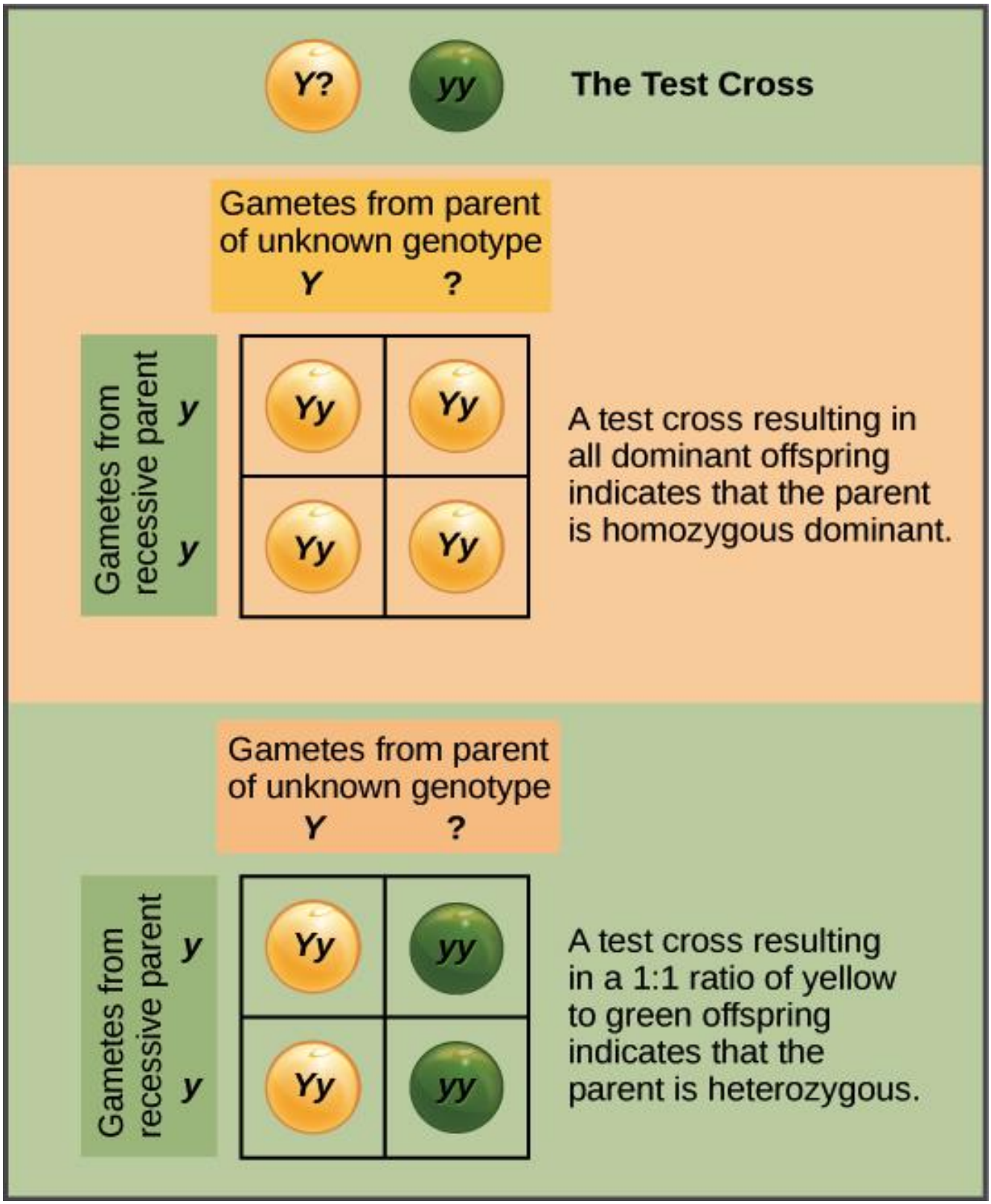
Topic:

Test Cross, Back Cross and Dominance.

The test cross:

- Mendel also came up with a way to figure out whether an organism with a dominant phenotype (such as a yellow-seeded pea plant) was a heterozygote (Yy) or a homozygote (YY). This technique is called a test cross and is still used by plant and animal breeders today. In a test cross, the organism with the dominant phenotype is crossed with an organism that is homozygous recessive e.g. green-seeded (yy).
- The purpose of test Cross is to determine the genetic make-up of the dominant organism. Mendel wanted to do this so that he could be sure he was working with the dominant organism which was homozygous or contain only dominant alleles however the phenotype alone does not tell you the genotype of an organism. The organism may be hiding a recessive non expressed allele. To find out what this unknown allele was Mendel developed the technique of breeding this individual with a homozygous recessive individual for the same trait.
- The test cross is an experiment first employed by Gregor Mendel in his studies of genetics of traits in pea plants. Mendel's theory which holds true today was that each organism carried two copies of each trait. One was dominant trait while one could be known as recessive trait. The dominant trait if present could be determine by outward appearance of the organism or the phenotype. Thus Mendel become interested in the question of determining which organisms with the dominant phenotype had two dominant alleles and which have one dominant allele and one recessive allele his answer came in the form of test cross
- The organisms will show a dominant phenotype if the organisms with the dominant phenotype is homozygous and the all the F1 offsprings will get an allele which will be dominant from their parents be heterozygous. If the organism with dominant phenotype organism is instead a heterozygous then the F1 offsprings will be half heterozygotes the dominant phenotypes and the half will be recessive homozygotes the recessive one.
- The fact that we get a 1:1 ratio in this second case is another confirmation of Mendel's law of segregation.


Y?
yy
The Test Cross
Gametes from parent of unknown genotype
Y
?
Gametes from recessive parent
y
y
Yy
Yy
Yy
Yy
A test cross resulting in all dominant offspring indicates that the parent is homozygous dominant.
Gametes from parent of unknown genotype
Y
?
Gametes from recessive parent
y
y
Yy
yy
Yy
yy
A test cross resulting in a 1:1 ratio of yellow to green offspring indicates that the parent is heterozygous.

Back Cross

When individual of F1 generation are crossed with one of the two parents either dominant or recessive one the cross is called back cross.

When individual of F1 generation are crossed with the parents having dominant characters in the next generation all individual are produced with dominant characters no recessive individual are produced

Plants of F1 generation. X Homozygous Parent Plants

(Hybrid tall) (Homozygous tall)

Tt TT

(T) (t) X (T)

After cross

TT Tt (All Tall Plants)

Difference between Test Cross and Back Cross

Test Cross.	**Back Cross**
●Test Cross is the breeding of dominant. Phenotype with its recessive phenotype.	●Back cross is the breeding of F1 Hybrid with one of the parents
●All test crosses are back crosses.	● Back cross of F1 hybrid with the Recessive phenotype can be considered as test cross
●The F1 hybrid is crossed with recessive genotype in test cross.	● F1 hybrid is crossed with either Homozygous dominant or. Heterozygous genotype
●Test cross identity the zygosity of the dominant. Phenotype.	● Back cross recovers elite Genotype.

Dominance and Incomplete Dominance

Dominance:

Dominance is a physiological effect of an allele over its partner allele on the same locus. The state of having two different variants of the same gene on each chromosome is originally caused by a mutation in one of the genes either new or inherited.

The term of autosomal dominant or autosomal recessive are used to describe gene variants or non sex chromosomes and their associated traits while those on sex

chromosomes are termed as X-linked dominant, X-linked recessive or Y-linked; these have an inheritance and presentation pattern that depends on sex of the both parents and the child. Since there is only one copy of Y chromosomes, Y linked traits can not be dominant or nor recessive

Types of Dominance

- **Complete Dominance**
- **Codominance**
- **Incomplete Dominance**
- **Over Dominance**

Complete Dominance:

When one allele (R) is completely dominant over the other (r), presence of the recessive allele is functionally hidden, so the heterozygote (Rr) has the same round phenotype as (RR) homozygote.

The contrasting pairs of alleles for all the seven characters chosen by Mendel showed complete dominance. After Mendel, further breeding experiments were carried out on different plants and animals. Many novel phenotypes and phenotypic ratios were observed that could not be explained on the basis of complete dominance.

Co-Dominance:

Codominance occurs when both the alleles express independently in heterozygote; (A|A2) and form their respective products X and Y. The codominant heterozygote would have both substances at the same time.

Different alleles of a gene that are both expressed in a heterozygous condition are called codominant.

The phenotype of heterozygote is distinct in quality from those of the two homozygotes. It is not an intermediate quantitative expression like incomplete dominance. Each allele of the gene pair is associated with a different substance.

$$\text{Allele } A_1 \xrightarrow{\text{Produces}} \text{Substance X}$$

$$\text{Allele } A_2 \xrightarrow{\text{Produces}} \text{Substance Y}$$

Incomplete Dominance:

●Mendel's Principles:

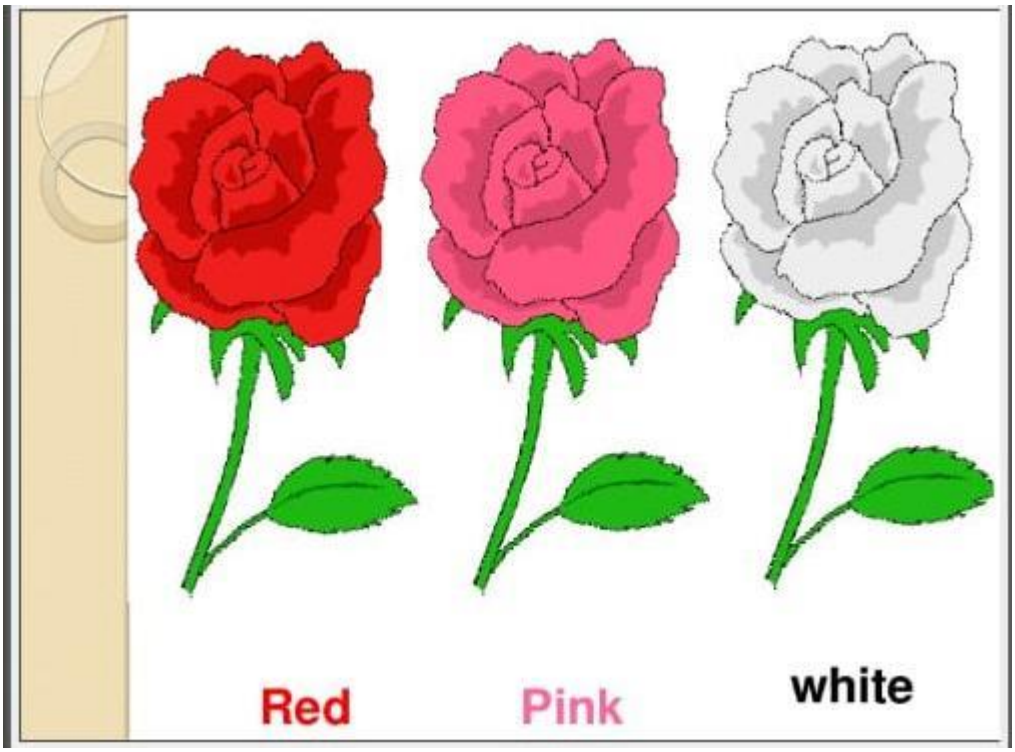
Inheritance of biological characteristics is determined by individual units known as genes.

During sexual reproduction genes are passed from parents to offspring.

Two or more forms of a gene for a single trait exist some forms of the gene may be dominant or recessive.

What is incomplete Dominance?

•Incomplete Dominance is a type of inheritance in which one allele for a specific trait is not completely dominant over the other allele. This result in a combined phenotype. (Expressed physical trait)



In 1899 Carl Correns was working on a flowering plant named 4 o'clock. When he crossed a true breeding red flower plant with a true breeding white flower 4 O' Clock F1 had pink flowers. This new phenotype had a shade intermediate between those of the parents due to an intermediate amount of pigment in petals. When he self-fertilized F1 pink F2 showed all the three phenotypes of the flowers in the ratio of 1 red: 2 pink : 1white red was homozygous for red alleles and white was homozygous for white alleles. But when alleles for red and alleles for white were present together in the same plant neither of them masked the effect of other rather these alleles

showed incomplete dominance in the form of pink colour. When the phenotype of the heterozygote is intermediate between the phenotypes of the two homozygotes. It is called incomplete all partial dominant.

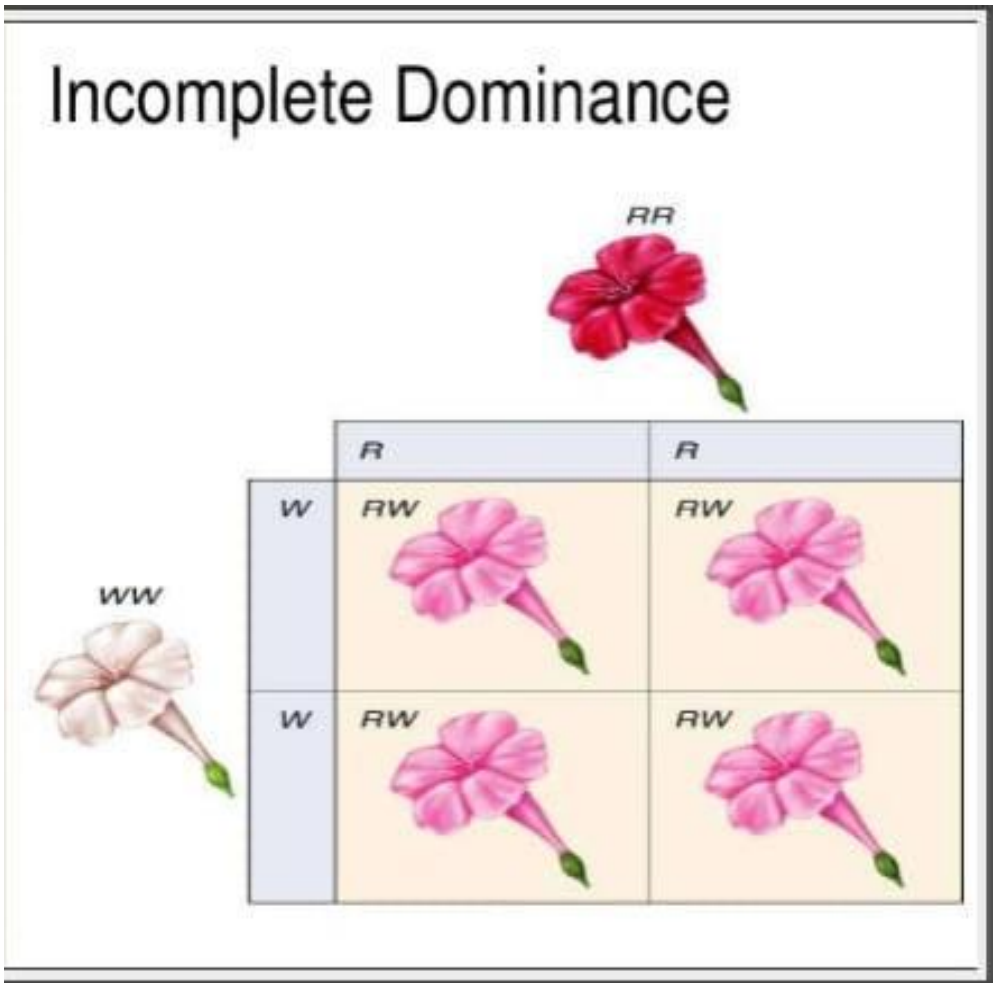
As there is no truly dominant allele the usual capital and small letters distinction for dominant and recessive trait is not necessary. Both the alleles are represented by the same letter R but are numbered differently to distinguish white from red. Allele for red is designed as R and the allele for white is W.

Punnett square indicates that the phenotypic ratio is the same as the genotypic ratio. There is absolutely no need of test crops. The flower colours show blending at phenotypic level in F1 which is quite contrary what Mendel observed. But the reappearance of red and white flowers in F2 confirms that blending does not occur at genetic level.

In incomplete Dominance neither allele is dominant so there is a blending of traits when two different alleles for the same traits occur together heterozygous individuals=3^{rd} phenotype.

Incomplete dominance is when a dominant allele is form of a gene, does not completely mask defects of recessive alleles and the organisms resulting physical appearance shows a blending of both alleles.

Incomplete Dominance may occur because neither of the two alleles is fully dominant over the other or because the dominant allele does not fully dominate recessive allele.



This result in a phenotype that is different from both dominant and recessive alleles and appears to be a mixture of both.

Over Dominance:

This dominance relation is fascinating because the over dominant heterozygote exceeds in quantity the phenotypic expression of both the homozygotes. In fruit fly Drosophila the heterozygote (W+ / W) has more quantity of fluorescent pigments in eyes than wild (W+ / W+) or white eye (w / w) homozygotes.