

## Into to Genetics

### ~Mendelism~

*Classical Genetics*



### MENDEL IGNORED FROM 1866-1900

- Mendel was an unknown researcher
- Cytology of time could not explain his hypothesis
  - Unable to replicate results in all organisms
- Darwin's Origin of Species (1859)
  - continuous not discontinuous variation

### Gregor Mendel Father of Genetics



#### POSTULATES:

- Unit factors (genes) in pairs
- Dominance/ Recessiveness
- Segregation of alleles into gametes in equal frequencies
  - one set from each parent
- Independent Assortment of alleles from different gene pairs into gametes

### MENDEL: REDISCOVERED IN 1900

- Carl Correns
- Hugo De Vries [link](#)
- Eric Von Tschermak [Link](#)



<http://www.bakerfoundation.org/news/gm0/melina/1900a.html>

### Some useful genetic vocabulary

- Homozygous
- Heterozygous
- Phenotype
- Genes
- Genotype
- Monohybrid cross
- Dihybrid cross
- Testcross
- Dominant
- Recessive
- Allele
- P
- F<sub>2</sub>
- F<sub>1</sub>

#### homozygote

- an individual carrying identical alleles of one gene.

#### heterozygote

- an individual carrying two different alleles of one gene.

#### recessive allele

- an allele whose phenotype is not expressed in a heterozygote

#### dominant allele

- an allele whose phenotype is expressed when heterozygous with a recessive allele.

**pure breeding line**

- a group of genetically identical individuals that always produce offspring of the same phenotype when mated to each other.

**allele**

- one of different forms of a gene that can exist at a single locus

**genotype**

- the specific combination of alleles at a locus.

**phenotype**

- the form taken by a character in an individual, or, the detectable appearance of a specific genotype.

**F<sub>1</sub> generation**

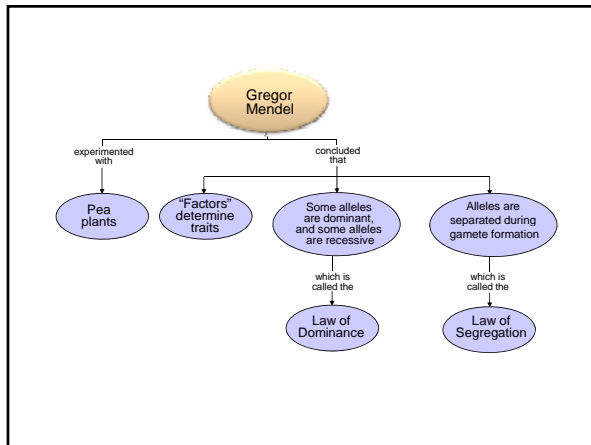
- first filial generation; the progeny resulting from the first cross in a series (P generation).

**F<sub>2</sub> generation**

- second filial generation; the progeny resulting from a cross of the F<sub>1</sub> generation.

**monohybrid cross**

- a genetic cross between two individuals involving only one character (e.g. AA x aa)



**The Work of Gregor Mendel**

- A. Gregor Mendel's Peas
- B. Genes and Dominance
- C. Segregation
  1. The F<sub>1</sub> Cross
  2. Explaining the F<sub>1</sub> Cross

**GARDEN PEAS**



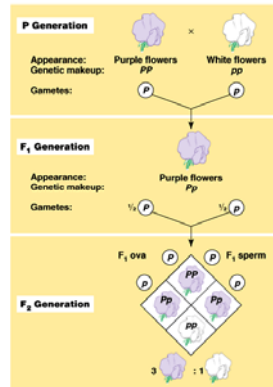
*Advantages*

- seeds easy to obtain
- characters easy to score
- crosses easily controlled
- short generation time
- large numbers of progeny

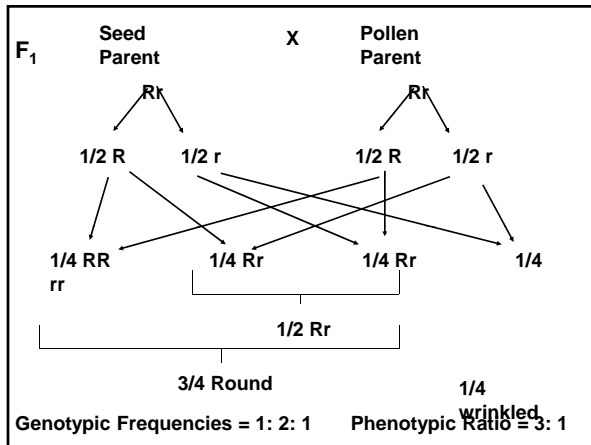
- In a typical breeding experiment, Mendel would cross-pollinate (**hybridize**) two contrasting, **true-breeding** pea varieties.
  - The true-breeding parents are the **P generation** and their hybrid offspring are the **F<sub>1</sub> generation**.
- Mendel would then allow the F<sub>1</sub> hybrids to self-pollinate to produce an F<sub>2</sub> generation.

## Punnett Square

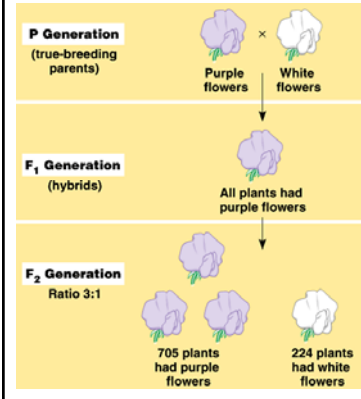
- predicts the results of a genetic cross between individuals of known genotype



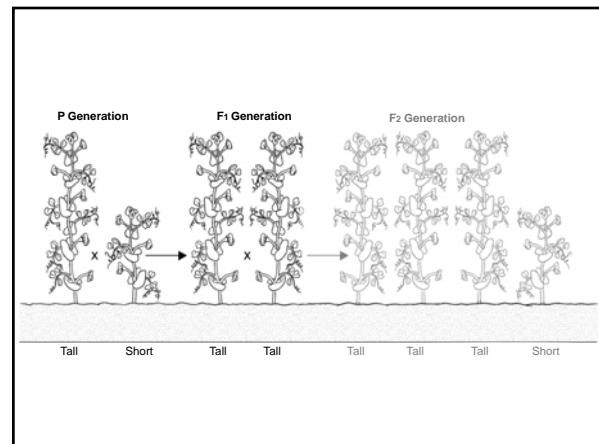
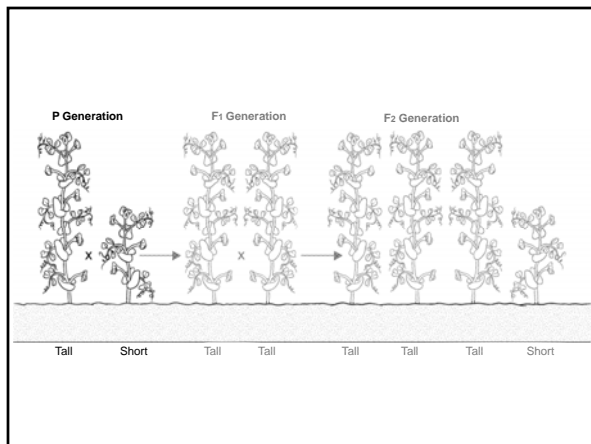
	Seed Shape	Seed Color	Seed Coat Color	Pod Shape	Pod Color	Flower Position	Plant Height
P	Round X Wrinkled	Yellow X Green	Gray X White	Smooth X Constricted	Green X Yellow	Axial X Terminal	Tall X Short
F <sub>1</sub>	Round	Yellow	Gray	Smooth	Green	Axial	Tall

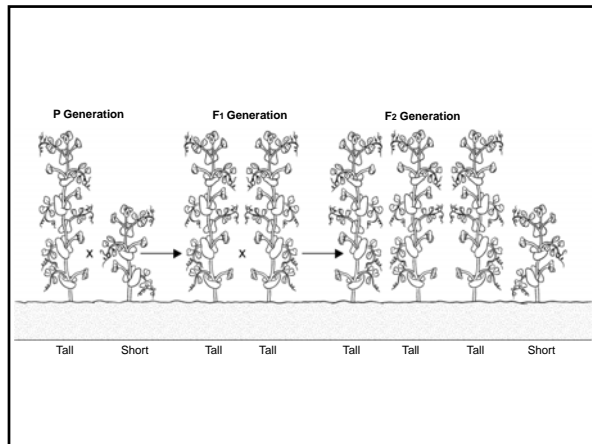


Mendel tracked heritable characters for three generations



- Mendel's quantitative analysis of F<sub>2</sub> plants revealed the two fundamental principles of heredity:
- the law of segregation
  - the law of independent assortment





## Height

- Height in pea plants is controlled by one of two alleles
  - the allele for a tall plant is dominant
  - the allele for a short plant is recessive

## Probability and Punnett Squares

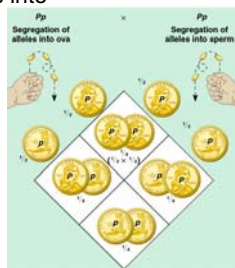
- Genetics and Probability
- Punnett Squares
- Probability and Segregation
- Probabilities Predict Averages

## Mendelian Inheritance: Rules of probability

- Mendel's laws of segregation and independent assortment reflect the same laws of probability that apply to tossing coins or rolling dice.
- The probability scale ranged from **zero** (*an event with no chance of occurring*) to **one** (*an event that is certain to occur*).
  - The probability of tossing heads with a normal coin is  $\frac{1}{2}$  or 50:50.
  - The probability of rolling a 3 with a six-sided die is  $\frac{1}{6}$ , and the probability of rolling any other number is  $1 - \frac{1}{6} = \frac{5}{6}$ .

- When tossing a coin, the outcome of one toss has no impact on the outcome of the next toss.
- Each toss is an independent event, just like the distribution of alleles into **gametes**.

- Like a coin toss, each egg from a heterozygous parent has a  $\frac{1}{2}$  chance of carrying the dominant allele and a  $\frac{1}{2}$  chance of carrying the recessive allele.
- The same odds apply to the sperm.



## The rule of addition also applies to genetic problems

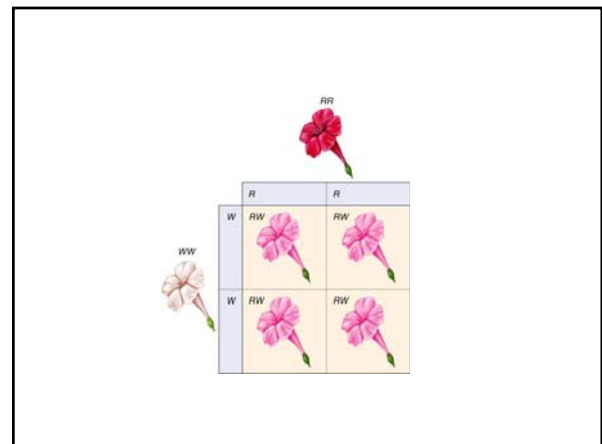
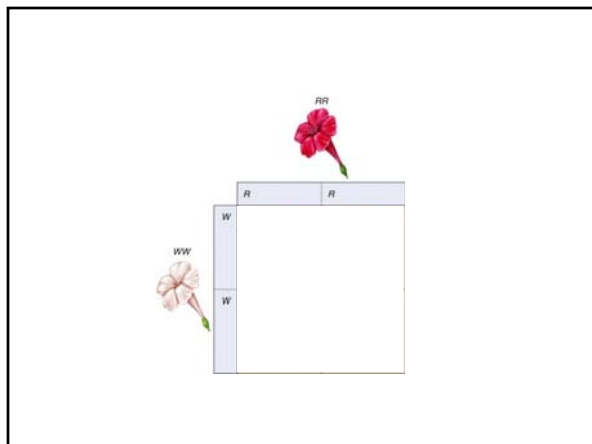
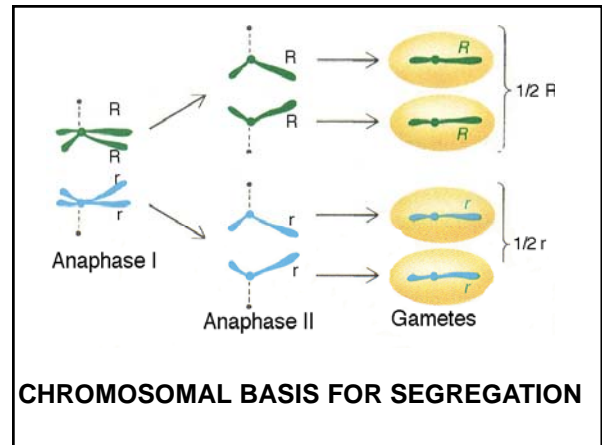
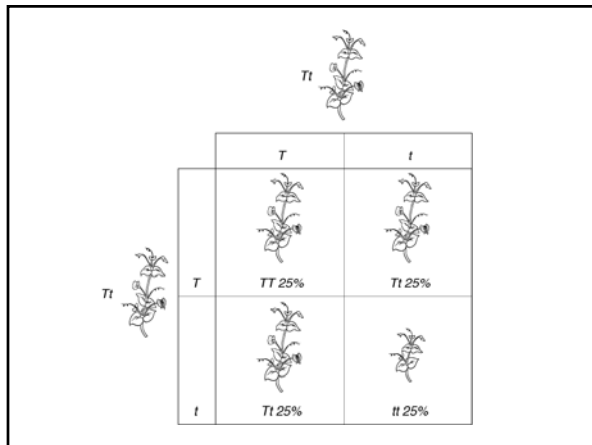
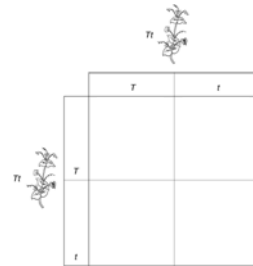
- Under the rule of addition, the probability of an event that can occur two or more different ways is the sum of the separate probabilities of those ways.
  - There are two ways that  $F_1$  gametes can combine to form a heterozygote.
    - dominant allele could come from the sperm and recessive from the ovum or egg (probability =  $\frac{1}{4}$ ).
    - Or, vice versa (probability =  $\frac{1}{4}$ ).
    - The probability of a heterozygote is  $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$ .

## Mendel's First Law - Law of Equal Segregation

- different alleles of one gene segregate into different gametes in equal frequencies  
(i.e. each gamete carries only one allele of a gene)

- the union of gametes to make a zygote is random  
(it doesn't matter which allele is in each gamete).

Proof: **testcross** - crossing an individual to another individual that is homozygous and recessive for all gene characters being tested (e.g.  $Rr \times rr$ ).



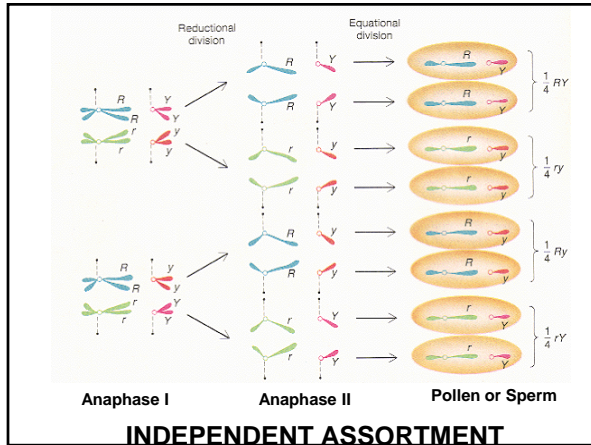
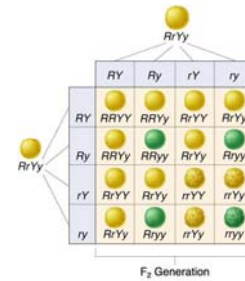
## Mendel's Second Law - Independent Assortment

- different gene pairs assort independently during gamete formation.

Mitosis Vs. Meiosis

<http://www.teachersdomain.org/resources/tdc02/sci/life/gen/mitosis/index.html>

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## Law of Independent Assortment

