

CBSE Class 10 Science
Revision Notes
CHAPTER – 09
HEREDITY & EVOLUTION

- **Genetics** : Branch of science that deals with Heredity and variation.
- **Heredity** : It means the transmission of features/ characters/ traits from one generation to the next generation.
- **Variation** : The differences among the individuals of a species/population are called variations. It takes place due to environment changes, crossing over, and recombination of genes and mutation.
- **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 are those organisms which are exact copies of each other.

Mendel and His Work on Inheritance

- Gregor Johann Mendel (1822 & 1884) : Started his experiments on plant breeding and hybridisation. He proposed the laws of inheritance in living organisms.
- Law of Dominance, Law of segregation, Law of Independent Assortment.

Mendel was known as **Father of Genetics**

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

→

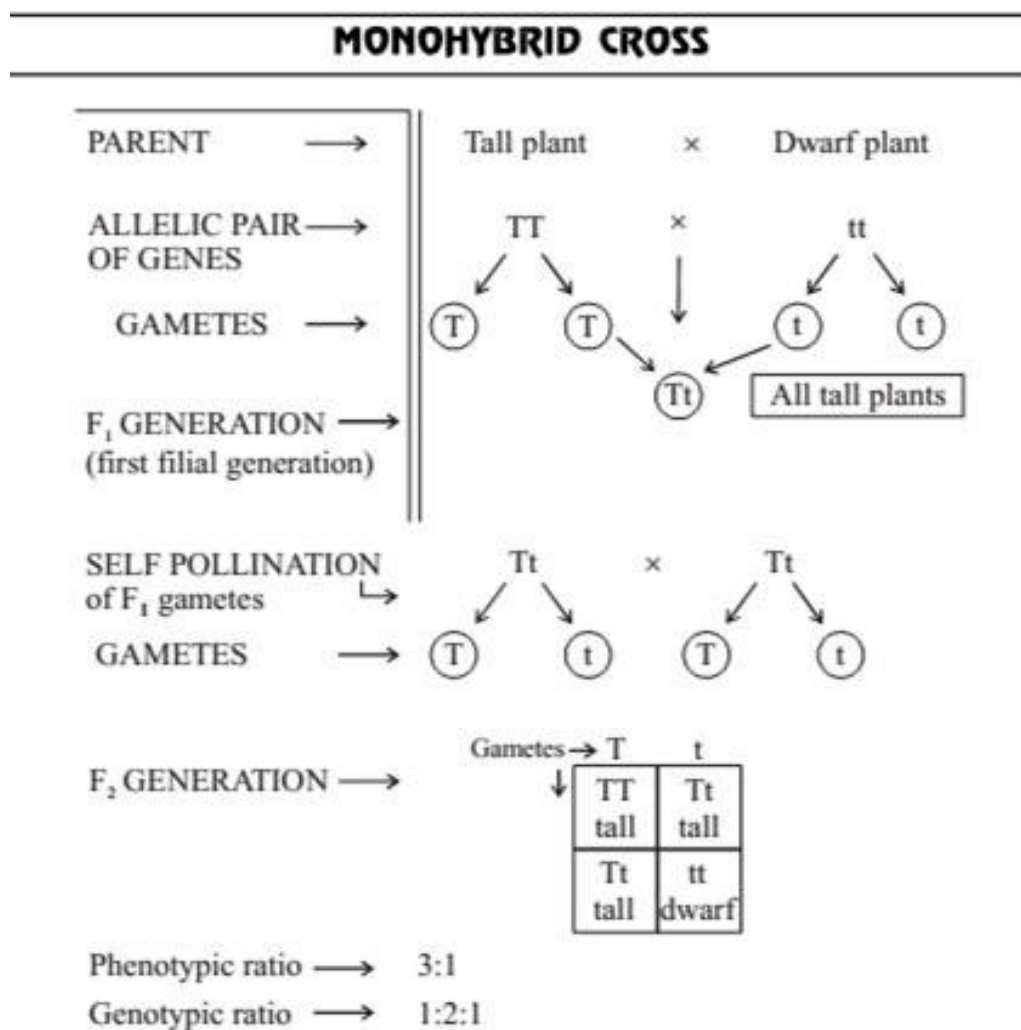
(TABLE OF CONTRASTING CHARACTERS. SEVEN PARTS)		
CHARACTER	DOMINANT TRAIT	RECESSIVE TRAIT
Flower colour	Violet	White
Flower position	Axial	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf/Short















Seven pairs of contrasting characters in Garden Pea.

- Mendel's Experiments** : Mendel conducted a series of experiments in which he crossed the pollinated plants to study one character (at a time)

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

- Cross between a tall and a dwarf plant (short).



CHARACTER	DOMINANT TRAIT	RECESSIVE TRAIT
Seed shape	 Round	 Wrinkled
Seed colour	 Yellow	 Green
Flower colour	 Violet	 White
Pod shape	 inflated/full	 Constricted
Pod colour	 Green	 Yellow
Flower position	 Axial	 Terminal
Stem height	 Tall	 Dwarf

$\begin{matrix} TT \\ tt \end{matrix} \rightarrow \begin{matrix} \text{Both dominant traits} \\ \text{Both recessive alleles} \end{matrix} \rightarrow \begin{matrix} \text{Pure or homozygous} \\ \text{condition} \end{matrix}$

$Tt \rightarrow \begin{matrix} \text{One dominant, one} \\ \text{recessive trait} \end{matrix} \rightarrow \begin{matrix} \text{Heterozygous} \\ \text{condition - Hybrid} \end{matrix}$

Phenotypic ratio : 3:1

Genotypic ratio : 1:2:1

Phenotype ® Physical appearance [Tall or Short]

Genotype ® Physical appearance [Tall or short]

Observations of Monohybrid Cross

1. All F1 progeny were tall (no medium height plant (half way characteristic))
2. F2 progeny $\frac{1}{4}$ were short, $\frac{3}{4}$ were tall
3. Phenotypic ratio F2 – 3 : 1 (3 tall : 1 short)

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

Genotypic ratio F2 – 1:2:1

Conclusions

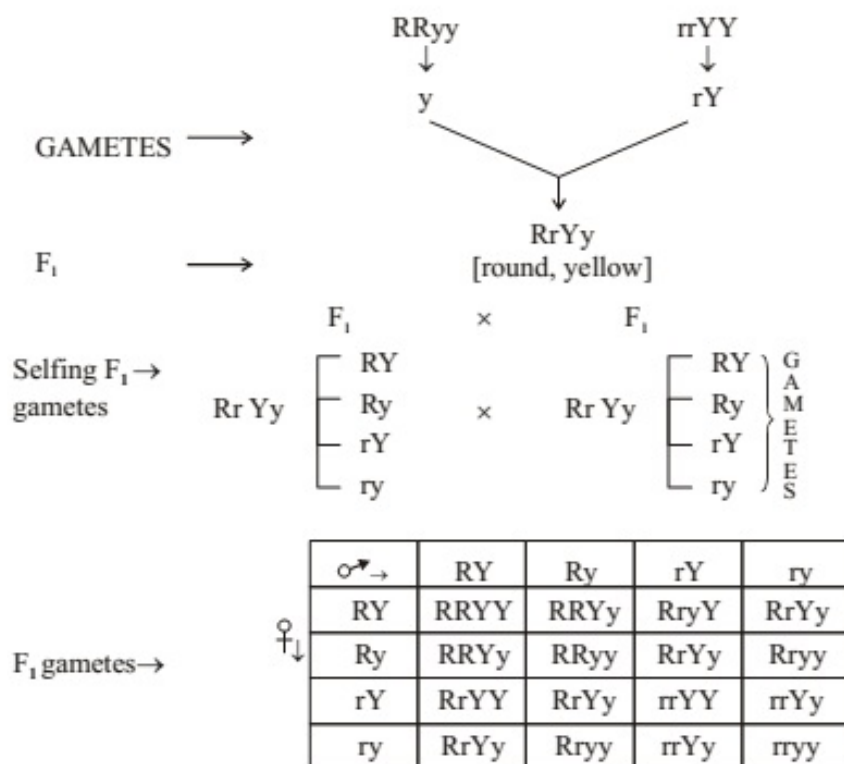
1. TT and Tt both are tall plants while tt is a short plant.
2. A single copy of T is enough to make the plant tall, while both copies have to be 't' for the plant to be short.
3. Characters/Traits like 'T' are called dominant trait (because it express itself) and 't' are recessive trait (because it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

From these observation, Mendel put forward the rules of inheritance

Law of Segregation: Every individual possesses 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 in a particular generation.

Dihybrid Cross : A cross between two plants having two pairs of contrasting characters is called dihybrid cross.

Parent → *Round* × *Wrinkled*
Generation *Green seeds* *Yellow seeds*



Phenotypic Ratio

Round, yellow : 9

Round, green : 3

Wrinkled, yellow : 3

Wrinkled, green : 1

Observations

1. When **RRyy** was crossed with **rrYY** in F_1 generation all were **Rr Yy** round and yellow seeds.
2. Self pollination of F_1 plants gave parental phenotype and two mixtures(recombinants round yellow & wrinkled green) seeds plants in the ratio of 9:3:3:1

Conclusions

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 of each other.

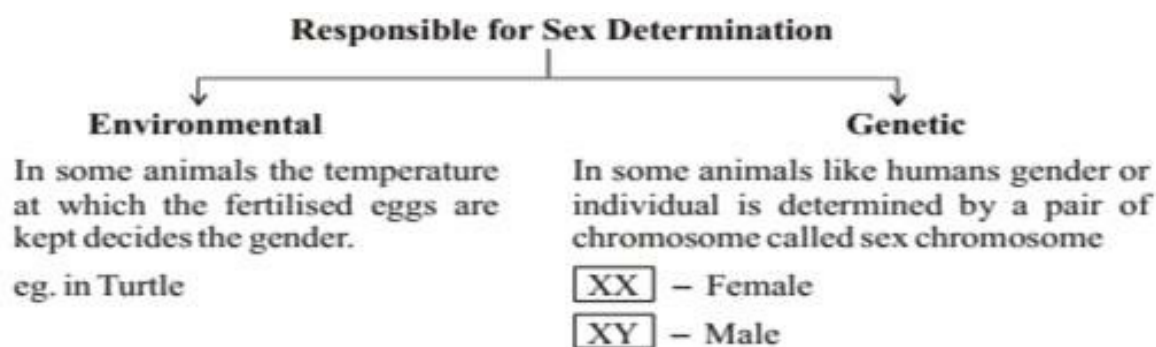
Law of Independent Assortment: Alleles of different characters separate independent from each other during gamete formation.

In the above example, alleles of texture were assorted independently from those of seed colour.

SEX DETERMINATION

Determination of sex of an offspring.

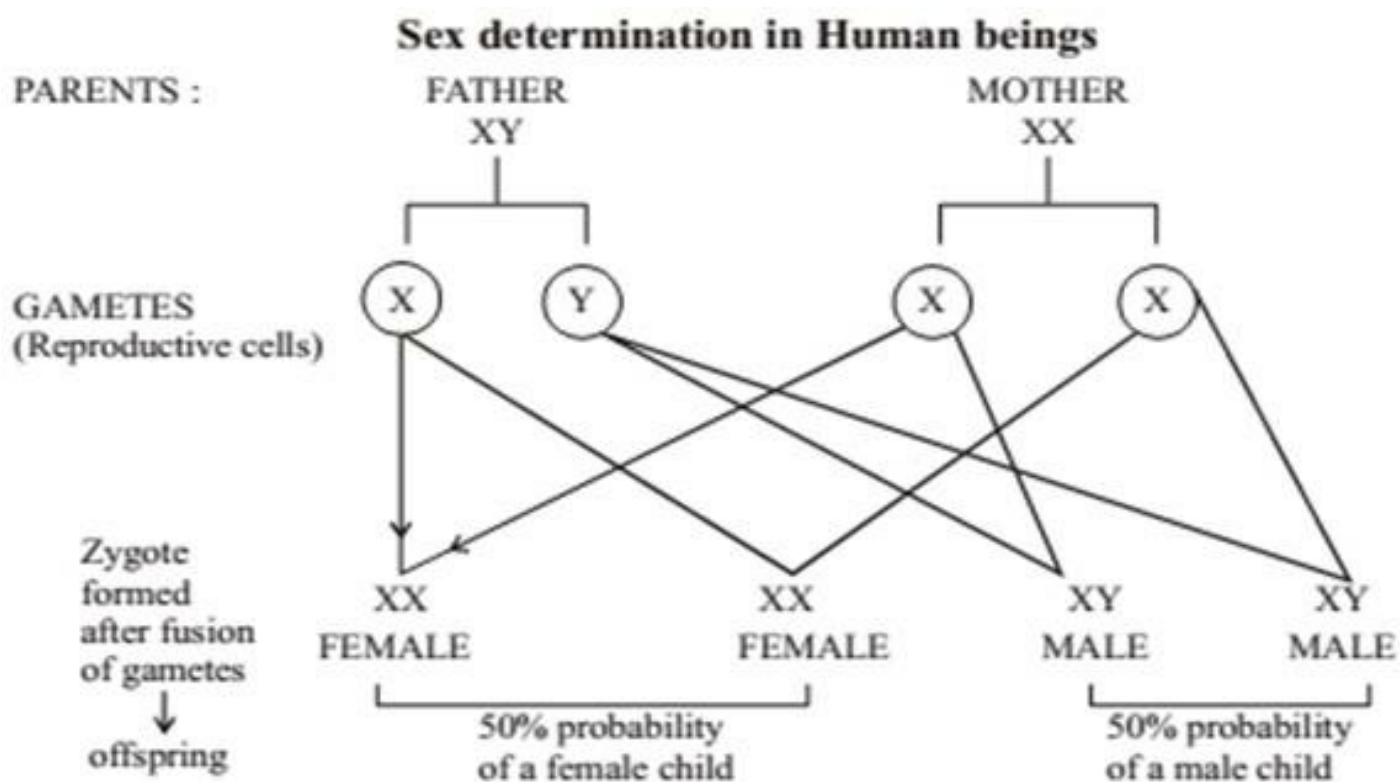
FACTORS



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

XX – female

XY – male

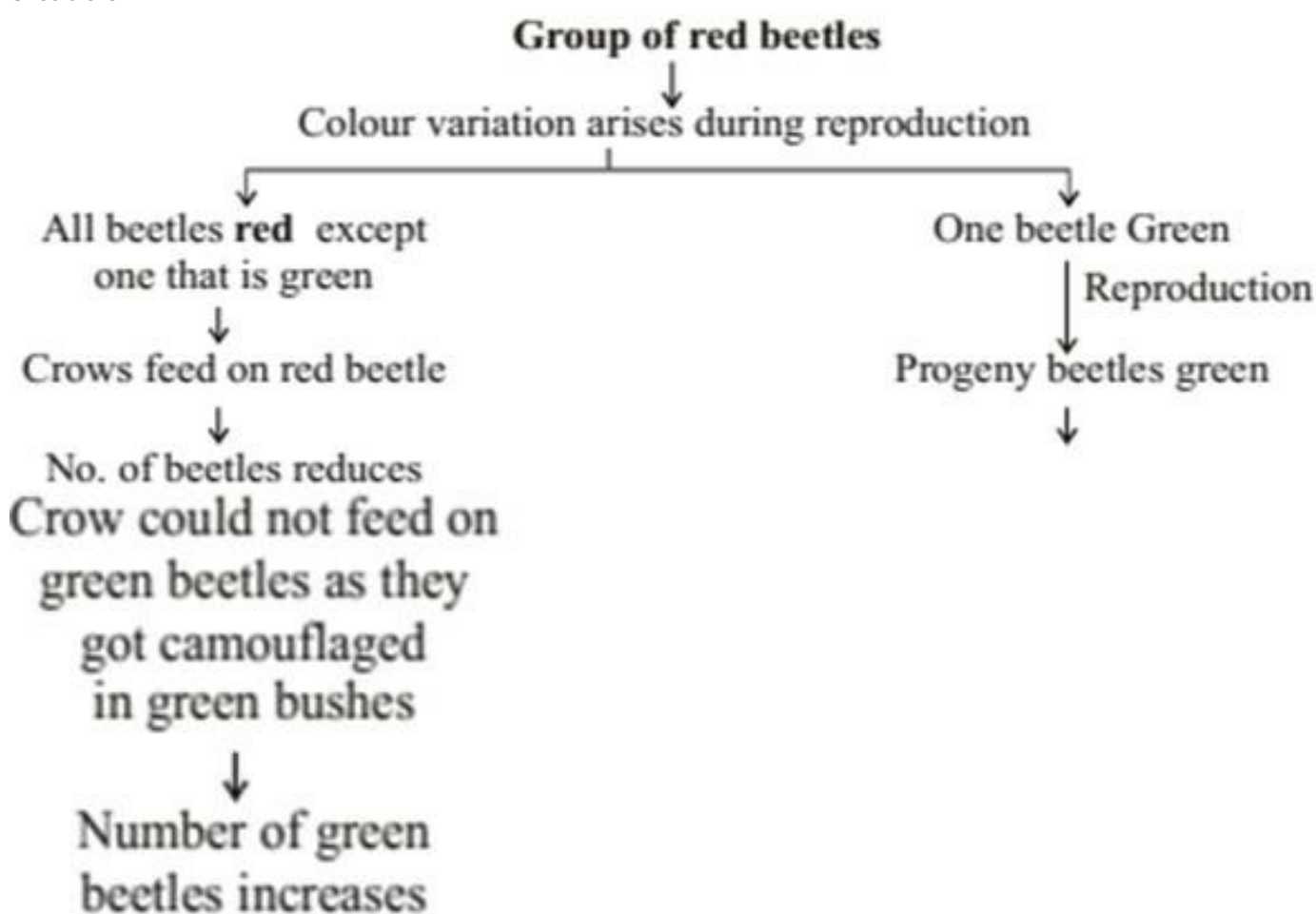


This shows that half the children will be boys and half will be girls. All children will inherit an X chromosome from their mother regardless whether they are boys or girls. Thus sex of children will be determined by what they inherit from their father, and not from their mother.

EVOLUTION

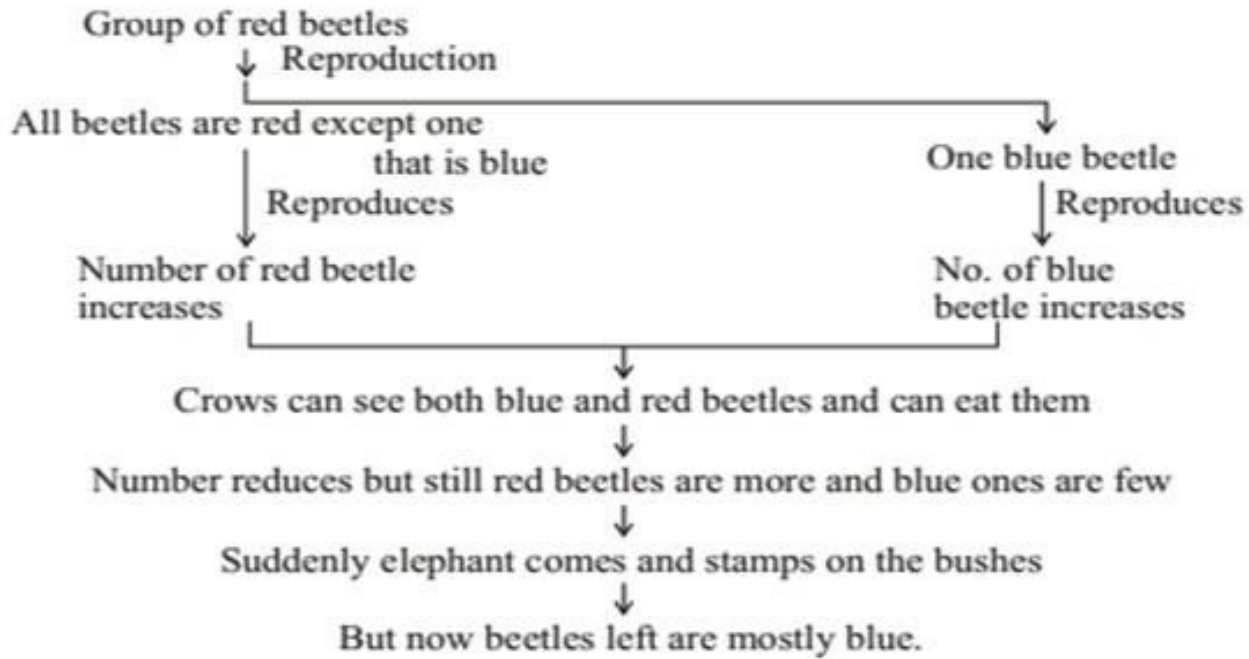
Evolution is the sequence of gradual changes which takes place in the primitive organisms, over millions of years, in which new species are produced.

Situation - I



Situation 1 : Green beetles got the survival advantage or they were naturally selected as they were not visible in green bushes. This natural selection is exerted by crows resulting in adaptations in the beetles to fit better in their environment

Situation-II



Situation 2 : Blue beetles did not get survival advantage. Elephant suddenly caused major havoc in beetle population otherwise their number would have been considerably large.

From this we can conclude that accidents can change the frequency of some genes even if they do not get survival advantage: This is called genetic drift and it leads to variation.

SITUATION-III

Group of red beetles



Habitat of beetles (bushes)

Suffer from plant disease



Average weight of beetles

decreases due to poor nourishment



Number of beetles kept on reducing



Later plant disease gets eliminated



Number and average weight of the beetles

increases again

Situation 3 : No genetic change has occurred in the population of beetle. The population gets affected for a short duration only due to environmental changes.

ACQUIRED AND INHERITED TRAITS

Acquired Traits	Inherited Traits
1. These are the traits which are developed in an individual due to special conditions	1. These are the traits which are passed from one generation to the next.
They cannot be transferred to the progeny	2. They get transferred to the progeny.
They cannot direct evolution eg. Low weight of starving beetles	3. They are helpful in evolution eg. Colour of eyes and hair

SPECIATION

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

The process by which new species develop from the existing species is known as speciation.

Speciation : it is the process of formation of new species.

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

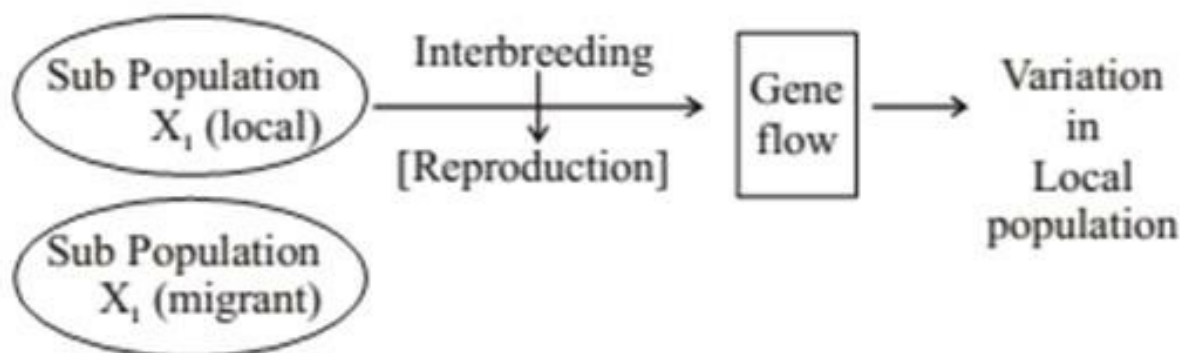
Factors which lead to speciation : Geographical isolation, genetic drifts and variations.

Geneflow : It is exchange of genetic material by interbreeding between populations of same species or individuals

WAYS BY WHICH SPECIATION TAKES PLACE

Speciation takes place when variation is combined with geographical isolation.

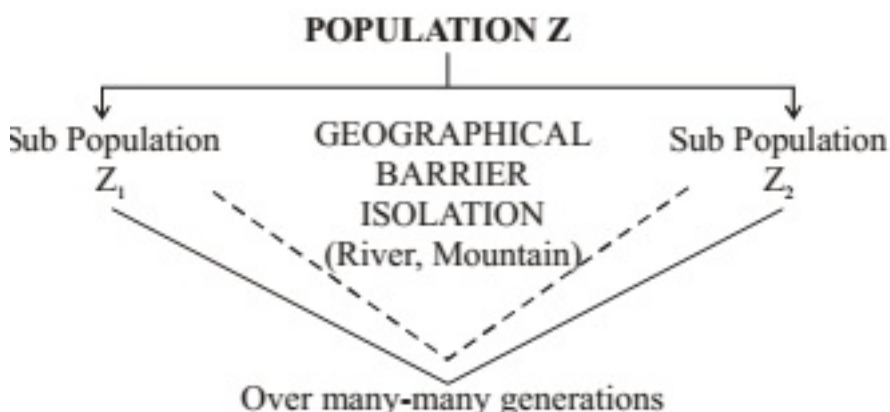
Gene flow :occurs between population that are partly but not completely separated.



GENETIC DRIFT

It is the random change in the frequency of alleles (gene pair) in a population over successive generations.

***Natural Selection** : The process by which nature selects and consolidate those organisms which are more suitably adapted and possesses favorable variations



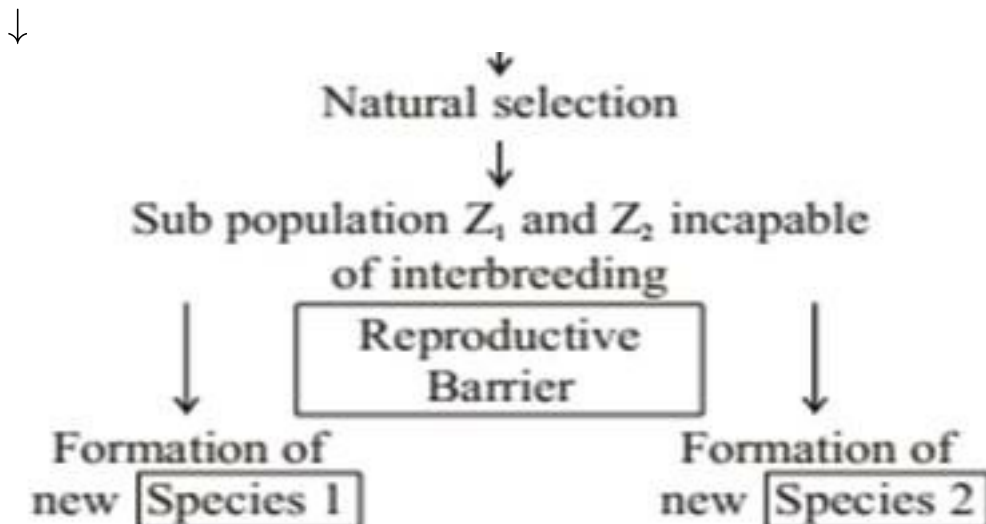
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Results in Accumulation of different variations in

Sub population Z_1 and Z_2

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Genetic drift



Genetic drift takes place due to :

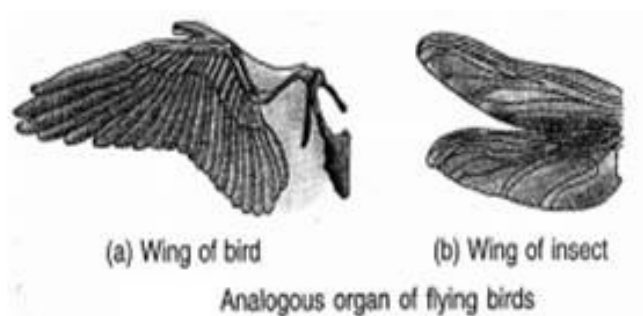
- (a) Severe changes in the DNA
- (b) Change in number of chromosomes

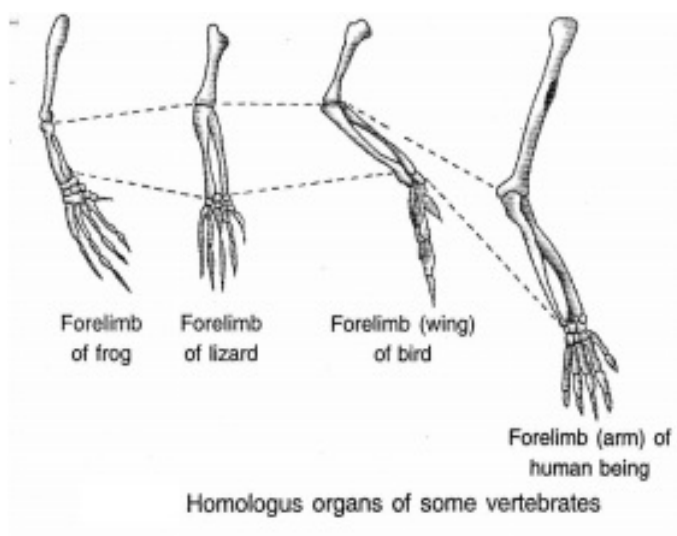
Evolution and Classification

EVOLUTION : the process by which different kinds of living organism are believed to have developed from earlier forms during the history of the 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 the more closely they are related.
3. The more closely they are related, the more recently they have a common ancestor.
4. Similarities among organisms allow us to group them together and to study their characteristic.





TRACING EVOLUTIONARY RELATIONSHIPS : Jean Baptiste Lamarck gave the first theory of evolution. The accepted one is The Origin of Species by Charles Darwin.

(Evidences of Evolution)

I. Homologous Organs : (Morphological and anatomical evidences. 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 derived from the same ancestor.

Example :

Forelimb of Horse	(Running)	Same basic structural plan, but different functions perform.
Wings of bat	(flying)	
Paw of a cat	(walk/scratch/attack)	

II. Analogous Organs : These are the organs that have different origin and structural plan but same function example :

Example : Analogous organs provide mechanism for evolution.

Wings of bat →	Elongated fingers with skin folds	Different basic structure, but perform similar function i.e.,

Wings of bird →	Feathery covering along the arm	flight.
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III. Fossils : (Paleontological evidences)

The remains and relics of dead organisms of the past.

FOSSILS ARE PRESERVED TRACES OF LIVING ORGANISMS

Fossil Archaeopteryx possess features of reptiles as well as birds. This suggests that birds have evolved from reptiles.

Examples of Fossils

AMMONITE - Fossil-invertebrate

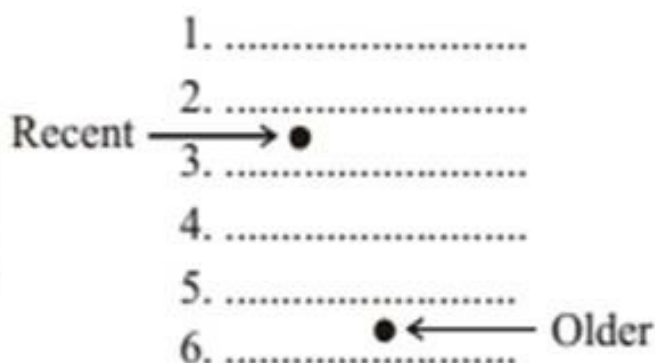
TRILOBITE - Fossil-invertebrate

KNIGHTIA - Fossil-fish

RAJASAUROS - Fossil dinosaur skull

AGE OF THE FOSSILS

- I. Deeper the fossil, older it is.
- II. Detecting the ratios of difference of the same element in the fossil material i.e. **Radio-carbon dating** [C-(14) dating]



Evolution by Stages

Evolution takes place in stages ie bit by bit over generations.

I. Fitness Advantage

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

→ Flat worm has rudimentary eyes enough to
give fitness
advantage

x rightarrow Insects have compound eyes

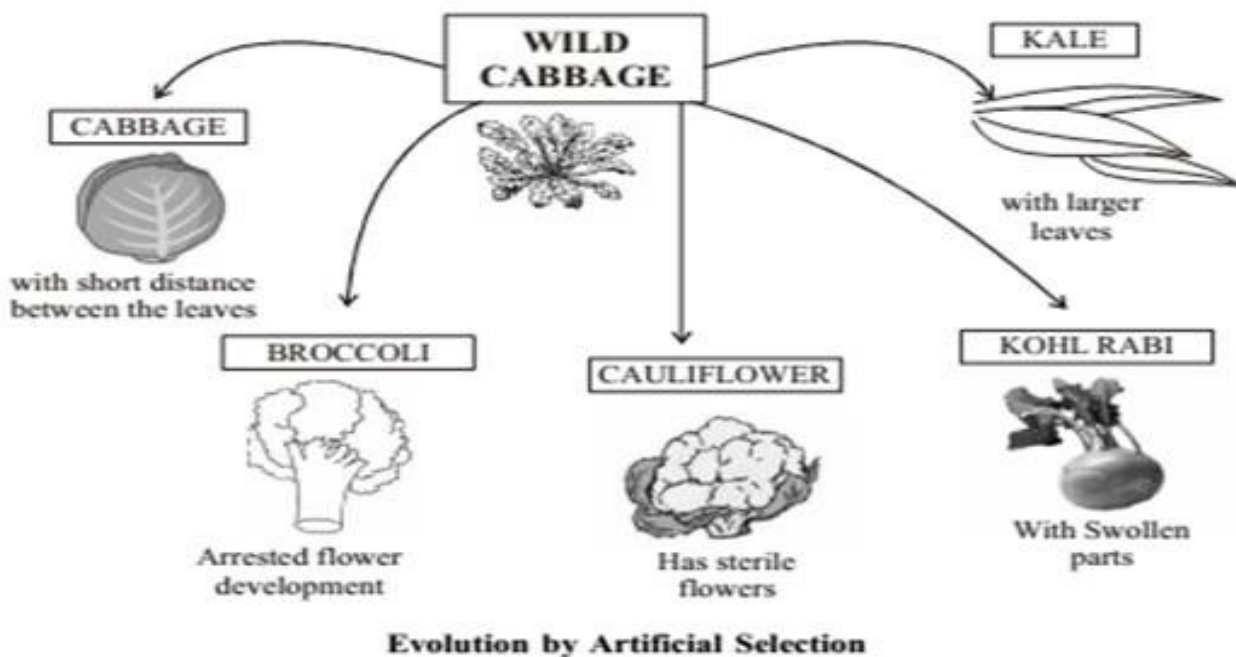
x rightarrow Humans have binocular eyes

II. Functional Advantage

Evolutions of Feathers

Feathers provide insulation in cold weather but later they might become useful for flight.

Example : Dinosaurs had feathers, but could not fly using feathers. 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. e.g. (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 differences in their DNA

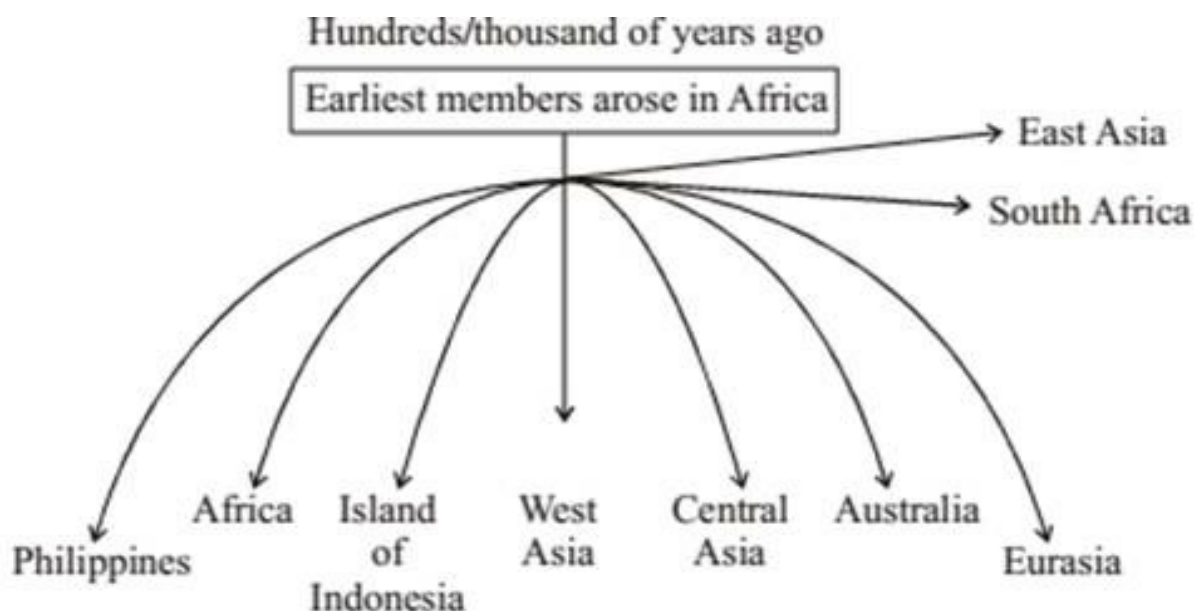
Tools to Study Human Evolutionary Relationship

- Excavating
- Time dating
- Fossils
- Determining
- DNA Sequences

Although there is great diversity of human forms all over the world get all humans are as single species

GENETIC FOOTPRINTS OF HUMANS

Hundreds/thousand of years ago



- They did not go in a single line
- They went forward and backward
- Moved in and out of Africa

- Sometimes came back to mix with each other.

What you have learnt

- Variations arising during the process of reproduction can be inherited.
- These variations may lead to increased survival of the individuals.
- Sexually reproducing individuals have two copies of genes for the same trait. If the copies are not identical, the trait that gets expressed is called the dominant trait and the other is called the recessive trait.
- Traits in one individual may be inherited separately, giving rise to new combinations of traits in the offspring of sexual reproduction.
- Sex is determined by different factors in various species. In human beings, the sex of the child depends on whether the paternal chromosome is X (for girls) or Y (for boys).
- Variations in the species may confer survival advantages or merely contribute to the genetic drift.
- Changes in the non-reproductive tissues caused by environmental factors are not inheritable.
- Speciation may take place when variation is combined with geographical isolation.
- Evolutionary relationships are traced in the classification of organisms.
- Tracing common ancestors back in time leads us to the idea that at some point of time, non-living material must have given rise to life.
- Evolution can be worked out by the study of not just living species, but also fossils.
- Complex organs may have evolved because of the survival advantage of even the intermediate stages.
- Organs or features may be adapted to new functions during the course of evolution.

For example, feathers are thought to have been initially evolved for warmth and later adapted for flight.

- Evolution cannot be said to 'progress' from 'lower' forms to 'higher' forms. Rather, evolution seems to have given rise to more complex body designs even while the simpler body designs continue to flourish.
- Study of the evolution of human beings indicates that all of us belong to a single species that evolved in Africa and spread across the world in stages.