BASIC GENETICS

Mendelian Genetics

- Established by Gregor Mendel by experimenting on pea plants (*pisum sativum*)
- Established basic patterns of inheritance
- Identified the following concepts:
  1. <u>True breeding</u>
     Self-fertilization leads to offspring identical to the parent.
  2. <u>Hybrids</u>
     Self-fertilization leads to offspring that are not identical to parents.
  3. <u>Dominant alleles</u>
     Alleles that exerts its effect when present
  4. <u>Recessive alleles</u>
     Alleles whose effects are masked or not expressed when a dominant allele is present
  5. <u>Homozygous genotype</u>
     - The genetic makeup of the individual contains identical alleles
     - Example: homozygous dominant GG, homozygous recessive gg
  6. <u>Heterozygous genotype</u>
     - The genetic makeup of the individual contains different alleles.
     - All heterozygous genotypes show dominant traits.
     - Example: heterozygous Gg

Laws of Inheritance by Mendel

1. <u>Law of Segregation</u>
   The alleles which code for the same trait will separate and be packaged into different gametes.

2. <u>Law of Independent Assortment</u>
   Non-homologous alleles or alleles that do not code for the same character do not influence each other during segregation.

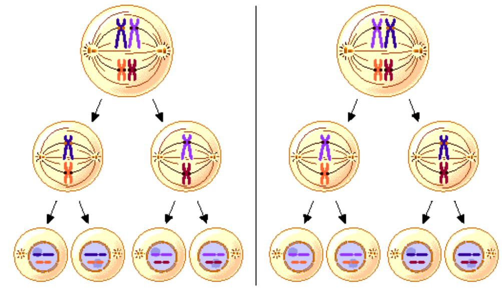

Image 1.0 **The Law of Segregation and Law of Independent Assortment**
Source: http://www.phschool.com/science/biology_place/biocoach/meiosis/geneseg1.html

Monohybrid Cross

- A breeding experiment between two (2) heterozygous individuals showing contrasting traits of one character
- Example: Yy x Yy

Dihybrid Cross

- A breeding experiment between two (2) individuals showing contrasting traits of two (2) different characters (both individuals are heterozygous for the two characters)
- Example: RG rg x rG Rg

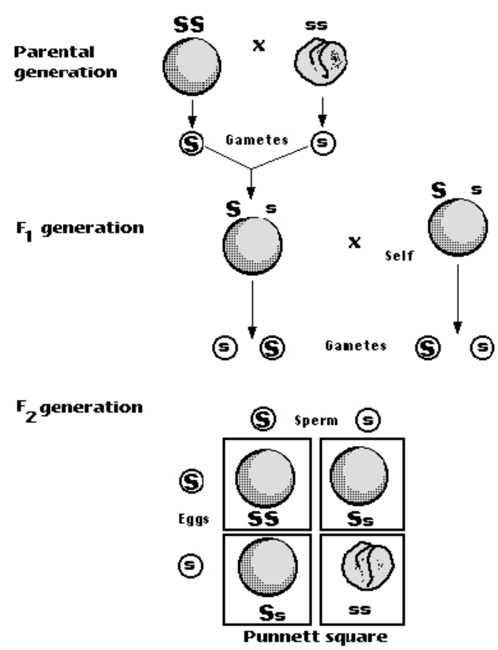

Image 1.1. **Monohybrid Cross**
Source: http://knowgenetics.org/mendelian-genetics

In *Image 1.1*, the P_1 or <u>Parental Generation</u> is the set of individuals being mated. Alleles are shown as letters, where dominants are uppercase and recessives are lowercase. Monohybrid crosses require one homozygous dominant parent and one homozygous recessive parent.

The F_1 or <u>Filial Generation</u> is the resulting offspring of P_1; it contains one allele per parent. This generation will only be heterozygous offspring.

The F_2 is the resulting offspring after self-fertilization of F_1. Because of its heterozygous parent, these offspring will have a <u>phenotypic ratio</u> of 3:1 (3 dominants, 1 recessive), and a <u>genotypic ratio</u> of 1:2:1 (1 homozygous dominant, 2 heterozygous, 1 homozygous recessive).

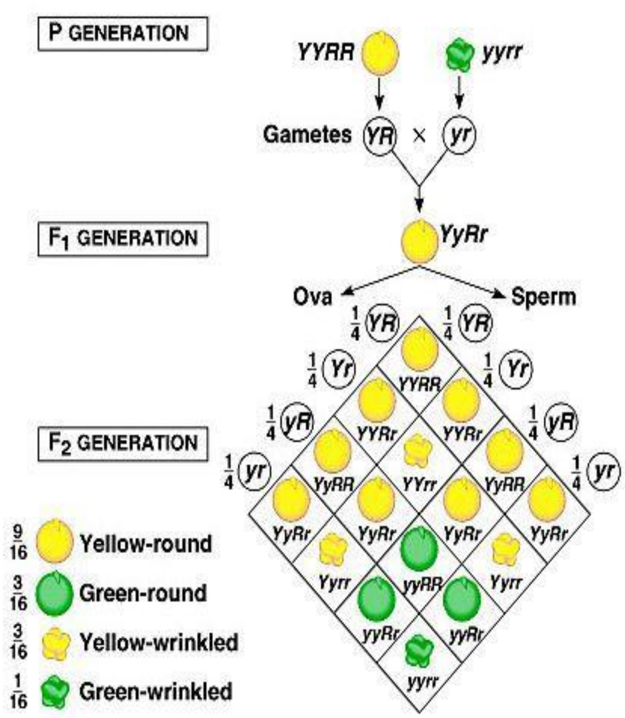

Image 1.2 **Dihybrid Cross**
Source: https://brainly.in

In *Image 1.2*, the P_1 shows the two individuals with homozygous alleles for 2 different characters (color and texture). Law of segregation and independent assortment allows the gametes of F_1 to have equal and different alleles per character.

The F_1 will then self-fertilize. Each side of the figure in F_2 shows the possible combinations of gametes of F_1. Using the Punnett square, the possible combinations formed will be the resulting offspring.

The F_2 shows a total of 16 possible offspring combinations. This also shows a phenotypic ratio of 9:3:3:1 (meaning there is a 9/16 possibility that the offspring is yellow and round). Additionally, it will have a genotypic ratio of 1:2:2:1:4:1:2:2:1 (meaning there is a 2/16 probability that the offspring will have a genotype of YYRr).

Test-Cross

- A breeding experiment used to identify the unknown genotype of an individual by crossing it with a homozygous recessive individual
- If the offspring all show dominant phenotypes, then the unknown genotype is homozygous.
- If the offspring shows 50% dominant and 50% recessive phenotypes, then it is heterozygous.

Back Cross

- A breeding experiment where a member of the F generation is crossed with its parent (from the P generation)
- A back cross can also be a test cross if the parent has a homozygous recessive genotype

Reciprocal Cross

The parallel to a regular breeding experiment where the genotypes of the parents are switched

<u>Monohybrid cross</u>		*<u>Reciprocal cross</u>*	
P_1	*RR x rr*	P_1	*rr x RR*

Central Dogma of Molecular Biology

Start Codons – AUG

Stop Codons – UAG, UAA, UGA

FIRST LETTER (base)	SECOND LETTER (base)								THIRD LETTER (base)
	A		U		C		G		
A	AAA	Lysine	AUA	Isoleucine	ACA	Threonine	AGA	Arginine	A
A	AAU	Asparagine	AUU	Isoleucine	ACU	Threonine	AGU	Serine	U
A	AAC	Asparagine	AUC	Isoleucine	ACC	Threonine	AGC	Serine	C
A	AAG	Lysine	AUG	Initiation Codon; Methionine	ACG	Threonine	AGG	Arginine	G
U	UAA	Stop Codon	UUA	Leucine	UCA	Serine	UGA	Stop Codon	A
U	UAU	Tyrosine	UUU	Phenylalanine	UCU	Serine	UGU	Cysteine	U
U	UAC	Tyrosine	UUC	Phenylalanine	UCC	Serine	UGC	Cysteine	C
U	UAG	Stop Codon	UUG	Leucine	UCG	Serine	UGG	Tryptophan	G
C	CAA	Glutamine	CUA	Leucine	CCA	Proline	CGA	Arginine	A
C	CAU	Histidine	CUU	Leucine	CCU	Proline	CGU	Arginine	U
C	CAC	Histidine	CUC	Leucine	CCC	Proline	CGC	Arginine	C
C	CAG	Glutamine	CUG	Leucine	CCG	Proline	CGG	Arginine	G
G	GAA	Glutamic Acid	GUA	Valine	GCA	Alanine	GGA	Glycine	A
G	GAU	Aspartic Acid	GUU	Valine	GCU	Alanine	GGU	Glycine	U
G	GAC	Aspartic Acid	GUC	Valine	GCC	Alanine	GGC	Glycine	C
G	GAG	Glutamic Acid	GUG	Valine	GCG	Alanine	GGG	Glycine	G

DEFINITIONS BOX

Gamete

Allele

Character

Phenotype

Genotype

Punnett Square

Phenotypic Ratio

Genotypic Ratio

References

Genetics Generation. (n.d.). Retrieved from Know Genetics: http://knowgenetics.org

Mason, K. A., Losos, J. B., & Singer, S. R. (2017). *Biology* (11th ed.). New York: McGraw Hill Education.