

Chapter :- Heredity and Evolution

Genetic :- Branch of science that deals with Heredity and Variation is called Genetics.

Heredity :- It means the transmission of features/characters/traits from one generation to next generation.

Variation :- The differences among the individuals of a species of a populations are called variation.

Genotype :- The complete set of genes in an organism's genome is called genotype.

Phenotype :- The observable characters in an organism make the phenotype. Phenotype is a modified genotype and many of the phenotypes cannot be inherited.

Clones :- Organisms which are exact copies of each other.

Mendel's Work :-

- Gregor Johann Mendel, known as 'Father of Genetics' was an Austrian Monk who worked on Pea plant to understand the concept of heredity.

- His work laid the foundation of modern genetics.

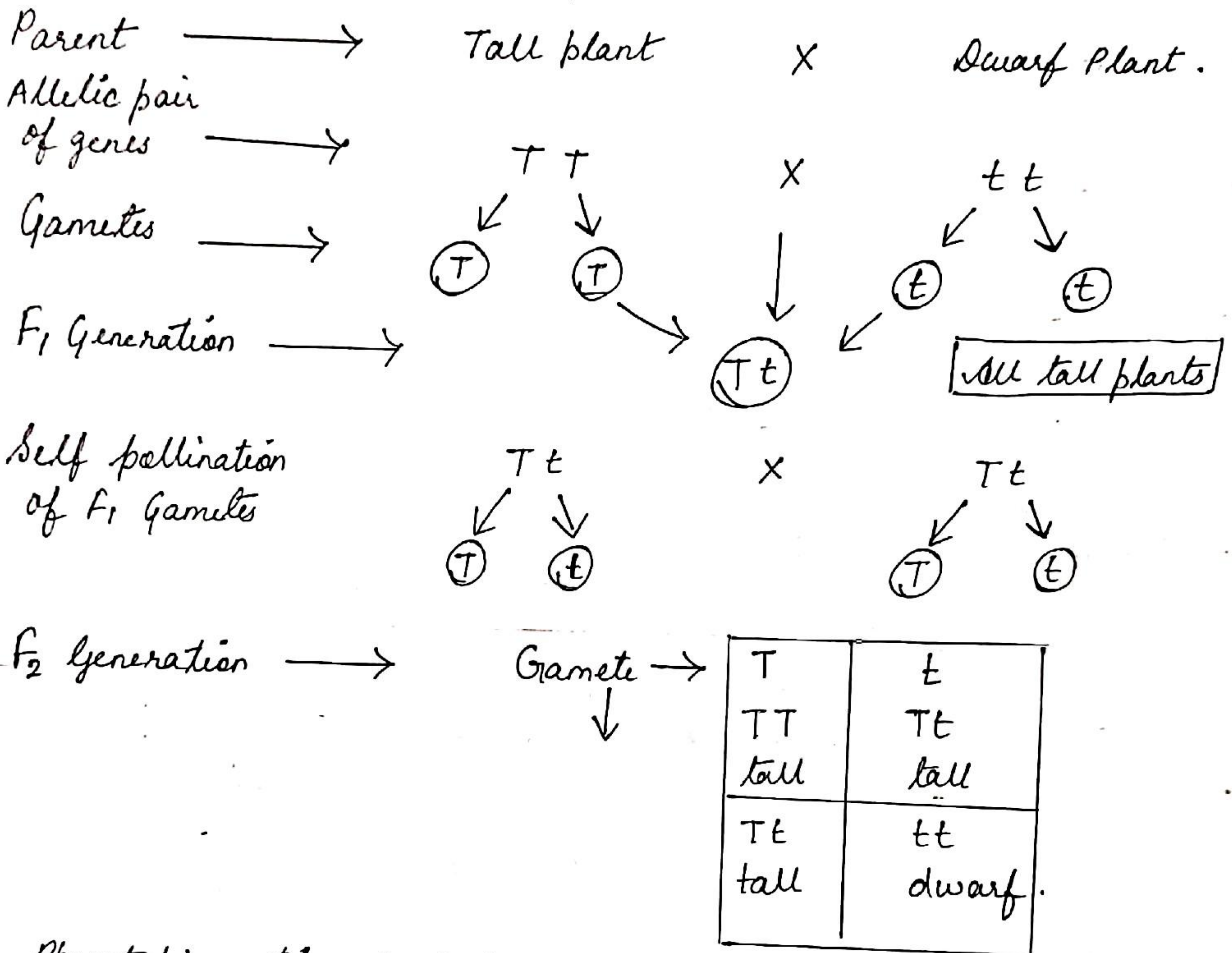
- He made Law of Dominance, Law of segregation, Law of Independent Assortment.

• Plant Selected by Mendel :- *Pisum sativum* (garden pea). Mendel used a number of contrasting characters for garden pea.

• Mendel's Experiment :- He conducted a series of experiments in which he crossed the pollinated plants to study character (at a time).

Cross between two pea plants with one pair of contrasting character is called a monohybrid cross.

Monohybrid Cross



Phenotypic ratio $\longrightarrow 3:1$

Genotypic ratio $\longrightarrow 1:2:1$

Observation of Monohybrid Cross :-

1. All F_1 progeny were tall (no medium height plant).
2. F_2 progeny $1/4$ were short, $3/4$ were tall.
3. Phenotypic ratio $F_2 - 3:1$ (3 tall : 1 short).

$$\left(\begin{array}{ccc} TT & : & Tt & : & tt \\ 1 & : & 2 & : & 1 \end{array} \right)$$

Genotypic ratio $F_2 - 1:2:1$.

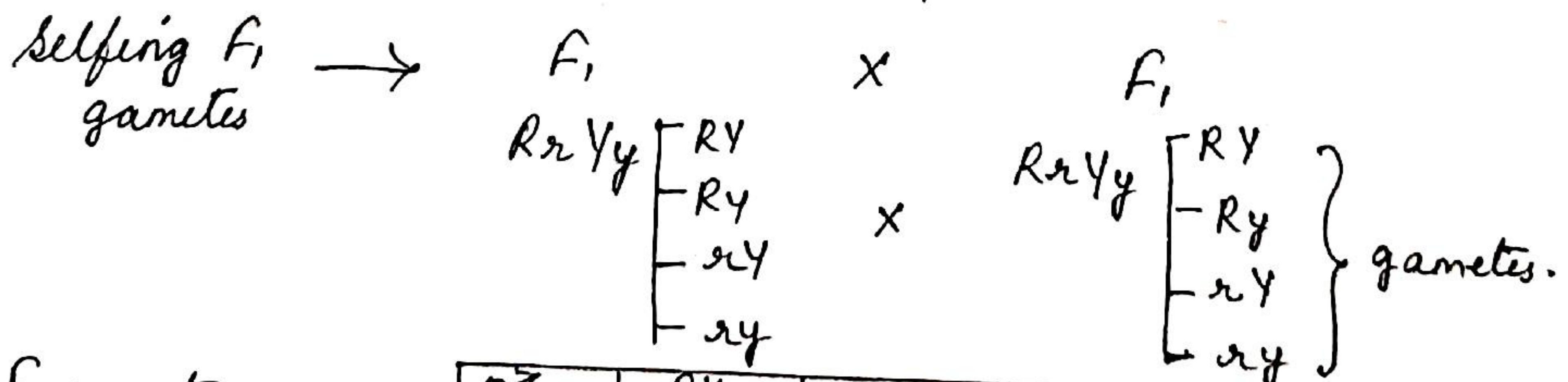
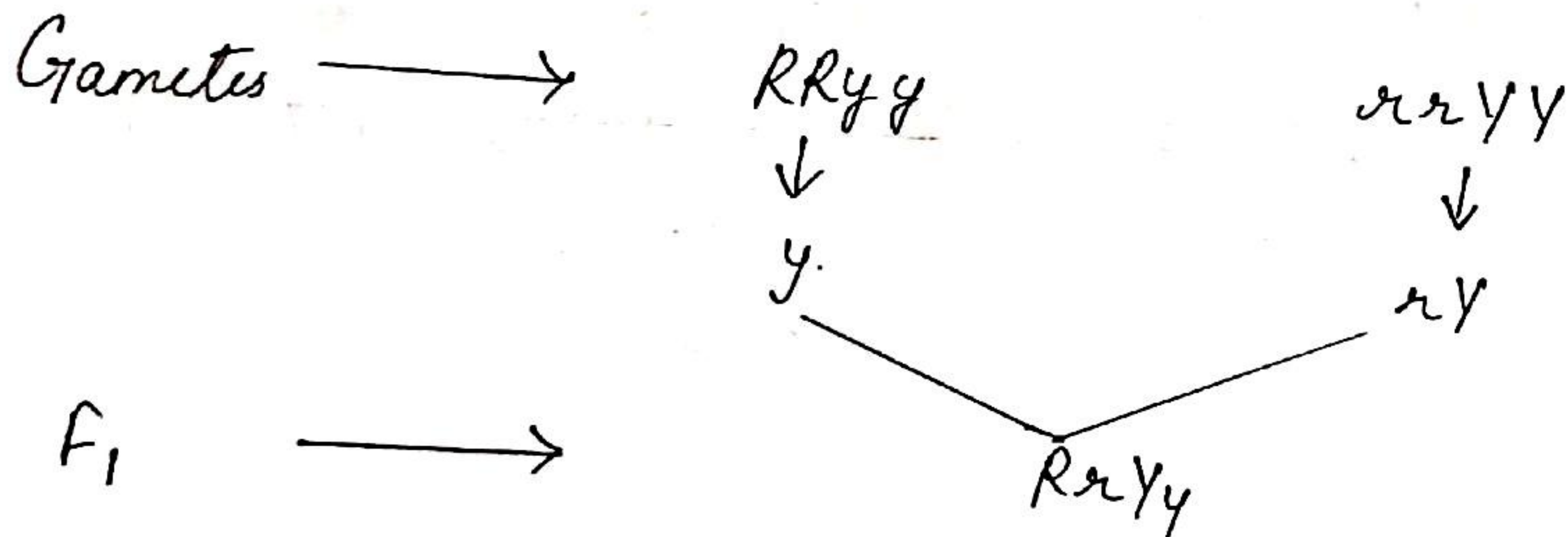
Conclusion of Mendel's Experiment :-

1. TT and Tt both are tall plants while tt is a short plant.
2. A single copy of T is enough to make the plant tall, while both copies have to be ' t ' for the plant to be short.
3. Characters/Traits like ' T ' are called dominant trait and ' t ' are recessive trait.

Law of Segregation :- Every organism possess a pair of alleles for a particular trait. During gamete formation, a gamete receives only one trait from the alleles.
- A particular trait can be dominant or recessive.

Dihybrid Cross :- A cross between two plants having two pairs of contrasting characters.

Parent generation $\rightarrow$ Round green seeds $\times$ Wrinkled Yellow seeds.



F_1 gametes $\rightarrow$

σ^7	RY	Ry	ry	ry
$\downarrow$				
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
ry	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Phenotypic ratio

Round, yellow : 9

Round, green : 3

Wrinkled, yellow : 3

Wrinkled, green : 1

Conclusion:-

1. Round and yellow seeds are Dominant characters.
2. Occurrence of new phenotypic combinations show that genes for round and yellow seeds are inherited independently.

Law of Independent Assortment:- Alleles of different characters separate independently from each other during gamete formation.

Sex Determination:- Determination of sex of an offspring.
Factors:- Environment and Genetic.

Environment:- In some animals the temperature at which the fertilised eggs are kept decide the gender. eg. in Turtle.

Genetic:- In some animals like humans gender is determined by a pair of chromosomes called Sex Chromosomes.

Sex Chromosomes:- In human beings there are 23 pairs of chromosomes. Out of these 22 chromosome pairs are called autosomes and the last pair of chromosome that help in deciding gender of that individual is called sex chromosomes.

XX - female
XY - male.

All children will inherit an X chromosome from their mother whether they are boy or girl. Thus sex of children will be determined by what they inherit from their father.

Evolution:- Evolution is a tangible change in the heritable characteristics of a population over several generations.

Group of red beetles.

↓
Colour variation arises during reproduction.

↓
All beetles red except one that is green.

↓
Crows feed on red beetle

↓
No. of beetles reduces

↓
One beetle Green.

↓
Progeny beetle green.

↓
No. of green beetle increases.

Green beetle got the survival advantage were naturally selected as they were not visible in green bushes. This natural selection is exerted by crows resulting in adaptations in beetles to fit in their environment.

Acquired and Inherited Traits:-

Acquired Traits

1. These are the traits which are developed in an individual due to special conditions
2. They cannot be transferred to the progeny

Inherited Traits

1. These are the Traits which are passed from one generation to the next.
2. They cannot direct evolution.

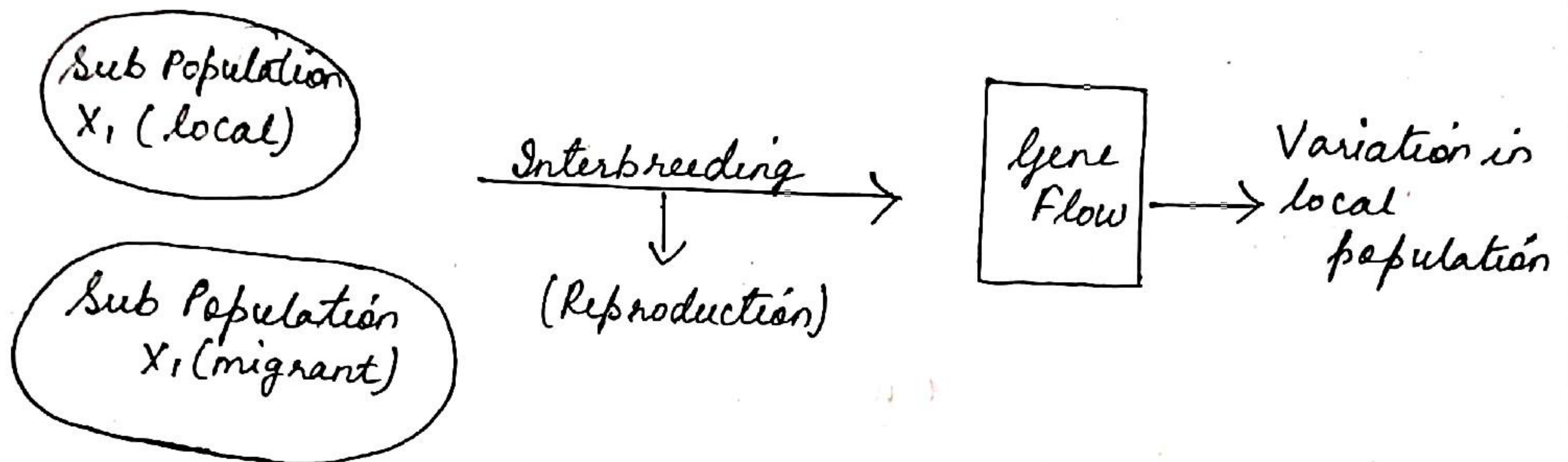
Speciations:-

Micro Evolution:- It is the evolution which is on a small scale eg. change in body colour of beetles.

Speciation:- It is the process of formation of new species.

Species:- Group of similar individuals within a population that can interbreed and produce fertile offspring.

Gene flow:- The exchange of genetic material by interbreeding between populations of same species or individuals.
- It occurs between population that are partly but not completely separated.



Genetic Drift:- It is the random change in frequency of alleles in population over successive generations.

* Natural selection:- The process by which nature selects and consolidate those organisms which are more suitably adapted and possesses favourable Variations.

Genetic Drift takes place due to:-

- (a) Severe changes in the DNA
- (b) Change in number of chromosomes.

Evolution and Classification:-

Evolution:- The process by which different kinds of living organism are believed to have developed from earlier forms during the history of earth.

Both evolution and Classification are interlinked:

1. Classification of species is reflection of their evolutionary relationship.
2. The more characteristic two species have in common, more closely they are related.
3. The more closely they are related, the more recently they have a common ancestor.
4. Similarities among the organisms allow us to group them together and to study their characteristic.

Frog



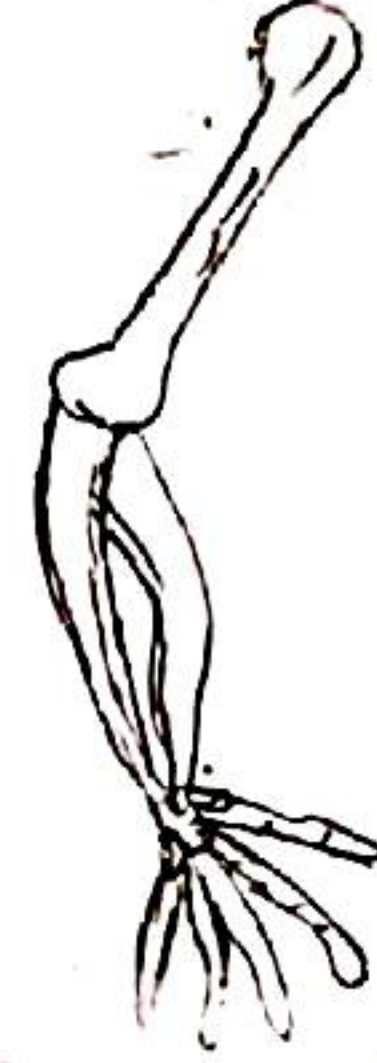
Lizard



Bird



Human



Homologous organ.

Homologous Organs:- These are the organs that have same basic structural plan and origin but different functions.

Homologous Organs provides evidence for evolution by telling us that they are divided from the same ancestors.
eg:- forelimbs of Horse. etc.

Analogous Organs:- These are the organs that have different origin and structural plan but same function. They provide mechanism of evolution. eg:- wings of bat, wings of bird.

Fossils:- The remains and relics of dead organisms of the past. Fossils are the preserved remains of ancient animals or plants that died millions of years ago. Fossils help us to understand the anatomy, physiology of organisms and the past.

Examples of Fossils:-

Ammonite - Fossil invertebrate.

Trilobite - Fossil invertebrate

Knightia - Fossil fish

Rajasaurs - Fossil dinosaur skull.

Evolution by stages:- Evolution takes place in stages, bit by bit over generations.

I. Fitness Advantage

Evolution of Eyes:- Evolution of complex organs is not sudden it occurred due to minor changes in DNA, however takes place bit by bit over generations.

II. Functional Advantage

Evolution of feathers:- Feathers provide insulation in cold weather but later they might become useful for flight.

Ex:- Dinosaurs had feathers, but could not fly.

Birds seem to have later adapted the feathers to flight.

Evolution by Artificial Selection:- Humans have been a powerful agent in modifying wild species to suit their own requirement through out ages by using artificial selection. eg. (i) From wild cabbage many varieties like. Broccoli, cauliflower, red cabbage, Kale, cabbage and Kohlrabi were obtained by artificial selection.

(ii) Wheat (many varieties obtained due to artificial selection).

Molecular Phylogeny:-

- It is based on the idea that changes in DNA during reproduction are the basic events in evolution.
- Organisms which are more distantly related will accumulate greater difference in their DNA

Tools to Study Human Evolutionary Relationship:-

- Excavating
- Time dating
- Fossils
- Determining
- DNA sequence.

Human Evolution:-

- Humans are known to belong to primate family.
- Humans today have very close genetic connection.
- Human include ancestors of Dryopithecus, Ramapithecus, Homo erectus, Homo sapiens neanderthalensis.
- Finally, we belong to the Homo sapiens.
- Human evolution traces back to the Africa. Then they migrated all over the world.
- They did not go in a single line, they went forward and Backward.
- Sometimes came back to mix with each other.