

















## Session 4

# Heredity II

### ❖ Fast Recapping

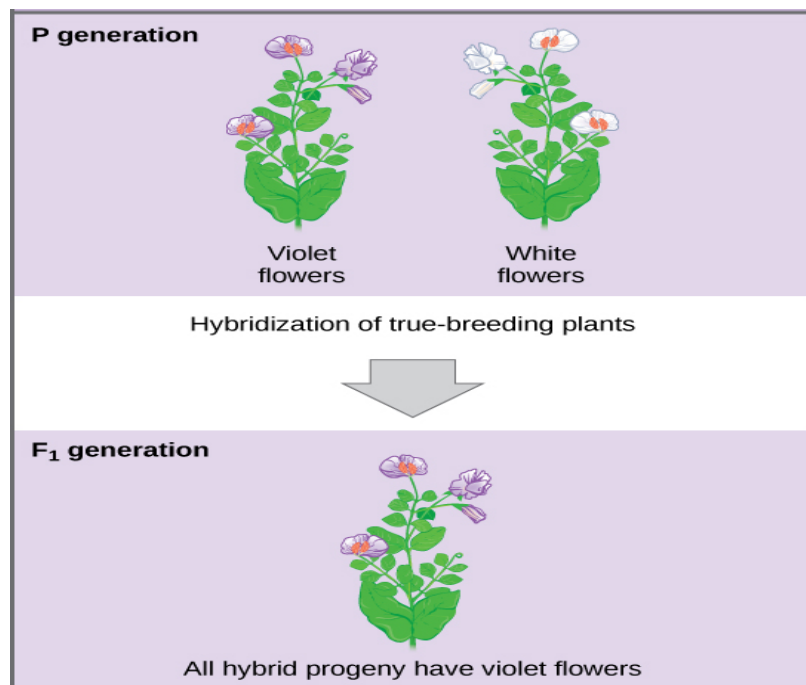
- ◇ Mendelian inheritance is a set of primary tenets, underlies much of genetics, relating to the transmission of hereditary characteristics *from parent organisms to their children*.
- ◇ **Mendel** spent 7 years, between 1856 and 1863, growing and testing about 28,000 **Pea plants**, he did two experiments, he deduced two **generalizations** that later became known as *Mendel's Laws of Heredity* or Mendelian inheritance. He described these laws in a paper, named "Experiments on Plant Hybridization", published in 1866.
- ◇ 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 two experiments: **Monohybrid Cross & Dihybrid Cross** to determine the laws of inheritance.

- ◇ He **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
<b>Dominant Trait</b>	 Purple	 Tall	 Yellow	 Round	 Green	 Inflated (full)	 Axial
<b>Recessive Trait</b>	 White	 Short	 Green	 Wrinkled	 Yellow	 Constricted (flat)	 Terminal

## ◇ Mendel's Laws

- Mendel discovered that by crossing: **white flower** and **purple flower**  
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**” => “**Genes**”, Characteristics are **Dominant - سائد** & **Recessive - متحي**, Each parent has a gene pair in each cell for each trait studied, One member of the gene pair segregates into a gamete, Each gamete only carries one member of the gene pair, Gametes unite randomly and irrespective of the other gene pairs.

### Mendel's Hypotheses

1. For each character, individual inherits **two copies of a gene**.
2. **Alternative versions** of genes are called **alleles**.
3. When two alleles present together are different, the **allele which is expressed** is known as the **Dominant allele**.
4. **Alleles separate during gamete formation**.

## ◇ Genetics Definitions

- **Allele**: one alternative form of a given allelic pair.
- **Allelic pair**: the combination of two alleles which comprise the gene pair.
- **Genotype**: the *specific allelic combination* for a certain gene.

## ◇ Mendel's Laws of Inheritance

- **Law of Segregation**:  
Alleles are separated during the gametes formation, so that each gamete carries only one allele for each gene
- **Law of Independent Assortment**::  
Segregation of alleles for gene occurs independently to any other gene
- **Principle of Dominance**:  
Recessive alleles will be masked by dominant alleles

◇ For the F<sub>2</sub> generation, there are three combinations of genotypes:

HD	⇒	Homozygous Dominant
HZ	⇒	Heterozygous
HR	⇒	Homozygous Recessive

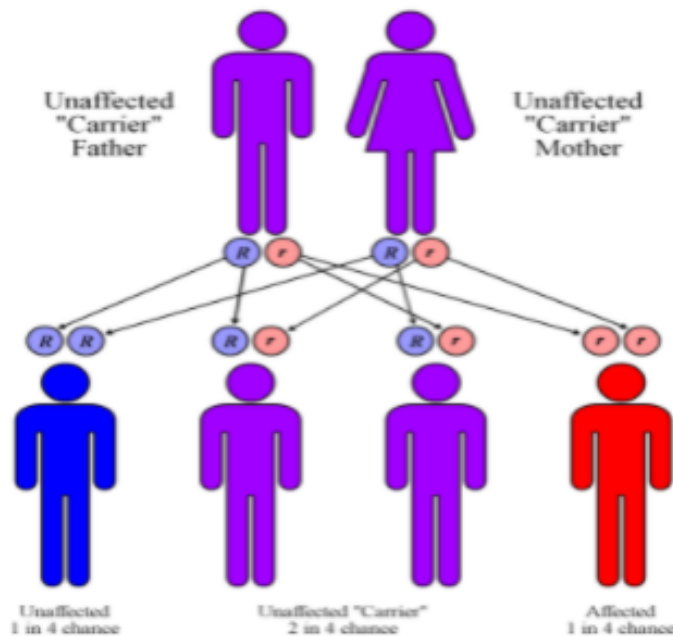
## ◇ Law of Dominance

- In a heterozygous **HD**, the allele which masks the other is referred to as **dominant**, while the allele that is masked is referred to as **recessive**.

## ◇ Mendel's 1st Law (segregation)

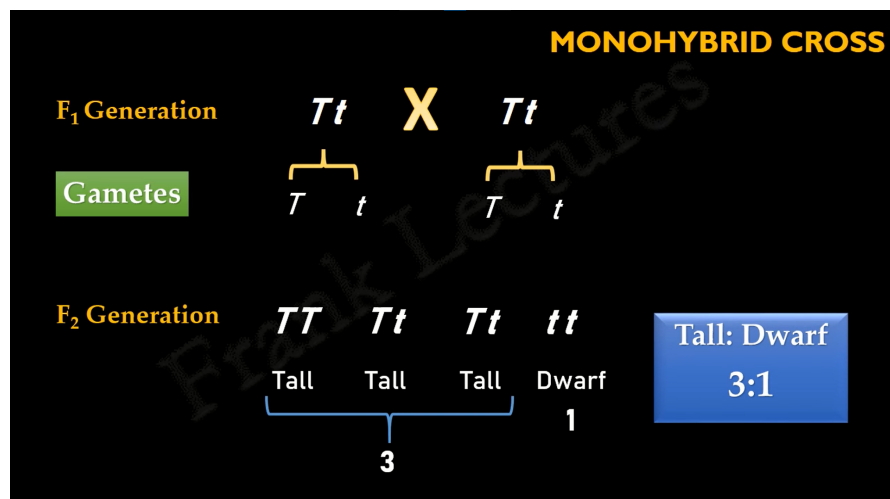
- States that a diploid organism passes a randomly selected allele to its offspring, such that the offspring receives one allele from each parent.

The **F<sub>2</sub>** generation **was created by selfing the F<sub>1</sub> Generations**.



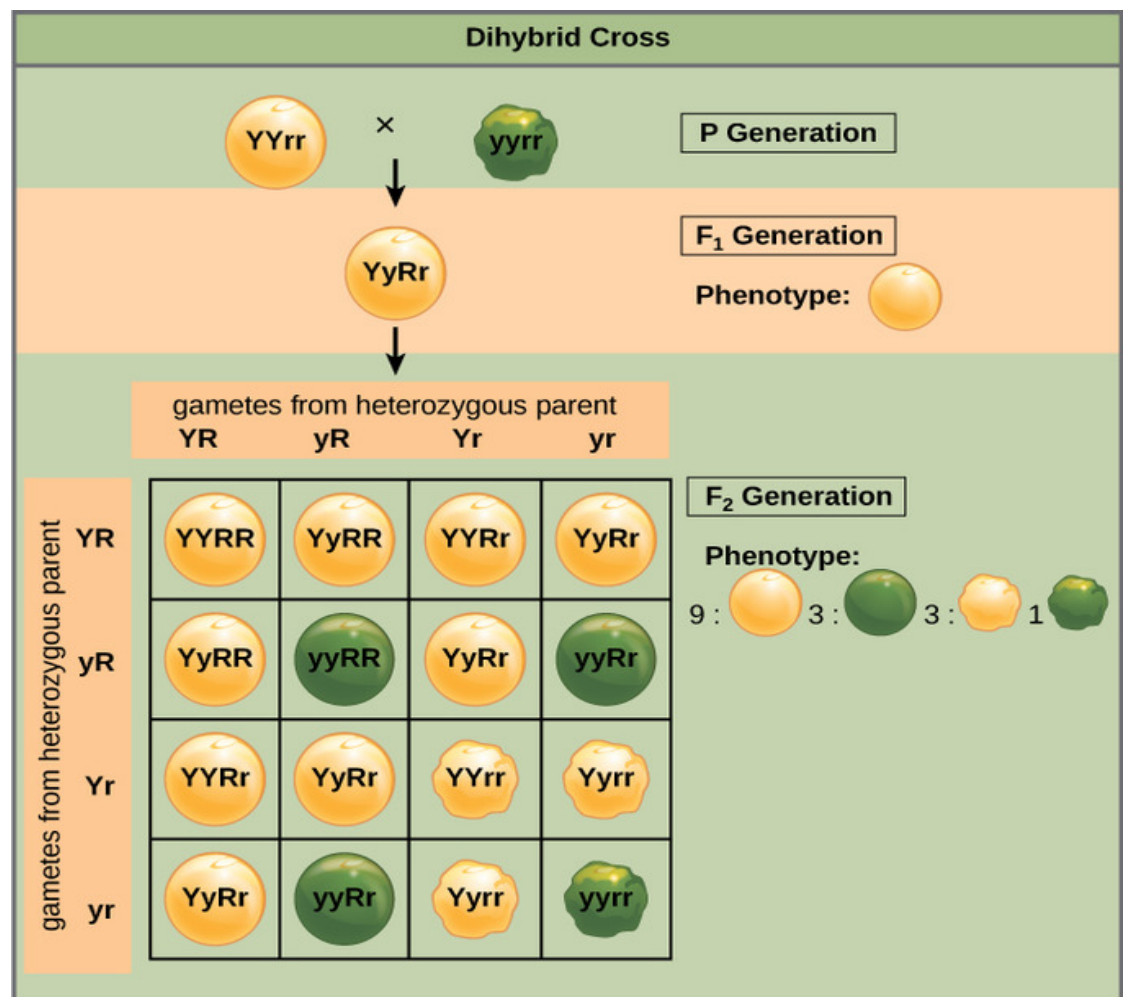
## ■ Monohybrid Cross:

As **HZ** and **HD** individuals are phenotypically identical **(3 : 1) ratio**.




## ◇ Mendel's 2nd Law (Independent Assortment)

















- Independent assortment allows the calculation of genotypic and phenotypic ratios based on the probability of individual gene combinations.
- It states that genes do not influence each other with regard to the sorting of alleles into gametes: every possible combination of alleles for every gene is equally likely to occur.
- **It can be illustrated by the dihybrid cross.**
- **Dihybrid Cross:** a cross between two parents that express different traits for two characteristics.




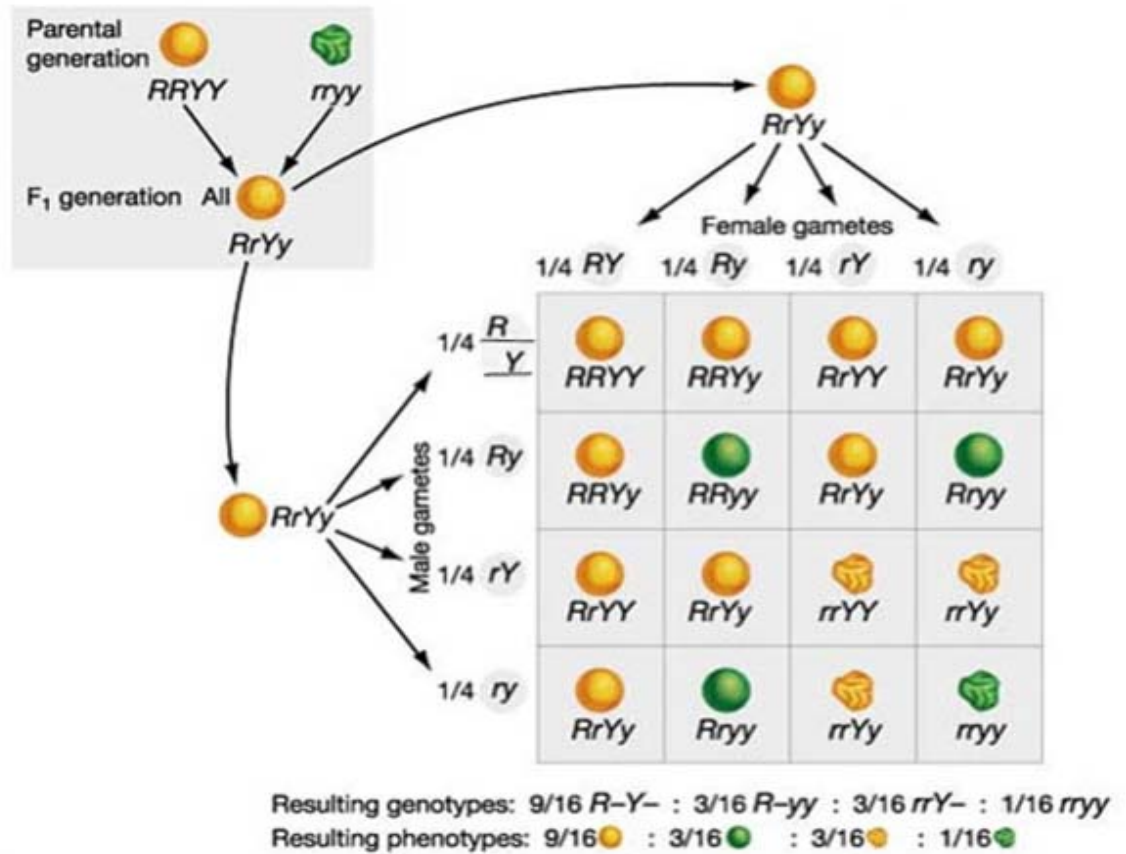
- Consider the characteristics of seed color and seed texture for two pea plants: one that has **Green, wrinkled seeds (yyrr)** and another has **Yellow, round seeds (YYRR)**. As each parent is homozygous.

- The law of segregation indicates that the gametes for the green/wrinkled plant are all **yr**, while the gametes for the yellow/round plant are all **YR**. Therefore, the F1 generation of offspring all are **YyRr**.
- For the F2 generation, the law of segregation requires that each gamete receive either an **R allele** or an **r allele** along with either a **Y allele** or a **y allele**.
- The law of independent assortment states that a gamete into which an **r allele** is sorted would be equally likely to contain either a **Y allele** or a **y allele**.
- Thus, **there are four equally likely gametes** that can be formed when the **YyRr** heterozygote is self-crossed as follows: **YR, Yr, yR, yr**. Arranging these gametes along the top and left of a **4 × 4 Punnett square** gives us 16 equally likely genotypic combinations.
  - From these genotypes, we infer a phenotypic ratio of: **9:3:3:1**  
**9 round/yellow : 3 round/green : 3 wrinkled/yellow : 1 wrinkled/green.**

round, yellow 

	<b>RY</b>	<b>Ry</b>	<b>rY</b>	<b>ry</b>
<b>RY</b>	RRYY 	RRYy 	RrYY 	RrYy 
<b>Ry</b>	RRYy 	RRyy 	RrYy 	Rryy 
<b>rY</b>	RrYY 	RrYy 	rrYY 	rrYy 
<b>ry</b>	RrYy 	Rryy 	rrYy 	rryy 

round, yellow 



Comparison	Law of Segregation	Law of Independent Assortment
Meaning	It denotes the theory of the separation of copies of genes before reproduction.	It denotes those multiple genes pertaining to similar traits can be passed on to the offspring without any segregation before.
Ratio of offspring	3:1 is the ratio.	9:3:3:1 is the ratio.
States about	Segregation of alleles	Behavior and end result of alleles
Number of alleles	Only one allele of one gene is passed on to the offspring.	Multiple genes pertaining to similar traits can be passed on to the offspring.