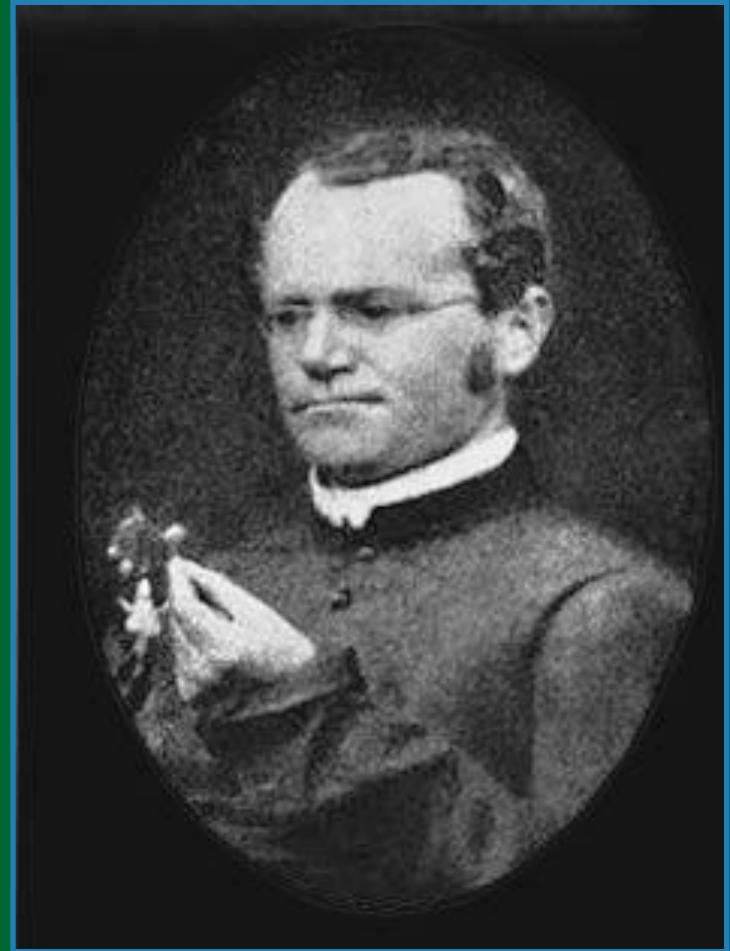


# Mendelian Genetics

Why we look the way we look...  
María Paula Vélez

# Gregor Johann Mendel

- 1822- 1884
- Austrian monk
- Experimented with pea plants
- He thought that 'heritable factors' (genes) retained their individuality generation after generation



María Paula Vélez

# VOCABULARY TO KNOW AND USE

**Genetics:** The study of genes and the inheritance of traits.

**Heredity:** The passing on of characteristics (traits) from parents to offspring.

**Trait:** variant for a gene: i.e. a purple flower, determined by alleles.

**Gene:** A DNA blueprint controlling synthesis of a protein.

**Allele:** a variation of a gene responsible for different traits, often represented as A or a.

**Chromosome:** strand of DNA containing the genes.

**Locus:** location of a gene or allele on a chromosome.



**Dominant trait:** expressed over recessive trait when both are present.

**Recessive trait:** not expressed when the dominant trait is present.

**True breeding line:** organisms that always pass the same genotype to their offspring.

**Hybrid:** offspring resulting from crossbreeding two true breeding lines:  $F_1$

**Genotype:** genes present in an organism (usually abbreviated as two letters).

Example:

- ∞ TT = **homozygous** = pure
- ∞ Tt = **heterozygous** = hybrid
- ∞ tt = homozygous = pure

**Phenotype:** how the trait physically shows-up in the organism.

Examples of phenotypes:

blue eyes, brown fur, striped fruit, yellow flowers.



# Garden Pea Experiments

## 1856-64

Mendel used peas...

- ∞ They reproduce sexually
- ∞ They have two distinct, male and female, sex cells called gametes
- ∞ Their traits are easy to isolate



# What did Mendel find after the crosses?

- ∞ There are alternate forms of 'genes'=alleles
- ∞ For each trait, organisms have 2 alleles, one from mom & one from dad
- ∞ Pollen and egg each carry 1 allele/trait because alleles segregate
- ∞ When only one allele is expressed & other has no noticeable effect, it is dominant

He discovered different laws and rules that explain factors affecting heredity.



# Mendel's Laws :

1. The Law of Dominance
2. The Law of Segregation
3. The Law of independent Assortment

# 1. The Law of Dominance

In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation. Offspring that are hybrid for a trait will have only the dominant trait in the phenotype.

Parent Pea Plants	F1 Pea Plants
tall stem x short stem	all tall stems
yellow seeds x green seeds	all yellow seeds
green pea pods x yellow pea pods	all green pea pods
round seeds x wrinkled seeds	all round seeds
axial flowers x terminal flowers	all axial flowers

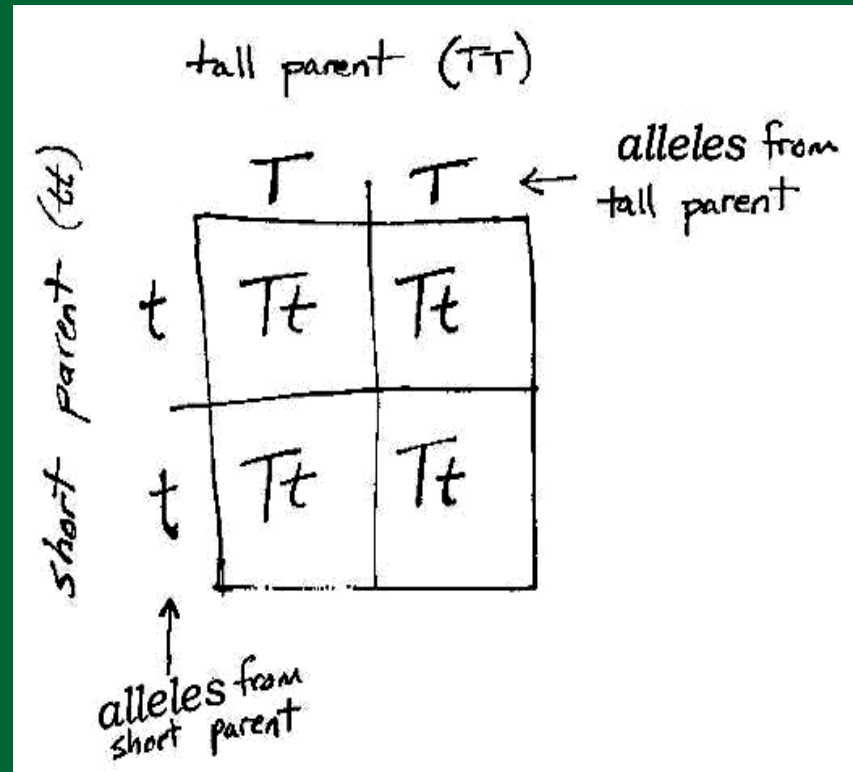
# THE PUNNETT SQUARE

This square help us illustrate the crosses Mendel did.

Parents (P):  $TT \times tt$

$T$  = the dominant allele for tall stems.

$t$  = recessive allele for short stems.



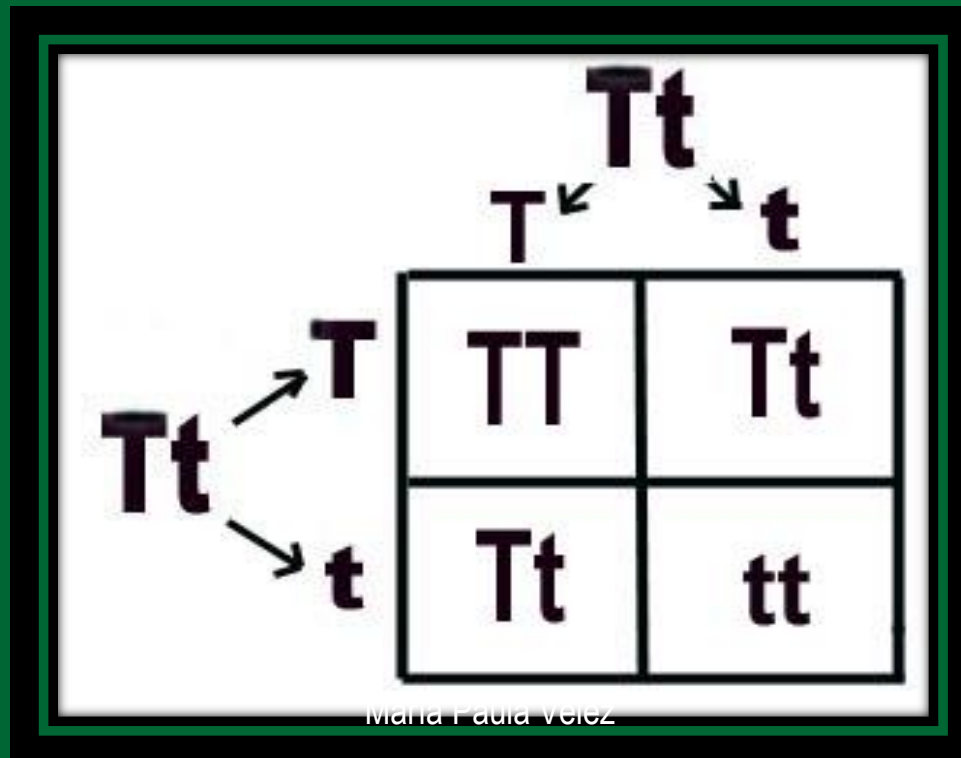
*ANY TIME TWO PARENT ORGANISMS LOOK DIFFERENT FOR A TRAIT, AND ALL THEIR OFFSPRING RESEMBLE ONLY ONE OF THE PARENTS, YOU ARE DEALING WITH MENDEL'S LAW OF DOMINANCE.*

*All the offspring are heterozygous for the trait, one parent is homozygous dominant, and the other is homozygous recessive.*



## 2. The Law of Segregation

During the formation of gametes (eggs or sperm), the two alleles responsible for a trait separate from each other. Alleles for a trait are then "recombined" at fertilization, producing the genotype for the traits of the offspring.



*A helpful fact to recognize 2<sup>nd</sup> law :*

***ANY TIME TWO PARENTS HAVE THE SAME PHENOTYPE FOR A TRAIT BUT SOME OF THEIR OFFSPRING LOOK DIFFERENT WITH RESPECT TO THAT TRAIT, THE PARENTS MUST BE HYBRID FOR THAT TRAIT.***

### 3. The Law of Independent Assortment

Alleles for different traits are distributed to sex cells (& offspring) independently of one another.

*OK. So far we've been dealing with one trait at a time. For example, height (tall or short), seed shape (round or wrinkled), pod color (green or yellow), etc. Mendel noticed during all his work that the height of the plant and the shape of the seeds and the color of the pods had no impact on one another.*

*In other words, being tall didn't automatically mean the plants had to have green pods, nor did green pods have to be filled only with wrinkled seeds, the different traits seem to be inherited **INDEPENDENTLY**.*



**The genotypes of our parent pea plants  
will be:**

**RrGg x RrGg**

where

"R" = dominant allele for round seeds

"r" = recessive allele for wrinkled seeds

"G" = dominant allele for green pods

"g" = recessive allele for yellow pods

Notice that we are dealing with two different traits: (1) seed texture (round or wrinkled) & (2) pod color (green or yellow). Notice also that each parent is hybrid for each trait (one dominant & one recessive allele for each trait).

We need to "split" the genotype letters & come up with the possible gametes for each parent.

# Questions...

- ⌚ How many **alleles** are there for each trait?
- ⌚ What is an **allele**?
- ⌚ How many **alleles** does a parent pass on to **each** offspring for **each** trait?
- ⌚ How do we call the trait that is **observed**?

# Dihybrid Cross

Mother contributes:

**SsBb x SsBb**

**SB**

**Sb**

**sB**

**sb**

Father contributes:

**SB**

**Sb**

**sB**

**sb**

<b>SSBB</b>	<b>SSBb</b>	<b>SsBB</b>	<b>SsBb</b>
<b>SSBb</b>	<b>SSbb</b>	<b>SsBb</b>	<b>Ssbb</b>
<b>SsBB</b>	<b>SsBb</b>	<b>ssBB</b>	<b>ssBb</b>
<b>SsBb</b>	<b>Ssbb</b>	<b>ssBb</b>	<b>ssbb</b>



# CLASSWORK

Base questions #1-5 on the following information:

A white-flowered plant is crossed with a pink-flowered plant. All of the F1 offspring from the cross are white.

1. Which phenotype is dominant?
2. What are the genotypes of the original parent plants?
3. What is the genotype of all the F1 offspring?
4. What would be the percentages of genotypes & phenotypes if one of the white F1 plants is crossed with a pink-flowered plant?
5. Which of Mendel's Laws is/are illustrated in this question?

# Questions...

- ⌚ What is the **phenotype**?
- ⌚ What is the **genotype**?
- ⌚ What is **homozygous**?
- ⌚ What is **heterozygous**?
- ⌚ What is **monohybrid crossing**?

# Questions

- ⌚ What did Mendel cross?
- ⌚ What are traits?
- ⌚ What are gametes?
- ⌚ What is fertilization?
- ⌚ What is heredity?
- ⌚ What is genetics?