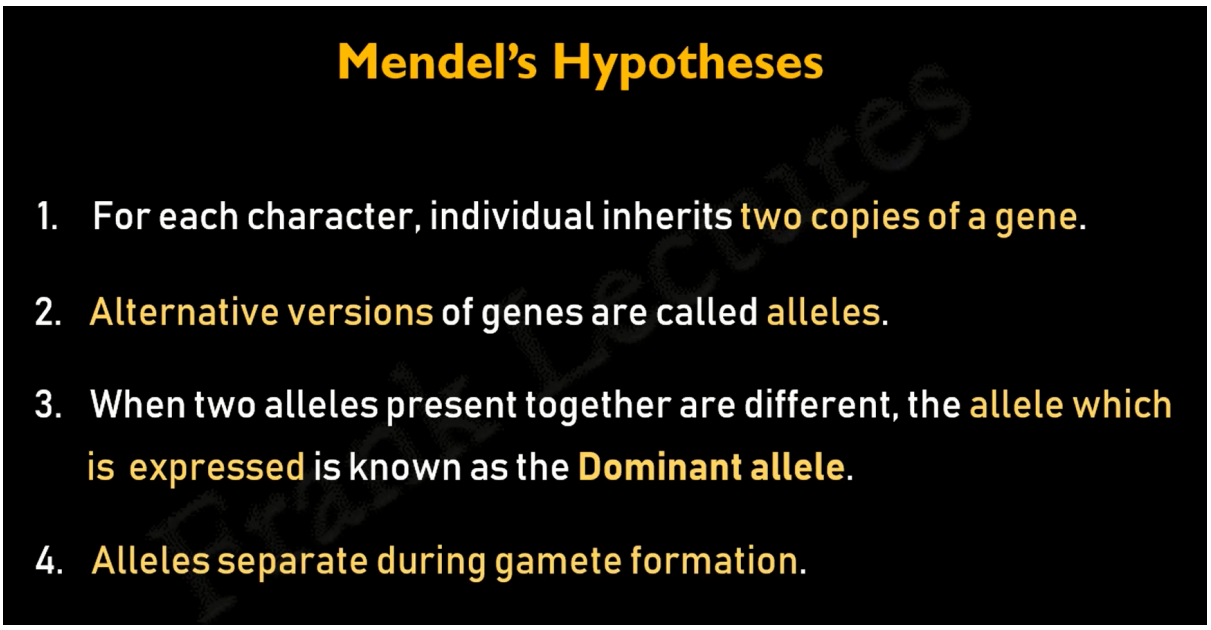
  2) Mendel's 2nd Law (independent assortment)

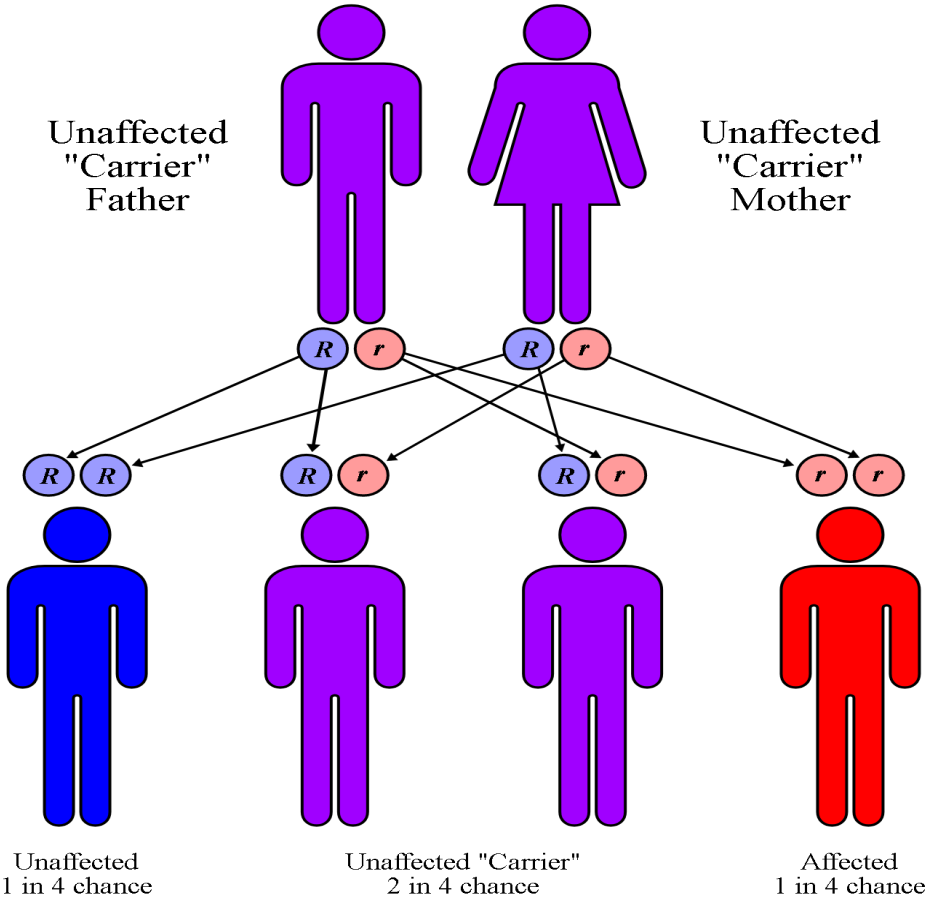
  3) Law of Dominance

- **Law of Dominance**
  - In a heterozygote, ***the allele which masks the other is referred to as dominant***, while ***the allele that is masked is referred to as recessive***.
  - For example, if the two alleles are different **Dd** so the **D** will mask **d** as **D** is the Dominant *allele* & **d** is *recessive allele.*



- **Mendel's 1st Law (segregation)**
  - Mendel's Law of Segregation states that a diploid organism passes a randomly selected allele for a trait to its offspring, such that the offspring receives one allele from each parent.
  - 

  - 



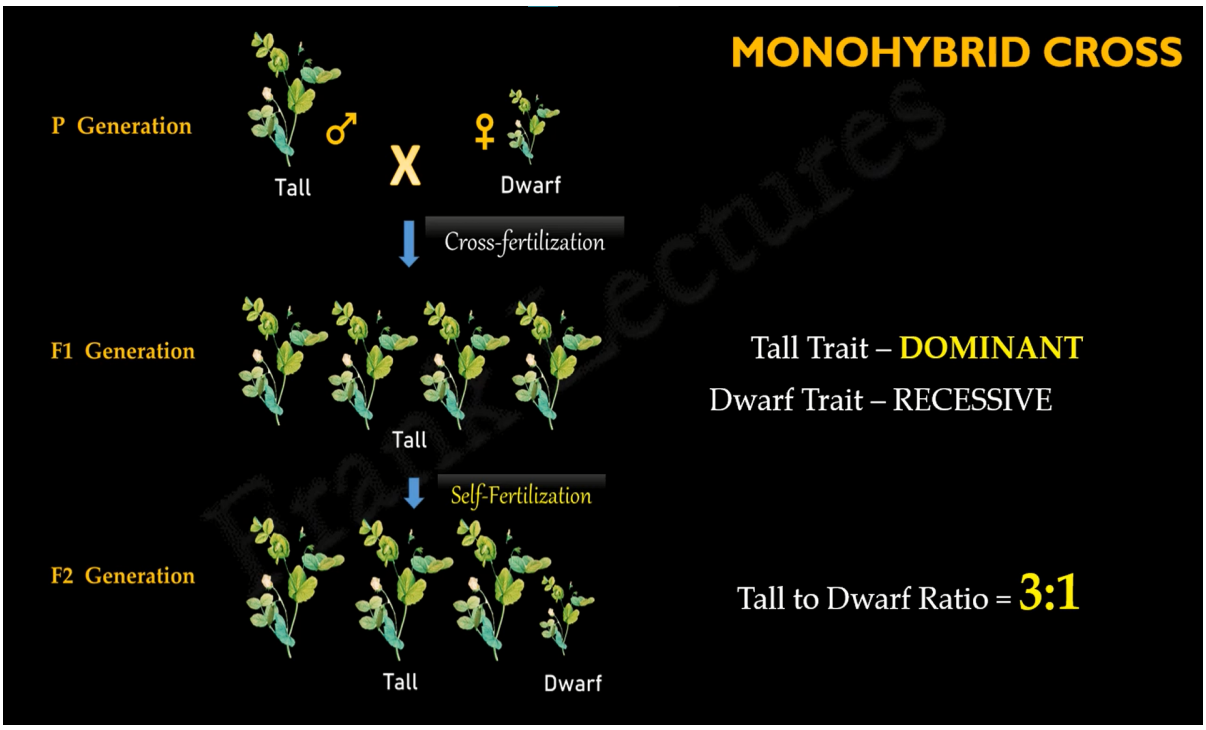
- The **F2** generation ***was created by selfing the F1 plants***.

Union of Gametes At Random		D	d
	D	DD (Tall)	Dd (Tall)
	d	Dd (Tall)	dd (Short)

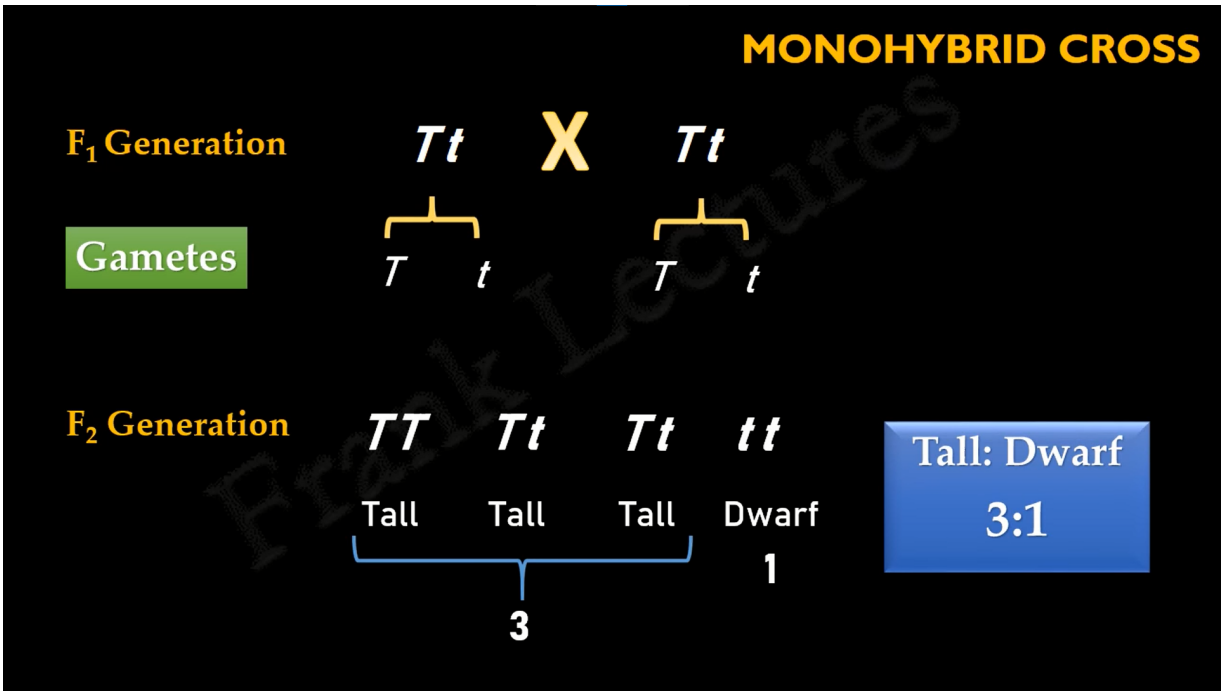
Punnett Square

- Capital **D** for the ***Dominant*** factor & Lowercase **d** for the ***Recessive*** factor.
  - **Genotypic ratio of F_2:** 1 DD : 2 Dd : 1 dd (3 D_ : 1 dd)
    Phenotypic ratio of F_2: 3 tall : 1 small

- **Monohybrid Cross**



- For the F2 generation of a monohybrid cross
- the following three possible combinations of genotypes could result: homozygous dominant, heterozygous, or homozygous recessive.
- Because heterozygotes could arise from two different pathways (receiving one dominant and one recessive allele from either parent), and because heterozygotes and homozygous dominant individuals are phenotypically identical, [3:1].
- the law supports Mendel's observed 3:1 phenotypic ratio.
- The equal segregation of alleles is the reason we can apply the Punnett square to accurately predict the offspring of parents with known genotypes.
- This can be depicted graphically in a ***Punnett square***
  It allows us to ***determine specific genetic ratios***.
- After Mendel self-fertilized the **F1** generation and obtained an **F2** generation with a **3 :1 ratio**, he correctly theorized that genes can be paired in three different ways for each trait: **DD** & **Dd** & **dd**.

- 

    - For the F2 generation of a monohybrid cross, the following three possible combinations of genotypes could result: homozygous dominant, heterozygous, or homozygous recessive.
    - Because heterozygotes could arise from two different pathways (receiving one dominant and one recessive allele from either parent), and because heterozygotes and homozygous dominant individuals are phenotypically identical, the law supports Mendel's observed 3:1 phenotypic ratio. The equal segregation of alleles is the reason we can apply the Punnett square to accurately predict the offspring of parents with known genotypes.

- **Mendel's 2nd Law(Independent Assortment)**
    - **Fast Recapping on Heredity**
    - **Mendel's Second Law: Independent Assortment**
    - **Mendel's Second Experiment: Dihybrid Cross**

To be Continued..